CEPS INSTEAD

WORKING PAPERS

Number of siblings and school achievement in sub Sahara Africa

Mathias KUEPIE[1, 2]
Michel TENIKUE[1, 3]
Samuel NOUETAGNI[4]
Nicaise MISANGUMUKINI[1]

CEPS/INSTEAD, Luxembourg[1]
DIAL, France[2]
University of Namur, Belgium[3]
IFORD Yaounde, Cameroon[4]

Working Paper No 2011-31
March 2011

Number of siblings and school achievement in sub Sahara Africa

Mathias Kuepie
CEPS/INSTEAD, Luxembourg
DIAL, France

Michel Tenikue
CEPS/INSTEAD, Luxembourg
University of Namur, Belgium

Samuel Nouetagni
IFORD Yaounde, Cameroon

Nicaise Misangumukini
CEPS/INSTEAD, Luxembourg

March 2011

Abstract

This paper uses biographical data from Dakar and Yaounde, two big African cities, to study the link between the number of siblings and school attainment. The data describe all fertility events meet by parents and the sibling's size structure of every child over time. The average sibling size effect is estimated first. Then, the sibling's size at given age effect is estimated. The results show that, in Dakar, both the overall and age specific siblings size effect on education are negative and statistically significant. In Yaounde, the overall effect is not significant, but we observed negative effects at some schooling ages (between 14 and 16).

Keywords: Education ; siblings ; Dakar; Yaounde

JEL classification codes: C14 ; J31 ; J71

1) Introduction

The shift towards low mortality rate and low fertility rate is currently underway in many African countries. A variety of benefits are expected from these demographic changes, including an improvement in human capital investment (Bloom et al. 2003). Given limited resources, parents with fewer children should be able to invest more per child and thereby should be able to better educate each child. In addition, the increasing prevalence of smaller families would contribute to raising the educational levels of successive generations of children, a major goal generally shared by both families and government. However, in the early age of a demographic transition and/or because of markets failures[1] it remains possible to observe a mild relationship between the number of siblings and school achievement. The actual quest is then whether, similar to developed countries, Africa will draw some educational demographic dividend from its demographic transition.

From a theoretical perspective, the link between fertility and socioeconomic outcomes can be studied with the capillarity theory framework. Arsene Dumont (1890) defines capillarity theory as follows: "Just as a colon has to be thin to allow liquid to rise by capillarity, the family size has to be small to allow the family to rise on the social scale". The main mechanism underlining the capillarity theory is the "dilution" of parental inputs (Blake 1981). Parental resources are finite and as the number of children in the family increases, the resources accrued to any one child necessarily decline. Siblings are competitors for parents' time, energy, and financial resources and so the fewer the better. The Quantity-Quality model (Becker and Lewis 1973) also provides a framework to investigate the relationship between family size and children's outcomes. The model presumes that household allocate resources to each child to improve its quality. A direct implication of this model is a trade-off between per child investment (quality) and the number of children in the family (quantity).

From an empirical perspective, the literature on the relation between quality and quantity of children is huge and diverse. The papers covert different regions in the world including the following countries: US (Blake 1981, Downey 1995), France (Goux and Maurin 2005), Thailan (Knodel, Havanon and Sittitrai, 1990; Knodel and Wongsith ,1991), Kenya, (Gomes ,1984), Botswana **(**Chernichovsky 1985), Ghana (Montgomery, Kouame and Oliver , 1995) Cote d'Ivoir (Montgomery, Kouame and Oliver ,1995) Malaysia (Sudha 1997), China (Lu and Treiman, 2005) Hungary, (Van Eijck and De Graaf 1995) and Cameroon (Eloundou-Enyegue and Williams, 2006). In developed countries, the literature displays a consistent negative relationship between the number of sibling and the schooling (Becker and Lewis 1973; Becker and Tomes 1986; Sewell 1968; Blake 1981). However, in developing countries, the literature shows mixed conclusions. In some context a negative relationship is found (Cote d'Ivoir, Ghana) while in other a positive relationship is observed (Kenya, Botswana). These results raised the possibility of systematic variation of the relation across societies as noted by Eloundou-Enyegue and Williams (2006).

This paper contributes to this debate in providing new evidence from two different countries. It uses an original datasets, biographical data, collected in two big African cities: Dakar and Yaounde. The data provide information on the number of brothers and sisters any individual had at different ages, from its birth to the survey date. They also give suitable instruments for the number of siblings, especially parent's and grandparent's socioeconomic characteristics, fertility "chocks" and offspring sex ratios. We first estimate the relation between the number of sibling and the final schooling outcome. We then look at how the sibling size at a given age might have affected the schooling outcome. In the process, we consider the sibling size effect at different ages from 10 to 19 years.

[1] Examples are the lack of credit markets or imperfect credit markets in developing world

The results in Dakar show that, after controlling for family socioeconomic background, children with larger number of siblings reach lower level of education. Thus, the number of siblings has an important detrimental effect on schooling. In addition, we observe that, having a higher number of siblings of schooling age when a child is also of schooling is very damaging. The number of siblings aged 11 to 19 years when the child was 10 years old has a negative effect on the education level attained. The number of siblings aged 0 to 9 years when the child was 10 years old has no effect on the education level attained. Thus we have evidence of a "capillarity effect" in education in Dakar.

In Yaounde however, a weak relation between the number of sibling and schooling is observed. The estimated coefficient is negative but not significant. Considering the effect of the number of sibling at a given age, it appears that, having many siblings of schooling age (between 10 and 19) is damaging for school achievement at some points in the course of study and particularly between 14 and 16. At other age points, sibling size effect is not significant. This is a striking difference between the two cities. In Dakar indeed the negative effect of siblings remains significant all over the whole schooling period (between 11 and 19 years) while in Yaounde, there are critical ages.

The remaining of this paper is organized as follows. Section 2 describes the data and discusses the measurement issues related to the number of siblings. Section 3 presents the estimation strategy and the results. Section 4 provides concluding remarks.

