Mothers' years of schooling and their investment in early education of children

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Abstract

In this paper, we test whether the parents' years of education can affect their investment decision on early education of children. Similar discussions are found in the past literature, which empirically shows the intergenerational education link between parents and their children. While most of those findings are geographically limited to the industrialized countries, we address the same topic in sub-Sahara African countries, particularly in the Republic of Kenya. By using the exogenously changed compulsory schooling year as instrumental variable, we estimate the effect of years of education. The result shows that marginal effect of years of education increase the investment for their children with statistical significance.

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1. Introduction

This paper investigates the causal association between parents' years of education and their investment behavior in child education, especially in early education. The empirical studies on early education impacts were shed light on in the past literature. The literature shows the positive short-run impacts on cognitive and language skills based on the random experiments of preschool educational interventions such as the Perry Preschool Project or the Abecedarian Project (Gormley and Gayer, 2005; Currie, 2001). At the same time, not only short-term but long-lasting effects on education qualifications, employment status, and income levels are reported (Heckman et al., 2013).

In terms of the investment behavior in child education, it is often discussed in topics of intergenerational education link. Empirical works are found from geographically limited datasets in developed countries such as France, Norway, the United Kingdom, the United States, and South Korea. However, the educational link is not less prioritized issue in developing countries, such as in sub-Sahara Africa. It is partly because the early education has significant association with learning outcomes in early primary school as well as longer period of time. In this paper, we empirically focus on parents' investment behavior in early education with datasets from the Republic of Kenya (hereafter, Kenya).

The term "early education" that we use in this paper is often called "Early Childhood Development Education (ECDE)", and it refers to different types of child care, offered by different institutions (Githinji and Kanga, 2011)[1)]. There are public or community-owned centers as well as private ECDE centers. The qualitative information reports that majority of the ECDE centers are privately owned (Githinji and Kanga, 2011). Although Kenya introduce the Free Primary Education policy, ECDE remains to cost parents. Accordingly, attending to the early education program highly depends on the socio-economic status of households (Githinji and Kanga, 2011, UNESCO, 2005). At the same time, ECDE creates significant gap between those experienced in early education and those not. For example, pupils in lower grade primary schools who attended ECDE have significantly higher test score of reading and writing in the Republic of Kenya. Not only the test scores, but also other educational outcomes such as repetition or dropout rates are highly associated with early education experiences prior to the primary schools (Githinji and Kanga, 2011, UNESCO, 2005). In this way, the investment behavior in early childhood education could be associated with life-long

outcomes in developing countries as in industrialized countries as explained by the literature.

2. Literature

2.1 Review of the literature on intergenerational educational links

The literature of causal relationships between parents' education level and children's school outcomes spent considerable effort to clarify whether children would become smarter due to the genetic inheritance from parents or due to other environmental resources (Holmlund et al., 2011). To isolate the genetic inheritance effect, one identification strategy is based on a dataset of twin parents or an adoptees dataset (Behrman and Rosenzweig, 2002; Antonovics and Goldberger, 2005; Bingley et al., 2009; Haegeland et al., 2010) [2].

Other identification strategies are aimed at isolating only the effect of parents' years of schooling. To isolate the effect of schooling from innate characteristics or genetic factors, those studies use the exogenous shocks such as school reforms or the extension of compulsory school years. There are four empirical papers found in this area. They show the mixed results with instrumental variable estimation method although all the papers show that the parents' schooling is highly associated with children's school outcomes in the ordinary least squares (hereafter OLS) estimation result. A paper that utilizes exogenous policy reform in Norway shows that parental schooling increased children's schooling only for mother and son pairs with 10 percent statistical significance (Black et al., 2005). On the other hand, in the United States, the empirical result shows that the possibility of grade retention is partly caused by the parents' education level (Oreopoulos et al., 2006). Another empirical result from France shows the significant effect of fathers' schooling level on grade repetition of children.

These previous studies show that the effect of parents schooling level in industrialized countries. As far as author understands, there are no empirical works that focus on the intergenerational links which apply to developing countries in sub-Sahara Africa, particularly in the Republic of Kenya. By using exogenous policy reform that has forced mothers to extend their years of schooling from seven to eight years since 1985, we examine whether a mothers' schooling level causes them to invest in early childhood education.