2) Data and descriptive analyses

We use data from biographical surveys conducted in Dakar in 2000 and in Yaounde in 1996. A biographical questionnaire is administered to individuals selected through a simple process. First a household survey is conducted on a representative sample of households. From the roster of household members, all people aged 15 or more, who are not household head, are listed. From this list a sample of individuals is drown. All household heads and sampled individuals are then interviewed. The paper uses data on all individuals aged 20 to 40 at the time of the survey. They were born between 1960 and 1980 in Dakar and between 1956 and 1976 in Yaounde. The lower bound of 20 years old is chosen so as to reduce the number of children currently enrolled at school.

The basic principle of biographical data is to retrospectively reconstruct demographic events (marriages, divorces, births, deaths of children), professional mobility (periods of inactivity and all activities engaged in over time) and migration (residential mobility) that have happened to a person from his birth until the time of the survey. In general, these family events have lasting implications and are easy to recall. The information gathered allows reconstructing the entire lifecycle of the individual. They are properly dated and the approach enables identifying correctly when each event took place and the status of other events around it. During the survey, parents provided the education level of their entire offspring, including details on children who were not living with them.

Measurement

The main variables in this study are schooling achievement and the number of siblings. Schooling achievement is our dependent variable and is measured ordinarily. We use the number of completed year of education, which in our case is a completely realized variable. We recode this variable into five ordinal categories: No education, primary, secondary 1, secondary 2 and university level. These categories correspond respectively to having 0, 1 to 6, 7 to 10, 11 to 13 and 14 or more completed years of education.

The second variable is the number of siblings. For a given child, this variable measures its number of brother and sisters irrespective of where they live. The framework of the survey enables to have its value at the time of the survey and to recover its value at any point in time from birth to the date of the survey. While this variable in general is censored on the right due to continuing fertility, in our sample we are able to focus on cases were fertility decisions are almost completely realized at the time of the survey. Indeed parents of children in the sample are relatively old. [2].

[2] The parent average age is 57 years in Dakar and 48 in Yaounde (Table 1).

Descriptive statistics

Table 1 presents descriptive of the main variables used. It shows schooling differences in the two cities. In Dakar, at the time of the survey, people were less educated than in Yaounde: 27% of individuals[3] had never been to school, 35% had stopped in primary and only 22% have reached the first cycle of secondary education. Unlike in Dakar, in Yaounde, all "children" have ever been at school, and have reached higher grades: almost 60% have reached the first cycle of secondary education. The difference appears also in parent's schooling. In Dakar, 52% of parents are uneducated while this proportion is only 7% in Yaounde.

Table 1 also shows fertility differences in the two cities. The fertility level seems more important in Dakar than in Yaounde. The average number of siblings in the Dakar is 7.5, 1 sibling higher than in Yaoundé. The average number of children per parent follows the same pattern (8,5 in Dakar, 7 in Yaoundé). However, the difference in average number of children in the two cities shown in the table might only be due to weights. The weights are the number of children age 20 to 40 a given parent has that might be biased upward in Dakar where parents are older. Actually, parents are on average 57 years old in Dakar and on average 48 years old in Yaoundé[4]. Multivariate analyses will allow fixing theses differences in structures.

In addition to these differences in schooling and fertility, individuals in the samples of Dakar and Yaounde had lived in different socio-economic context. Indeed, from the sixties to the nineties and more precisely to the devaluation of the CFA Franc in 1994, standard of living was decaying in Senagal[5]. Unlike in Senagal, from 1960 to 1985, Cameroon had better living standard[6]. Economic environment really deteriorated in Cameroon only 2 to 4 years prior to the survey, probably after the schooling period of individuals in our sample.

[3] In this study, we consider only children of aged 20 to 40 who are supposed to have finished their studies or have advanced enough so that we can measure the effect of family environment.

[4] In Yaounde the survey was addressed to 25-54 years olds persons whereas in Dakar, adults above 20 years old were considered.

[5] In urban areas, annual income per capita decreased from 322,200 FCFA to 168300FCFA throughout the period, down nearly 50% (Duruflé, 1994). GDP per capita followed the same depressing with a 16% drop between 1960 and 1997 (Antoine et alli, 2001). A huge contraction in wages and in public employment was also observed in Dakar(see Anthony and Piché, 1998)

[6] Indeed, from the independence (in 1960) to mid-70s, Cameroon's economy recorded a steady annual growth rate of around 4%. From 1977 until 1986, thanks to mining, the economy experienced an explosive growth rate of around 10% (see Aerts et al, 2000). After the 1986, the country got into a recession due to the combined effect of lower oil prices and the depreciation of the dollar. Living standards completely collapsed in 1992 after a drop of more that 50% of civil servants

Table 1: Mean and standard deviation of main variables,

	Dakar			Yaounde		
Variable	Obs	Mean	Std.Dev.	Obs	Mean	Std.Dev.
Children (aged 20 to 40) characteristics						
No schooling	1191	0,27	0,45	576	0,00	0,06
Primary	1191	0,35	0,48	576	0,12	0,33
Secondary 1	1191	0,16	0,37	576	0,28	0,45
Secondary 2	1191	0,12	0,32	576	0,40	0,49
University	1191	0,10	0,30	576	0,19	0,39
Age	1191	27,73	5,57	576	24,43	4,00
Gender (Male=1)	1191	0,51	0,50	576	0,55	0,61
Siblings	1191	7,46	3,05	575	6,08	1,61
Muslim	1191	0,93	0,26	576	0,02	0,15
Christian	1191	0,07	0,26	576	0,90	0,30
Born abroad	1191	0,05	0,22	576	0,00	0,00
Born Dakar/Yaoundé	1191	0,33	0,47	576	0,14	0,34
Born in a city	1191	0,25	0,43	576	0,27	0,44
Parents characteristics						
No schooling	1191	0,52	0,50	568	0,07	0,26
Primary	1191	0,25	0,43	568	0,36	0,48
Secondary 1	1191	0,09	0,29	568	0,39	0,49
Secondary 2	1191	0,04	0,19	568	0,11	0,31
University	1191	0,09	0,29	568	0,07	0,25
Gender parent (Male=1)	1191	0,44	0,50	576	0,28	0,45
Age	1191	56,76	9,07	576	47,46	4,75
Number of children	1191	8,47	4,06	576	7,04	2,61
Parent's number of divorces	1191	0,27	0,59	576	0,36	0,58
Parent's number mariage/remariage	1191	0,34	0,63	576	0,14	0,41

Sources: Yaounde: Enquête insertion urbaine de la ville de Yaoundé, IFORD, CEPED 1996 ; Dakar, Enquête IRD-INFAN-CODESRIA.