3. Conceptual Framework

As explained earlier, we estimate the marginal effect of mothers' schooling years on their investment decision in the early education of their children by using the instrumental variable method. Our instrument is the policy reform in 1985, which extended the length of primary school education from 7 to 8 years. In 2003, the Republic of Kenya introduced a free primary education policy, which allows parents to send children to primary schools without tuition fees. Our theoretical prediction is that i) marginal effect of parents' schooling on child educational investment is positive and ii) the effect of cost in compulsory education is negative on the investment decision. In the empirical section, we test whether these two predictions are supported by our dataset.

4. The Education System in Kenya

The current education system in Republic of Kenya was set in 1985 as eight years for primary, four years for secondary, and four years for post-secondary education. Prior to the year of 1985, the schooling system was set in 1963 as seven years for primary, four years for lower secondary, two years for upper secondary, and three years for post-secondary education. The policy reform in 1985 extended the length of primary school education from seven to eight years, which is assumed to be exogenous to other factors related with the investment decision. Table [1] shows mothers' birth year, school entry year, and primary school graduation year. The policy reform was applied to those mothers who were born after year 1973. By using this exogenous shock in prolonging their primary education year from 7 to 8 years, we estimate the effect of years of education on the investment in early education.

For children of our sample, the school year starts in January and ends in December. Children eligible to be enrolled in primary school are six years old. Therefore, children who become six years old in the first year are eligible to enter primary school in January. Due to

Table [1] Effective sample of mothers who were born from **1966** to **1979** with their primary school entry year

This table shows mothers' birth year, school entry year, and primary school graduation year.
The policy reform was applied to those mothers who were born after year 1973.

	Before policy reform							After policy reform						
Year of birth for mothers	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
School entry for mothers	1972. Jan	1973. Jan	1974. Jan	1975. Jan	1976. Jan	1977. Jan	1978. Jan	1979. Jan	1980. Jan	1981. Jan	1982. Jan	1983. Jan	1984. Jan	1985. Jan
School graduation for mothers	1978. Dec	1979. Dec	1980. Dec	1981. Dec	1982. Dec	1983. Dec	1984. Dec	1986. Dec	1987. Dec	1988. Dec	1989. Dec	1990. Dec	1991. Dec	1992. Dec

the UPE policy reform since 2003, primary education does not cost parents any tuition fees. This paper estimates the effect of years of education as well as the cost reduction in compulsory education in parents' investment behavior in early education investment.

5. Data

We use the dataset from the Kenya Integrated Household Budget Survey (KIHBS) (2005/06). This survey was the first major household survey implemented by the Central Bureau of Statistics (CBS) to develop a database for measuring socio-economic indicators. The data collection for KIHBS 2005/06 was conducted for 12 months beginning in May 2005 for 1,343 randomly selected clusters composed of 861 rural and 482 urban clusters. This survey was to generate representative statistics at the national, provincial, and district levels. In each cluster, 10 households were randomly selected with equal probability; the total sample size is 13,430 households.

From the surveyed sample, as Table [1] shows, we restrict our sample to mothers who entered primary school from January 1972 to January 1985[3)]. In the Republic of Kenya, policy reform took place in January 1985 to extend the primary school length from seven to eight years. This reform targeted all pupils in primary school regardless of their grades. Therefore, we name the controlled group who had graduated as of December 1984 and the treated that were still in school as of January 1985. In our sample, approximately 62 percent of mothers is in the treated group and the rest is in the controlled as in Table [3]. It is not exactly half in numbers due to mothers who enrolled in primary schools at older age than at the eligible age.

In addition to the mothers' sample, we restrict our sample to children whose age is above three and less than 18 years, as in Table [2]. Since early education begins at age three, we do not include children younger than age three. The total effective sample is 3,684 children and their biological mothers. Out of the 3,684 children, as in Table [3], children who were born from 1998 to 2003 are the group that were affected by the "Free primary education policy reform," while children born before 1998 had already passed age six by the time the free primary education policy was effective.