Bivariate relationship between school achievement and the number of siblings

Table 2 presents the bivariate relationship between school achievement and the number of siblings. It shows a negative link between the number of siblings and school achievement, especially in Dakar. The more a child has siblings, the less he accumulates schooling grades. In Dakar, the share of individuals who reached the highest level of education decline from 15% when surrounded with less than 3 siblings, to 5% when living in an overcrowded family of 10 siblings or more. The likelihood of reaching secondary level follows a similar pattern: 34% of children from small families reached secondary level while only 16% of children from larger families reached that level. In Yaounde in contrast, the relationship seems very weak and is not clear cut.

Table 2: Cross table of child schooling level and number of siblings (in %)

	Number of siblings											
	Dakar						Yaounde					
	0-3	4-5	6-7	8-10	10 +	total	0-3	4-5	6-7	8-10	10 +	total
No schoolling	24	27	24	30	31	27	0	0	1	0	0	0
Primary	27	28	35	36	48	35	8	7	17	12	12	12
Secondary	34	34	32	24	16	28	78	67	60	78	65	68
University	15	12	9	10	5	10	14	26	22	9	23	19
Total	100	100	100	100	100	100	100	100	100	100	100	100

Sources: Yaounde: Enquête insertion urbaine de la ville de Yaoundé, IFORD, CEPED 1996 ; Dakar, Enquête IRD-INFAN-CODESRIA.

3. Estimation strategy and results

3.1 Estimation strategy

The schooling variable is ordinal with 5 categories. Defining Y_i , to be the ith observation on the dependent variable and Y_i^* to be its corresponding latent value. The latent regression if defined by

$$Y_i^* = X_i\beta + \theta\, n_i + u_i \qquad (1)$$

, where X is a vector of observable explanatory variables (without a constant), n is the number of siblings and u ~ N(0,1) the unobserved error term. The observed variable Y is characterized by:

$$Y_i = 1 \quad if \quad Y_i^* \leq \mu_1$$

$$Y_i = 2 \quad if \quad \mu_1 < Y_i^* \leq \mu_2$$

$$Y_i = 3 \quad if \quad \mu_2 < Y_i^* \leq \mu_3$$

$$Y_i = 4 \quad if \quad \mu_3 < Y_i^* \leq \mu_4$$

$$Y_i = 5 \quad if \quad \mu_4 < Y_i^*$$

where $0 < \mu_1 < \mu_2 < \mu_3 < \mu_4$ are unknown threshold parameters to be estimated. These parameters must be positive to make sure that the estimated probabilities are positive (Greene, 2003)

The coefficient of interest is θ. It measures directly the marginal effect of the family size on the latent index. The marginal effect of the family size on the probability is proportional to θ. The sign of the marginal effect of the family size on the probability is unambiguous for the two extreme cases: the lowest and highest level of education considered. The marginal effect on the probability of being at the lowest level of education (y=1) has an opposite sign to θ. The marginal effect of the family size on the probability of being at the highest level of education is of the sign of θ.

Decomposition of the effect of number of siblings on schooling

Final schooling outcome is the result of a cumulative process. Every child accumulate grade per grade over time. Over time as well, children face different household environment. Our biographical data makes it possible to trace back all socioeconomic and demographic constraints, in particular different number of siblings, faced by a child at any point in time throughout his life. The varying dynamic of this environment affects the final schooling outcome (Tenikue & Verheyden 2010). We thus study the effect of the number of siblings at different age on the final schooling outcome. This would allow identifying critical age points, namely ages where the sibling's size effect on education is more important. To computer these effects, we estimate a set of 8 equations derived from (1) as follows:

$$Y_i^* = X_{ij}\,\beta j + \theta j\, n_{ij} + u_{ij}$$

where X_j, n_j, β_j and θj are measured at age j, j =10 to 19. So X_j is the vector of explanatory variables when the indexed child was j years old. The number of siblings n_j, is defined accordingly.

For each specification, we run two sets of regressions. In the first sets of regressions, the number of siblings is considered predetermined/exogenous. Ordered probit models are estimated following the previous description and equation 1. In the second sets or regression, the number of siblings is considered endogenous in a household model where both family size and children schooling are jointly determined by parents (Baland and Robinson 2000).

Endogenous number of siblings

The family size reflects parental choice, and as such, it is endogenous in a household model (Baland and Robinson 2000). Thus, the effect of varying family size on schooling outcome runs the risk of being spurious. To overcome this limitation, in the second sets of regressions, we explicitly treat the number of siblings as endogenous. We have that

$$n_i = Z_i\delta + v_i \qquad (2)$$

where Z is a vector of observable variables with $X \subset Z$ and (u,v) correlated. Instrumental variables methods are often used to isolate the exogenous effect of the family size. Two sets of instruments have been used in the literature to isolate the exogenous effect of the family size. The first relies on the arrival of multiple births in the family (Black et al.2005, Cáceres-Delpiano 2006). A twin birth generates and exogenous/unexpected chock on the family size and is not the outcome of parental choices. The second set uses the sibling sex composition of the family (Goux and Maurin 2005, Conley and Glauber, 2006). Parents do not choose the gender of their children[7], and may increase the family size to increase the likelihood of having a child of given gender. Parents may also increase the family size to increase the likelihood of avoiding having children of same gender. The sibling sex composition instrument may improve on the twin instrument because it allows for a generalization of findings beyond twin families.

This paper relies on the second approach and uses the sex ratio of children as instrument of the family size. The sex ratio is included in the vector Z but not in X. This variable has to satisfy two conditions. First, it must be relevant. We have observed that families with more female children are more likely to be larger. The correlation between the sex ratio and the final family size is significant in our two datasets. The correlation plausibly reflects that in patriarchal societies, parents prefer larger family with boys than smaller family with only girls.

Second, the sex ratio must satisfy exclusion restrictions or be exogenous. We follow (Conley and Glauber 2006) and state the condition to be our identification assumption. The main channel through which the sex ratio affects schooling is only through its effect on the family size.

In addition to sex ratio, we use parent family background in the family size equation. The background includes the schooling level of parents and their socio economic activities. These background characteristics aim at controlling for factors influencing the ideal family size of parent.

[7] Some process of parental sex selection have been noted in India (Prabhat et al, 2006) and in China.

The estimation is carried out with a two-steps procedure (Wooldridge 2002, chap 16). In the first step, we estimate equation 2 by ordinary least squares and compute the predicted values of family size. These predicted values are included in the second stage equation (equation 1). In the second step, we run an oprobit model and standard errors are bootstrapped.

3.2 Results

Sex ratio and number of siblings (first stage regression)

Tables 3a and 3b show the estimated coefficients of the first stage regression in Dakar and in Yaounde**.** They show that the sex ratio is an important predictor of family size. The relationship is this: the larger the number of females with respects to the number of males in a family, the larger the family size. The result holds both in Dakar and Yaoundé and may be related to the fact that Cameroun and Senegal are patriarchal societies. In the two countries, males are more desired than females because males are those who can inherited and in general they are asked to occupy the most rewarding and powerful positions in the society. Every family that wants to increase or maintain his social position should have as more males as possible (Locoh, 1988).

The results show that a 1% reduction in the sex ratio (the number of female increases faster than that of males) leads to an increase of the family size by about 2 children in Dakar. The order of magnitude of the sex ratio effect on the family size in Yaoundé is 0.4 child smaller.

Table 3a: First stage regressions in Dakar

		Number of siblings at age of									
	sibsizel	10	11	12	13	14	15	16	17	18	19
Sex ratio	-0.020	-0.024	-0.026	-0.027	-0.028	-0.029	-0.030	-0.030	-0.031	-0.031	-0.032
	(7.84)***	(14.67)***	(15.33)***	(15.83)***	(15.79)***	(15.77)***	(15.76)***	(16.09)***	(15.97)***	(15.79)***	(16.09)***
Age Parent	0.131	0.191	0.181	0.173	0.167	0.160	0.152	0.147	0.142	0.136	0.133
	(15.43)***	(30.81)***	(28.79)***	(27.11)***	(25.54)***	(24.10)***	(22.72)***	(21.71)***	(20.57)***	(19.42)***	(18.74)***
Parent's number of divorces	-0.509	-0.540	-0.483	-0.404	-0.321	-0.346	-0.317	-0.380	-0.319	-0.299	-0.276
	(1.80)*	(2.59)***	(2.27)**	(1.84)*	(1.44)	(1.53)	(1.39)	(1.65)*	(1.36)	(1.24)	(1.13)
Parent's number mariage/remariage	0.603	0.083	0.059	-0.033	-0.088	-0.063	-0.113	-0.066	-0.123	-0.084	-0.122
	(2.01)**	(0.39)	(0.27)	(0.15)	(0.39)	(0.27)	(0.49)	(0.28)	(0.52)	(0.35)	(0.50)
Parent of Primary level	0.239	0.667	0.741	0.723	0.780	0.767	0.733	0.755	0.824	0.785	0.800
	(1.00)	(5.64)***	(6.19)***	(5.92)***	(6.26)***	(6.03)***	(5.73)***	(5.81)***	(6.23)***	(5.88)***	(5.90)***
Parent of Secondary 1 level	-0.584	-0.634	-0.650	-0.761	-0.732	-0.807	-0.803	-0.815	-0.823	-0.917	-0.917
	(1.91)*	(3.92)***	(3.99)***	(4.58)***	(4.31)***	(4.67)***	(4.61)***	(4.61)***	(4.57)***	(5.04)***	(4.97)***
Parent of Secondary 2 level	-0.245	0.191	0.201	0.214	0.335	0.214	0.220	0.220	0.307	0.122	0.180
	(0.57)	(0.78)	(0.82)	(0.85)	(1.31)	(0.82)	(0.84)	(0.83)	(1.13)	(0.44)	(0.65)
Parent of University level	-1.059	-1.055	-1.060	-1.146	-1.090	-1.097	-1.138	-1.188	-1.156	-1.281	-1.191
	(2.92)***	(5.08)***	(5.06)***	(5.36)***	(4.99)***	(4.94)***	(5.08)***	(5.24)***	(5.01)***	(5.51)***	(5.06)***
Gender Parent (Male=1)	-0.166	-0.533	-0.414	-0.306	-0.180	-0.076	-0.043	0.051	0.135	0.186	0.226
	(0.80)	(4.15)***	(3.18)***	(2.31)**	(1.33)	(0.55)	(0.31)	(0.36)	(0.93)	(1.28)	(1.53)
		Parent employment status at different age included but not shown									
	Religion, Grand father and grandmother employment status and education level and included but not shown										
Constant	-0.410	-1.650	-1.341	-1.101	-0.950	-0.741	-0.471	-0.359	-0.211	0.051	0.056
	(0.89)	(6.05)***	(4.77)***	(3.78)***	(3.14)***	(2.36)**	(1.46)	(1.08)	(0.61)	(0.14)	(0.15)
Observations	784	3255	3255	3255	3255	3255	3255	3255	3255	3255	3255
R-squared	0.45	0.39	0.38	0.37	0.36	0.35	0.34	0.34	0.33	0.33	0.32

Absolute value of t statistics in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%