Table [2] Children birth year and "Free primary education policy" affected group

This table shows the age matrix for child sample. We restrict our sample age from three to 18 years at the time of survey. Hence their birth year starts from 1986 and ends in 2003. For the group affected by the free primary education policy is those children who were born after year 1998, while those not affected by the policy is those born before 1997.

Birth Year	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Before Group	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
				0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
					0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
						0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
							0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
								0	1	2	3	4	5	6	7	8	9	10	11	12	13
									0	1	2	3	4	5	6	7	8	9	10	11	12
										0	1	2	3	4	5	6	7	8	9	10	11
											0	1	2	3	4	5	6	7	8	9	10
												0	1	2	3	4	5	6	7	8	9
After Group													0	1	2	3	4	5	6	7	8
														0	1	2	3	4	5	6	7
															0	1	2	3	4	5	6
																0	1	2	3	4	5
																	0	1	2	3	4
																		0	1	2	3

ⅰ) Definition of Mothers

In Kenya, some households care for children not directly related to the household head. Some household heads adopt children not biologically related in the first degree. In this paper, we define mothers as biologically related in the first degree and exclude any other female household members who execute parenting tasks as "mothers"[4].

ⅱ) Definition of Children

We restrict the sample to children who live with their biological father and mother. It could be a concern if we exclude children who live apart from their parents because such children might be systematically different from those living with their biological parents in terms of years of schooling (Chevalier, 2004; Oreopoulos et al., 2006). Since there is no information on those who are not living with the household head, we cannot remedy this situation. However, in our dataset, few children are living away from their household. Out of total observations in the dataset, the percentage of household heads whose children are under 15 years old live elsewhere is greater than zero (13.6%), zero (65.2%), and missing (21.2%). When we restrict our effective sample, it becomes less than 10 percent.

6. Descriptive Statistics

Table [3] shows the summary statistics, and there are two types of outcome variables. The first outcome is a dichotomous variable that indicates whether children received early education from the age of three to five. In this estimation, we use observations for those aged over six or below 18. The effective sample size is 2917 children with their biological mother. The second outcome is the indicator variable at which "age" children began to receive early education. We have three dichotomous outcome variables to indicate whether children start the early education at age three, four, or five. If the children started the early education at age of four, the outcome variable of "started at 4" takes one, while the outcome variable of "started at 3" is zero and "started at 5" takes one. In this estimation, we include observations for children aged from three, four, five to 18 years old. Each observation number is 3212, 3194, and 3116, excluding observations with missing values. Table [3] shows the summary statistics of children aged three to 18 years old and their biological mother pairs.

Table [3] shows that for the outcome variables, over 57 percent of those above six years of

Table [3] Summary statistics

Table includes 3684 pairs of biological mother and child with age from three to 18 years' old

	Children aged 3 to 18 years				
Variable	obs	mean	std	min	max
Early education investment	3684	0.57	0.50	0	1
Urban indicator	3684	0.22	0.41	0	1
Age of child	3684	9.30	3.98	3	18
Number of siblings	3684	4.38	1.80	1	12
Male indicator	3684	0.49	0.50	0	1
Delivery sequence of sibling	3684	2.91	1.48	1	9
Age of mother	3684	32.65	3.82	25	40
Years of education for mother	3684	7.58	0.49	7	8
Late enrollment dummy	3684	0.64	0.48	0	1
Policy change in 2003 applied to children	3684	0.50	0.50	0	1
Policy change in 1985 applied to mothers	3684	0.62	0.48	0	1

age experienced early education. For the independent variables, merely 22 percent of children are resident in urban areas and the remainder live in rural Kenya. The number of siblings is 4.38 on average, and males compose approximately 49 percent of the sample. The mothers' age is approximately 33 years, on average. There are important controlling variables such as mothers' age as well as the dummy variable for their late enrollment in schools. Through the 1970s and 1980s, when mothers attended primary schools, cases of late enrollment in primary schools were not scarce. Table [3] shows that over 64 percent of mothers attended primary schools after their eligible age passed and only 36 percent started primary school on time. Therefore, to control the effect of late enrollment on the outcome variable, the estimation includes late enrollment dummy variables for those starting school late from age 7.

7. Identification Strategy

As the past literature (Chevalier, 2004; Sandra et al., 2005; Oreopoulos et al., 2006), we model the investment decision of parents for children with a linear combination of covariates' parameters and error term as indicated in equation (10). For independent variables, we include the gender and age of the child, region of residence, and the mothers' years of education and age. Concretely, the estimation model is as follows:

$$I_j^c = \beta_s^m S_j^m + X_j^m \gamma + X_j^c \delta + urban_j + late\_enrolled\ dummy_j^m + \mu_j^c \quad (10)$$

$$S_j^m = X_j^m \zeta + X_j^c \eta + policy_j^m + urban_j + late\_enrolled\ dummy_j^m + \varepsilon_j \quad (11)$$

I_j^c denotes the investment decision of family j for child c, S_j^m denotes the years of schooling for mother m in family j, which is the variable of interest in this paper. Covariates X_j^c include age, gender, and the number of siblings of the child, and X_j^m includes the mother's age. $urban_j$ denotes the family j's residence area, either urban or rural, and the $late\_enrolled\ dummy_j^m$ denotes the age at which the mother enrolled in primary school.

The parameters in equation (10) should not be estimated by the ordinary least squares estimation method unless we plausibly assume that conditional expectation of μ_j^c on covariates is zero. It is not persuasive to assume that the variable of years of education is exogenous to the investment decision. For example, mothers' year of education is assumed to be correlated with unobserved ability A_i^m, which is naturally inherited to their children A_i^c if those unobservable are genetic inheritance. In this way, if the genetically inherited

intelligence is correlated with those determinants of mothers years of education, the assumption that mothers' education levels S_i^m are orthogonal to the error term is not valid. Hence, we require an instrumental variable, which is assumed to be orthogonal to the unobserved ability. We use the policy reform dummy in 1985, which forces pupils to stay one additional year in primary schools, regardless of their genetic ability.

8. Results and Interpretation

8.1 Investment in early education for children

ⅰ) Years of Mothers' Education

In this section, we first examine whether the marginal effect of mothers' years of education to the optimal investment decision is positive or not. Table [4] shows the estimated coefficient of years of schooling is positive. The effective sample includes children aged from six to 18. The instrumental variable estimation shows that the mothers' years of education has a positive impact on the investment decision. Compared to the coefficient of OLS estimation, the magnitude of the IV coefficient is greater than that of the OLS estimation[5]. To closely look at this OLS bias direction, there are two possible interpretations about this result. Firstly, without considering the possibility of heterogeneous treatment effect, the larger magnitude coefficient infers the OLS estimator is downward biased. It could be caused by the fact that our estimation model in equation (10) suffers from the omitted variables, which are negatively associated with the variable of schooling. We rewrite the estimation equation (10) as follows, decomposing error term μ_j^c into individual specific heterogeneity term A_j^c and random error ε_j^c . Z_j includes all the exogenous variables of mother and child except schooling variable of mother in equation (10):

$$I_j^c = a_0 + \beta_0 S_{0j} + \beta_1 Y_1(S_{0j}) + \beta_2 \rho(S_{0j}) + \beta_3 sk_{0j} + Z_j\gamma + A_j^c + \varepsilon_j^c \quad (10)'$$

Following the notation of the past literature (Card 1999, 2001), we assume that individual specific heterogeneity A_j is correlated with schooling level in two ways. The bias direction is determined by the sign of covariance cov (S_0, A_j), which decomposes into covariance of marginal benefit and ability σ_{ba} and covariance of marginal cost and ability σ_{ra}. As long as σ_{ba} is positive and σ_{ra} is negative, the sign of cov (S_0, A_j) is positive[6]. However, in case that σ_{ra} is positive, we must consider the bias direction becomes negative. Typically, this is the case where children with lower marginal cost of schooling do not necessarily earn more. Since

Table [4] The effect of years of education (instrumental variable method and the OLS estimation method)