Table 3b: First stage regressions in Yaounde

		Number of siblings at age of									
	sibsize	10	11	12	13	14	15	16	17	18	19
Sex ratio	-0.016	-0.018	-0.019	-0.020	-0.021	-0.021	-0.022	-0.023	-0.023	-0.024	-0.023
	(10.43)***	(18.51)***	(18.75)***	(19.18)***	(19.58)***	(19.50)***	(19.69)***	(19.96)***	(19.83)***	(20.17)***	(19.76)***
Age Parent	0.175	0.173	0.169	0.158	0.149	0.139	0.132	0.130	0.122	0.116	0.112
	(20.62)***	(34.74)***	(33.13)***	(30.58)***	(28.55)***	(26.02)***	(24.56)***	(23.40)***	(21.66)***	(20.63)***	(19.84)***
Parent's number of divorces	-0.801	-0.801	-0.813	-0.926	-0.908	-0.877	-0.896	-0.931	-0.887	-0.898	-0.884
	(4.40)***	(5.72)***	(5.68)***	(6.43)***	(6.29)***	(5.93)***	(6.02)***	(6.05)***	(5.75)***	(5.79)***	(5.67)***
Parent's number mariage/remariage	0.806	0.777	0.679	0.781	0.806	0.776	0.755	0.767	0.696	0.686	0.674
	(3.31)***	(4.36)***	(3.73)***	(4.26)***	(4.37)***	(4.12)***	(3.97)***	(3.90)***	(3.52)***	(3.46)***	(3.38)***
Parent of Primary level	1.196	0.822	0.876	0.900	0.848	0.897	0.937	0.928	0.916	0.893	0.914
	(3.78)***	(5.18)***	(5.39)***	(5.46)***	(5.10)***	(5.26)***	(5.46)***	(5.23)***	(5.11)***	(4.97)***	(5.06)***
Parent of Secondary 1 level	1.197	0.701	0.723	0.725	0.667	0.695	0.641	0.718	0.672	0.592	0.627
	(3.78)***	(4.36)***	(4.38)***	(4.33)***	(3.95)***	(4.02)***	(3.69)***	(3.99)***	(3.70)***	(3.24)***	(3.42)***
Parent of Secondary 2 level	0.933	0.392	0.377	0.385	0.348	0.366	0.399	0.378	0.312	0.315	0.267
	(2.80)***	(2.25)**	(2.11)**	(2.13)**	(1.90)*	(1.96)*	(2.12)**	(1.94)*	(1.59)	(1.60)	(1.35)
Parent of University level	0.789	0.259	0.244	0.201	0.123	0.174	0.194	0.131	0.094	0.112	0.077
	(2.25)**	(1.35)	(1.25)	(1.01)	(0.61)	(0.85)	(0.94)	(0.61)	(0.43)	(0.52)	(0.35)
Gender Parent (Male=1)	-0.576	-0.747	-0.725	-0.687	-0.585	-0.581	-0.583	-0.512	-0.444	-0.418	-0.413
	(4.59)***	(9.62)***	(9.11)***	(8.51)***	(7.17)***	(6.96)***	(6.94)***	(5.89)***	(5.06)***	(4.74)***	(4.66)***
		Parent employment status at different age included but not shown									
		Religion, Grand father and grandmother employment status and education level and included but not shown									
Constant	-3.079	-1.735	-1.691	-1.281	-0.870	-0.543	-0.389	-0.289	-0.017	0.105	0.184
	(5.98)***	(6.40)***	(6.02)***	(4.44)***	(2.95)***	(1.78)*	(1.25)	(0.89)	(0.05)	(0.31)	(0.53)
Observations	1140	3753	3753	3753	3753	3753	3753	3753	3753	3753	3753
R-squared	0.45	0.37	0.36	0.34	0.33	0.31	0.30	0.30	0.29	0.28	0.28

Absolute value of t statistics in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%

Sources: Yaounde: Enquête insertion urbaine de la ville de Yaoundé, IFORD, CEPED 1996 ; Dakar, Enquête IRD-INFAN-CODESRIA.

Endogeneity of the number of siblings

The last rows of table 4 present the results of an endogeneity test for the number of siblings in this framework. This test is based on separated regressions[8] (the Smith-Blundell procedure) described by Wooldridge (2002). The test is significant in Dakar. It indicates that the number of siblings is endogenous in Dakar, thus parents adjust their fertility to achieve the preferred level of education per child. In Yaounde however, there is no evidence of endogeneity.

The overall sibling's impact on school achievement

Table 4 presents estimated coefficients of the models described by eq 1. For every city, the first column shows results of an estimted ordered probit model, the second and third columns present results from and IV oprobit without and with bootstrapped standards errors. The results are in line with bivariate analysis. Namely, the number of siblings is negatively correlated to schooling achievement in Dakar. The result corroborates the resource dilution theory. In Yaounde however, the relationship between the two variables is weak. The coefficients are negative but not significant.

The difference in the observed effect in the two cities is in line with the ambiguous relationship between the number of siblings and schooling found in the literature. The lack of a strong relationship has been observed in other African contexts (Eloundou-Enyegue and Williams, 2006).

[8] The full results of the regression are available but not shown here. Only the two relevant coefficients, the corresponding z statistics and significance levels are shown in table 4.

Table 4: estimated coefficient of the school achievement model

	Dakar			Yaounde		
	1	2	3	1	2	3
	oprobit	iv Opro-bit	Iv Oprobit boostraped	oprobit	iv Opro-bit	Iv Oprobit boostraped
Number of siblings	-0.041	-0.292	-0.292	-0.029	-0.088	-0.088
	(2.42)**	(3.25)***	(3.01)***	(1.36)	(0.67)	(0.70)
Gender (Male=1)	0.224	0.211	0.211	-0.002	-0.009	-0.009
	(3.09)***	(2.96)***	(2.76)***	(0.03)	(0.12)	(0.12)
Age	-0.011	-0.018	-0.018	0.402	0.410	0.410
	(0.20)	(0.31)	(0.31)	(3.16)***	(3.23)***	(3.27)***
Agesq	0.001	0.001	0.001	-0.007	-0.007	-0.007
	(0.56)	(0.70)	(0.70)	(2.86)***	(2.92)***	(2.97)***
Gender Parent (Male=1)	-0.216	-0.286	-0.286	-0.290	-0.360	-0.360
	(1.63)	(2.28)**	(2.29)**	(2.22)**	(2.47)**	(2.26)**
Age Parent	0.015	0.048	0.048	0.028	0.039	0.039
	(2.04)**	(3.33)***	(3.09)***	(1.91)*	(1.39)	(1.45)
Parent's number of divorces	0.397	0.217	0.217	0.005	-0.049	-0.049
	(2.90)***	(1.46)	(1.41)	(0.03)	(0.27)	(0.27)
Parent's number mariage/remariage	-0.331	-0.164	-0.164	0.072	0.117	0.117
	(2.45)**	(1.10)	(1.08)	(0.30)	(0.45)	(0.40)
Parent of Primary level	0.549	0.526	0.526	0.691	0.753	0.753
	(4.28)***	(3.90)***	(3.42)***	(1.54)	(1.64)	(1.59)
Parent of Secondary 1 level	1.092	0.922	0.922	1.133	1.211	1.211
	(6.56)***	(4.94)***	(4.78)***	(2.55)**	(2.67)***	(2.65)***
Parent of Secondary 2 level	1.702	1.388	1.388	1.266	1.311	1.311
	(5.03)***	(4.91)***	(3.92)***	(2.60)***	(2.68)***	(2.54)**
Parent of University level	1.797	1.469	1.469	1.843	1.872	1.872
	(10.27)***	(6.68)***	(6.18)***	(3.96)***	(4.03)***	(3.76)***
Born abroad	-0.083	-0.156	-0.156			
	(0.34)	(0.59)	(0.59)			
Born Dakar/Yaoundé	0.252	0.199	0.199	-0.208	-0.210	-0.210
	(1.98)**	(1.62)	(1.82)*	(1.36)	(1.36)	(1.28)
Born in a city	0.305	0.265	0.265	-0.006	-0.014	-0.014
	(2.09)**	(1.74)*	(1.51)	(0.04)	(0.08)	(0.08)
Muslim				-0.248	-0.207	-0.207
				(0.63)	(0.53)	(0.41)
Christian	0.544	0.420	0.420	0.039	0.070	0.070
	(3.33)***	(2.64)***	(2.27)**	(0.21)	(0.37)	(0.34)
Observations	1191	1191	1191	568	568	568
Endogeneity of the number of siblings[9]		t = 2.67			t=0.26	
		p=0.003			p=0.4	

Robust z statistics in parentheses: * significant at 10%; ** significant at 5%; *** significant at 1%

Sources: Yaoundé : Enquête insertion urbaine de la ville de Yaoundé, IFORD, CEPED 1996 ; Dakar, Enquête IRD-INFAN-CODESRIA.

[9] T is the Absolute value of t statistics and p the corresponding probability

Following Tenikue & Verheyden (2010), the sibling's size effect can be more effective at some age/grade than at others. We then examine the variation of sibling's size effects across different schooling ages.

The impact of sibling size over different schooling ages.

The effect of the siblings size on education measured in Table 4 is an overall mean effect. It misses to show how the varying sibling size throughout the life of a child can affect the final schooling outcome. Table 5 presents, for a given age, the effect of the number of siblings at that age. It shows that in Dakar, large family size tends at hindering schooling at all age from 11 to 19 years. In Yaoundé, a different patter is observed. First, the family size has no effect on final schooling outcome between the age 10 to 13 and 17 to 19. However, between the 14 to 16 years old, the relationship is negative and significant.

Table 5:The estimated coefficient of the average effect of the number of siblings at different ages

	Dakar			**Yaounde**		
Age	Oprobit	iv Oprobit	Iv Oprobit boostrapped	Oprobit	Iv Oprobit	Iv Oprobit boostrapped
10	-0.054	-0.071	-0.071	-0.049	-0.106	-0.106
	(2.78)***	(1.43)	(1.51)	(1.68)*	(1.16)	(1.17)
11	-0.058	-0.149	-0.148	-0.057	-0.160	-0.175
	(3.09)***	(2.19)**	(2.21)**	(2.07)**	(1.37)	(1.49)
12	-0.053	-0.145	-0.144	-0.053	-0.143	-0.157
	(2.88)***	(2.39)**	(2.18)**	(1.92)*	(1.38)	(1.58)
13	-0.053	-0.145	-0.144	-0.045	-0.127	-0.138
	(2.93)***	(2.39)**	(2.14)**	(1.65)*	(1.26)	(1.39)
14	-0.050	-0.148	-0.148	-0.046	-0.160	-0.170
	(2.84)***	(2.50)**	(3.03)***	(1.67)*	(1.68)*	(2.06)**
15	-0.047	-0.143	-0.142	-0.040	-0.153	-0.175
	(2.72)***	(2.75)***	(2.63)***	(1.49)	(1.34)	(1.70)*
16	-0.044	-0.158	-0.157	-0.041	-0.146	-0.166
	(2.56)**	(2.83)***	(2.29)**	(1.56)	(1.70)*	(1.78)*
17	-0.043	-0.150	-0.149	-0.036	-0.093	-0.112
	(2.52)**	(2.12)**	(2.48)**	(1.39)	(1.02)	(1.17)
18	-0.041	-0.144	-0.144	-0.036	-0.086	-0.109
	(2.43)**	(2.28)**	(2.33)**	(1.39)	(0.87)	(1.29)
19	-0.040	-0.149	-0.149	-0.035	-0.051	-0.070
	(2.40)**	(2.50)**	(2.32)**	(1.40)	(0.50)	(0.60)
Observations	1191			568		

Robust z statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

Sources: Yaounde: Enquête insertion urbaine de la ville de Yaoundé, IFORD, CEPED 1996 ; Dakar, Enquête IRD-INFAN-CODESRIA.

Finally, whereas in Dakar, overcrowded families have damaging effect on children school achievement It seems that in Yaounde there are some critical ages points (between 14-16) where family size acts more intensively. These age points correspond to the ages where children are expected to complete grade 7 and grade 8. Completing grade 8 correspond to the transition from the first part to the second part of secondary education characterized by succeeding a national standardized exam.