	Investment decision at age 3 to 5 (IV)				
VARIABLES	Age <=14	Age <=15	Age <=16	Age <=17	Age <=18
Years of Education (mother)	0.370	0.450**	0.487**	0.507**	0.539**
	(0.229)	(0.227)	(0.246)	(0.239)	(0.261)
Observations	2,427	2,607	2,742	2,838	2,917
Kleibergen-Paap Wald rk F statistic	19.427	20.935	18.422	19.881	17.241

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

	Investment decision at age 3 to 5 (OLS)				
VARIABLES	Age <=14	Age <=15	Age <=16	Age <=17	Age <=18
Years of Education (mother)	0.0364*	0.0365*	0.0343*	0.0330*	0.0331*
	(0.0198)	(0.0192)	(0.0188)	(0.0185)	(0.0182)
Observations	2,427	2,607	2,742	2,838	2,917
R-squared	0.079	0.085	0.088	0.090	0.089

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

our datasets do not have any socio-economic household information variables of parents when they were in schooling, this could be merely conjecture. However, there could be cases that pupils with lower marginal cost did not expect high return of schooling, since most of those female pupils from 1970s to early 1980s were expected to serve domestic work after the completion of schooling.

The second interpretation of large IV coefficient is about the heterogeneous treatment effect. Based on the framework of local average treatment effect (LATE) (Imbens and Angrist, 1994; Angrist, 1998; Imbens and Wooldridge, 2007; Angrist and Pischke, 2009), it is understandable that the magnitude of schooling coefficient differs from the OLS estimates because it is the local effect only for those who complied with the exogenous policy reform of 1985. If the policy reform affects those with a low schooling level, IV estimates reflect the marginal effect of those who complied. Hence, it is understandable that the marginal effect is larger than the effect for mothers who are not strongly affected by the school reform.

ii）Compulsory school cost reduction effect to the investment decision

The free primary education policy (often referred to UPE policy) was introduced in January 2003. As simple economic model predicts, we expect to have positive effect on early education investment for those children who would enter the primary schools after January 2003. To examine this effect, Table [5] includes born year dummy variables for those

Table [5] The effect of years of education and the effect of "Free primary policy reform" in 2003

	Investment decision at age 3 to 5				
VARIABLES	Age <=14	Age <=15	Age <=16	Age <=17	Age <=18
Years of Education (Mother)	0.313	0.412*	0.457*	0.493**	0.532**
	(0.224)	(0.222)	(0.241)	(0.235)	(0.259)
Born in year 1998	0.0269	0.0153	0.0177	0.0233	0.0297
	(0.0376)	(0.0368)	(0.0363)	(0.0360)	(0.0359)
Born in year 1999	0.133***	0.119***	0.124***	0.132***	0.140***
	(0.0399)	(0.0389)	(0.0383)	(0.0381)	(0.0386)
Born in year 2000	0.290***	0.270***	0.277***	0.284***	0.292***
	(0.0448)	(0.0431)	(0.0422)	(0.0418)	(0.0417)
Observations	2,427	2,607	2,742	2,838	2,917
Kleibergen-Paap rk LM statistic	19.467	21.149	18.618	20.07	17.253
Robust standard errors in parentheses					
*** p<0.01, ** p<0.05, * p<0.1					

applicable to the policy change. In other words, as of January 2003, those applicable children to UPE policy were younger than or equal to five years old[7]. We find a statistically significant positive effect on the investment behavior as expected. Compared to the base group of children, a positive and significant effect is observed in children that were born in the year 1999 and 2000. This implies that three-year or four-year-old children at the time of the introduction of the policy reform were largely affected.

8.2 Starting age of investment in early education for children

ⅰ) Years of Mothers' Education

As in Section 8.1, we estimate the effect of schooling. In this section, we estimate the effects on three dichotomous outcome variables to indicate whether children start the early education at age three, four, or five. If the children started the early education at age of four, the outcome variable of "started at 4" takes one, while the outcome variable of "started at 3" is zero and "started at 5" takes one. Table [6] shows the estimated coefficient of years of schooling with IV estimation. The years of schooling marginally affect the investment starting age of five, however, not earlier than five years old.

ⅱ) Compulsory school cost reduction effect to the investment decision

When we examine the effect of cost reduction in compulsory education since 2003, we confirm the positive and significant effect. It is consistent that the effect of cost reduction in compulsory schooling has strong impact on the investment behavior of parents in early

Table [6] The effect of years of education of mothers

	started at 5					started at 4					started at 3				
VARIABLES	Age <=14	Age <=15	Age <=16	Age <=17	Age <=18	Age <=14	Age <=15	Age <=16	Age <=17	Age <=18	Age <=14	Age <=15	Age <=16	Age <=17	Age <=18
Years of Education (mother)	0.303	0.366*	0.385*	0.397*	0.412*	0.0108	0.0418	0.0229	-0.00820	-0.0278	0.0510	0.0413	0.0233	0.00547	-0.00945
	(0.209)	(0.206)	(0.220)	(0.213)	(0.230)	(0.202)	(0.191)	(0.200)	(0.193)	(0.205)	(0.135)	(0.126)	(0.132)	(0.126)	(0.134)
Constant	-1.408	-1.984	-2.176	-2.305	-2.468	0.732	0.441	0.557	0.790	0.938	-0.0659	-0.0214	0.103	0.243	0.361
	(1.756)	(1.741)	(1.871)	(1.815)	(1.960)	(1.701)	(1.619)	(1.700)	(1.643)	(1.753)	(1.136)	(1.071)	(1.128)	(1.075)	(1.143)
Observations	2,626	2,806	2,941	3,037	3,116	2,704	2,884	3,019	3,115	3,194	2,722	2,902	3,037	3,133	3,212
Kleibergen-Paap rk LM statistic	21.477	22.956	20.544	22.111	19.507	21.315	22.769	20.423	21.98	19.428	21.088	22.58	20.275	21.831	19.3

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

Table [7] The coefficient of the instrumental variable method with “Free primary policy reform” year dummy

	started at 5					started at 4					started at 3				
VARIABLES	Age <=14	Age <=15	Age <=16	Age <=17	Age <=18	Age <=14	Age <=15	Age <=16	Age <=17	Age <=18	Age <=14	Age <=15	Age <=16	Age <=17	Age <=18
Years of Education (Mother)	0.282	0.371*	0.408*	0.441**	0.472**	-0.0607	0.00850	0.0133	0.0134	0.00901	-0.0134	0.00230	-0.00106	0.000495	-0.00717
	(0.204)	(0.202)	(0.218)	(0.213)	(0.232)	(0.195)	(0.183)	(0.192)	(0.184)	(0.197)	(0.127)	(0.119)	(0.125)	(0.119)	(0.127)
Born in year 1998	0.0253	0.0139	0.0166	0.0221	0.0281	-0.00920	-0.0194	-0.0158	-0.00956	-0.00678	0.0129	0.0148	0.0184	0.0171	0.0166
	(0.0371)	(0.0362)	(0.0356)	(0.0353)	(0.0350)	(0.0347)	(0.0326)	(0.0316)	(0.0310)	(0.0305)	(0.0213)	(0.0201)	(0.0196)	(0.0191)	(0.0188)
Born in year 1999	0.138***	0.124***	0.130***	0.138***	0.146***	0.0981**	0.0855**	0.0901**	0.0978***	0.101***	0.0378	0.0409*	0.0455**	0.0441**	0.0434*
	(0.0391)	(0.0379)	(0.0372)	(0.0369)	(0.0372)	(0.0394)	(0.0367)	(0.0356)	(0.0350)	(0.0349)	(0.0249)	(0.0234)	(0.0229)	(0.0224)	(0.0223)
Born in year 2000	0.297***	0.277***	0.284***	0.293***	0.302***	0.272***	0.255***	0.261***	0.270***	0.275***	0.0722**	0.0762***	0.0822***	0.0805***	0.0798***
	(0.0401)	(0.0368)	(0.0346)	(0.0335)	(0.0328)	(0.0457)	(0.0414)	(0.0396)	(0.0385)	(0.0378)	(0.0312)	(0.0287)	(0.0277)	(0.0269)	(0.0263)
Born in year 2001	0.317***	0.297***	0.304***	0.314***	0.324***	0.573***	0.555***	0.563***	0.575***	0.580***	0.275***	0.280***	0.287***	0.285***	0.284***
	(0.0450)	(0.0438)	(0.0426)	(0.0428)	(0.0434)	(0.0468)	(0.0411)	(0.0389)	(0.0378)	(0.0375)	(0.0531)	(0.0516)	(0.0511)	(0.0507)	(0.0506)
Born in year 2002						0.650***	0.624***	0.632***	0.643***	0.648***	0.740***	0.746***	0.755***	0.753***	0.752***
						(0.0502)	(0.0408)	(0.0370)	(0.0344)	(0.0320)	(0.0624)	(0.0599)	(0.0588)	(0.0580)	(0.0572)
Born in year 2003											0.891***	0.891***	0.897***	0.893***	0.893***
											(0.0373)	(0.0289)	(0.0260)	(0.0233)	(0.0220)
Constant	-1.472	-2.205	-2.540	-2.848	-3.134	1.048	0.504	0.441	0.419	0.449	0.317	0.174	0.187	0.177	0.245
	(1.696)	(1.698)	(1.843)	(1.806)	(1.978)	(1.627)	(1.544)	(1.625)	(1.570)	(1.687)	(1.063)	(1.002)	(1.058)	(1.010)	(1.083)
Observations	2,626	2,806	2,941	3,037	3,116	2,704	2,884	3,019	3,115	3,194	2,722	2,902	3,037	3,133	3,212
Kleibergen-Paap rk LM statistic	21.827	23.497	21.006	22.539	19.64	21.506	23.168	20.749	22.26	19.415	21.293	23.005	20.631	22.146	19.318