The absence of the inverse relationship between the number of siblings and schooling performance in Yaounde suggest that other factors play an important role there. The difference between Dakar and Yaounde may be related to preferences[10] or to socioeconomic conditions (Eloundou-Enyegue and Williams, 2006). We noted (section 2) that people from Dakar and those from Yaounde faced very different socioeconomic conditions during their childhood and adolescent period. So if the direct and indirect costs of education were higher in Dakar and very low in Yaounde during their teenage, it is possible that such difference in socioeconomic environment explains the difference in our results.

The effects of elders and younger siblings

Parents decide on the family size but the age structure of the family does not entirely depend on parental choices[11]. For a given child and at a given age, his siblings can be subdivided into three groups[12]: (1) younger siblings, (2) his elder siblings who are of schooling age and (3) his elder siblings who are not any more of schooling age. This subdivision allows measuring how the competition among children of schooling age over parent's schooling resources ultimately affects the schooling outcome. When relatively more children are of schooling age, we expect more damaging effects compared to the situation where relatively more siblings are not of schooling age. In addition, elder siblings may engage in labor market and help relaxing resources constrains (Basu & Van 1998, Edmonds 2006, Emerson and Susa 2002). To test the effect of sibling's composition, we run a set of regression where the variable number of siblings is substituted for the number of children in any of the three groups defined.

Table 6 shows the results of the estimated models. In Dakar, for any given child, the presence of younger siblings does not impact his school performance, whatever schooling age is considered. In contrast, the number of elder siblings under the age of 19 years affects negatively and significantly his school outcome.. Having elder siblings above the age of 19 years also hampers a child school achievement in Dakar. The effect is particularly important when the child aged between 16 and 18 years. Surprisingly these results suggest that competition for parental resource, is more intensive with elder siblings than with younger. They could be explained by a sort of "waiting queue" mechanism: because elder siblings are already in school, parents primarily allocated their resource to them and only the rest, if any, is allocated to younger siblings. Such an allocation rule can lead to sharp inequality among children. In Yaoundé, sibship decomposition does not lead to any significant results.

[10] Parents may be worse off when they have a child whose quality is lower than a given level (Minimum acceptable level of education) in Yaounde.
[11] Family planning techniques and birth control practices were seldom used in the two countries.
[12] Initially, the first group of younger siblings was divided into two subgroups, (1) those who are under 5 years old and (2) those who are of schooling age, but it turns out that the effects of the two categories are the similar. We then decide to create only one.

Table 6: **The estimated coefficient of the effect of elders and of younger siblings**

	Dakar								
	Age i								
	10	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
Number of young siblings at age i	-0.022	-0.028	-0.023	-0.025	-0.022	-0.021	-0.019	-0.019	-0.018
	(0.90)	(1.19)	(1.03)	(1.13)	(1.07)	(1.02)	(0.92)	(0.97)	(0.90)
Number of elder siblings under 19 years old at age i	-0.088	-0.115	-0.111	-0.132	-0.160	-0.200	-0.141	-0.172	-0.142
	(2.82)***	(3.58)***	(3.25)***	(3.60)***	(4.26)***	(4.45)***	(2.94)***	(2.89)***	(1.69)*
Number of elder siblings over 20 years old at age i	-0.070	-0.044	-0.058	-0.047	-0.046	-0.037	-0.067	-0.066	-0.078
	(1.89)*	(1.25)	(1.78)*	(1.43)	(1.46)	(1.21)	(2.24)**	(2.28)**	(2.79)***
Observations	1191	1191	1191	1191	1191	1191	1191	1191	1191
	Yaounde								
Number of young siblings at age i	-0.049	-0.057	-0.050	-0.039	-0.039	-0.036	-0.040	-0.034	-0.033
	(1.33)	(1.63)	(1.45)	(1.16)	(1.16)	(1.14)	(1.30)	(1.14)	(1.14)
Number of elder siblings under 19 years old at age i	-0.047	-0.047	-0.065	-0.060	-0.085	-0.113	-0.040	0.026	0.118
	(0.97)	(0.97)	(1.31)	(1.13)	(1.56)	(1.87)*	(0.58)	(0.32)	(0.99)
Number of elder siblings over 20 years old at age i	-0.071	-0.075	-0.030	-0.045	-0.020	-0.010	-0.066	-0.079	-0.076
	(0.64)	(0.86)	(0.35)	(0.65)	(0.27)	(0.14)	(1.14)	(1.46)	(1.62)
Observations	568	568	568	568	568	568	568	568	568

4 Conclusion.

The objective of this paper was to revisit Arsene Dumont theory of capillarity and investigate the effect the number of siblings on school achievement in Dakar and Yaounde. Based on the Becker's quanti-qualitative theory, numerous authors have exhibited negative impact of family size on children school outcome in developed countries and other developing countries. In sub-Saharan Africa however, results have been inconclusive: negative, positive and no effect have both been observed. Most of studies in the literature consider the overall effect of family size on school achievement. In this paper, we estimate the overall effect and then rely on biographical data to take issue one step further. We investigate the effect of the varying number siblings and the structure of siblings over time on the final schooling outcome. We identify critical ages where the number of siblings is more damaging. Similarly we identify ages where the relative position of child (structure) hinders most schooling. The results show that, in Dakar, the overall family size effect and age specific one have both negative and statistically significant effects on education. Whatever schooling age is considered, being surrounded by numerous siblings hinders school performance. In Yaoundé, the overall effect is not significant, but we observed local negative impact at some schooling ages (between 14 and 16). We think that these ages are critical and correspond to periods were school performances are the most sensitive to family size pressure.

In Dakar, the magnitudes of effects are comparable throughout the school live cycle. Disentangling sibling's size by relative age (younger, elder in school age interval and elder above the school age interval) allow us to bring into light interesting effects in Dakar. For any giving child in Dakar, having elder siblings tends to hamper his school performance, all over the schooling age interval, whereas being surrounded with younger siblings has no significant effect.

Finally, these results reflect, in particular in the case of Dakar, the well known fact that high fertility is a serious threat to the accumulation of human capital needed for development. More specifically, to achieve upward social mobility, a family in Dakar needs to reduce its fertility. Policies to improve the control of fertility are to be strengthened. This recommendation seams also relevant in Yaounde where we have noticed critical ages where sibling's size might undermine schooling.

Bibliography

Antoine, P., Fall, A. S. (2002) « Crise, passage à l'âge adulte et devenir de la famille dans les classes moyennes et pauvres à Dakar ». Rapport

Aerts J.J., Cogneau D., de Monchy G., Herrera J., Roubaud F. (2000), L'économie camerounaise : un espoir évanoui, Paris, Karthala, Les Afriques, 287 p.

Antoine P., Razafindrakoto M., Roubaud F., 2001 : « Contraints de rester jeune ? Évolution de l'insertion dans trois capitales africaines : Dakar, Yaoundé, Antananarivo », DT INED,

Antoine P., Piché V., (1998) « L'insertion à Dakar et à Bamako : une comparaison des inténéraires » in Antoine Philippe, Ouedraogo Dieudonné et Piché victor, Trois générations de citadins au Sahel. Trente ans d'histoire sociale à Dakar et à Bamako, L'Harmattan, pp11-44

Baland, J-M., Robinson, J. (2000) "Is Child Labor Inefficient?," Journal of Political Economy, vol. 108(4), pages 663-679.

Basu, K., Van, P. (1998) "The Economics of Child Labor," American Economic Review, vol. 88(3), pages 412-27,

Becker, G., Lewis, H. (1973) "On the Interaction between the Quantity and Quality of Children," Journal of Political Economy, vol. 81(2), pages S279-88,

Becker, G., Tomes, N. (1986) "Human Capital and the Rise and Fall of Families," Journal of Labor Economics, vol. 4(3), pages S1-39, July.

Black, S., Devereux, P. et Salvanes, K. (2005) "The More the Merrier? The Effect of Family Size and Birth Order on Children's Education," The Quarterly Journal of Economics, MIT Press, vol. 120(2), pages 669-700, May.

Blake, J. (1981) "Family size and the quality of children" Demography vol 18, pages 421-442

Bloom, D., Canning, D. et Sevilla, J. (2003) "The Demographic Dividend: A New Perspective on the Economic Consequences of Population Change." Population Matters Series. Santa Monica, California: Rand.

Cáceres-Delpiano, J. (2006) "The Impacts of Family Size on Investment in Child Quality," Journal of Human Resources, vol. 41(4).

DURUFLE G. ,1994 : *Le Sénégal peut-il sortir de la crise ?*, Karthala, Paris, 222 p

Chernichovsky, D. (1985) "Socioeconomic and Demographic Aspects of School Enrollment and Attendance in Rural Botswana," Economic Development and Cultural Change, vol. 33(2), pages 319-332.

Conley, D., Glauber, R. (2006) "Parental Educational Investment and Children's Academic Risk: Estimates of the Impact of Sibship Size and Birth Order from Exogenous Variation in Fertility," Journal of Human Resources, vol. 41(4).

Downey, D. (1995) "When Bigger Is Not Better: Family Size, Parental Resources, and Children's Educational Performance." American Sociology Review 60:746-61.

Dumont, A. (1890) Dépopulation et civilisation. Etude démographique, Paris, Lecrosnier et Babé. 1890, XII + 520 p.

Edmonds, E. (2006) "Understanding sibling differences in child labor," Journal of Population Economics, Springer, vol. 19(4), pages 795-821.

Eloundou-Enyegue, P., Williams, L. (2006), "Family Size and Schooling in Sub-Saharan African Settings: A Reexamination" Demography, Vol. 43, No. 1 , pp. 25-52

Emerson, P., Souza, A. (2002)"Birth Order, Child Labor and School Attendance in Brazil," Working Papers 0212, Department of Economics, Vanderbilt University.

Gomes, M. (1984) "Family Size and Educational Attainment in Kenya." Population and Development Review 10:647-60.

Goux, D. , Maurin, E. (2005) "The effect of overcrowded housing on children's performance at school" Journal of Public Economics 89 (2005) 797– 819

Greene, W. (2003) Econometric Analysis , fifth edition, Prentice-Hall Internatinal , London

Jha, P., Kumar, R., Vasa, P., Dhingra, N., Thiruchelvan, D., Moineddin, R. (2006) Low male-to-female sex ratio of children born in India: national survey of 1·1 million households. The Lancet, Volume 367, Issue 9506, Pages 211 - 218, 21

Knodel, J., Napaporn, H., Werasit, S. (1990) "Family Size and the Education of Children in the Context of Rapid Fertility Decline" Population and Development Review, Vol. 16, No. 1, pp. 31-62

Knodel, J., Wongsith, M. (1991) "Family Size and Children's Education in Thailand: Evidence From a National Sample." Demography 28:119-31.

Locoh, T. (1988) "Structures familiales et changements sociaux ", in : TABUTIN Dominique (dir), Population et société en Afrique, l'harmattan, Paris, p. 441-478

Lu, Yao and Treiman, D. (2005) "The Effect of Family Size on Educational Attainment in China: Cohort Variations" mimeo Department of Sociology, UCLA

Montgomery, M., Aka, K. et Raylynn, O. (1995) «The tradeoff between Number of children and child schooling: Evidence from Code d'Ivoire and Ghana » LSMS Working Papers 111. The World Bank, Washington, DC.

Sewell, W. (*1968)* "Parents' Education and Children's Educational Aspirations and Achievements." *American Sociological Review 33*: *191-209.*

Sudha, S. (1997) "Family Size, Sex Composition and Children's Education: Ethnic Differentials over Development in Peninsular Malaysia." *Population Studies* 51:139-51.

Tenikue, M., Verheyden, B. (2010) "Birth Order and Schooling: Theory and Evidence from Twelve Sub-Saharan Countries," Journal of African Economies, vol. 19(4), pages 459-495, August.

Van Eijck, K., De Graaf, P. (1995) "The Effects of Family Structure on the Educational Attainment of Siblings in Hungary." *European Sociological Review* 11:273-292.

Wooldridge, J. (2002) Econometric Analysis of Cross Section and Panel Data. The MIT Press, Cambridge, Massachusetts

CEPS
INSTEAD

B.P. 48
L-4501 Differdange
Tél.: +352 58.58.55-801
www.ceps.lu