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

education. On the other hand, the year of education is only statistically significant for investment starting at the age of five, not earlier than five years old. The years of schooling effect is marginal, compared to the cost reduction effect.

9. Conclusion and Further Studies

As in the past empirical evidence from industrialized countries, we argue that an intergenerational link is observed in the Republic of Kenya dataset. When mothers' schooling levels are exogenously increased from seven to eight years, parental investment in early education increases, especially for those aged five years old. This infers the existence of an intergenerational educational link in the Republic of Kenya since more educated parents would increase the investment in their children's early education. We also confirm the consistent positive effect of compulsory school cost reduction since 2003.

Note

1）Those names are as follows: such as "Children's homes, ECDE Pre-primary, Pre-school education, Pre-unit, Nursery, Baby Care, Day care centers, Baby class/infant class, Kindergarten, and Home care" (Githinji and Kanga, 2011). The Ministry of Education Science and Technology (MOEST) has defined early education as follows: "Pre-primary 1 refers to learning for children four years of age; pre-primary 11 refers to learning for children five years of age. Day Care refers to care for children three years and below" (Githinji and Kanga, 2011). In short, the ECDE is applicable for those children aged three to five years old.

2）The assumption when using the dataset of twin parents is that the idiosyncratic error term can be written in the additive form of the random error and unobservable genetic factor. This genetic part is the same between the twin parents. Hence, by taking the difference between the twins, the random error that is not correlated with the schooling level remains.

3）This group is the subsample of mothers who were born in 1966 to in 1979. To check the robustness of the finding, we also estimate with different subsample, such as mothers who are born in 1962 to 1982. The qualitative result does not differ. The result is available upon request.

4）We exclude other female members as mothers because it is impossible for us to confirm that household members who engage in parental tasks at the surveyed time are the same persons who made the investment decision when the child was aged three to five.

5）Similar to this paper, the literature has found a larger effect on the outcome from instrumental regression compared to the OLS estimation result (Oreopoulos et al., 2006; Maurin and McNally, 2008). Larger IV estimation coefficient magnitude is often interpreted as the omitted variable bias outweighed by the measurement error bias.

6）Detailed calculation formula of covariance $\mathrm{cov}(S_0, A_j)$ shall be referred to the literature (Card, 1999, 2001).

7）If they already passed age six as of 2003 January and did not enroll in primary schools, they entered the primary schools as late starters. It is unlikely that children above six years old start their education from ECDE. In that case, they directly start from the primary education as late starters.

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