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Children Who Have Never Gone to School: How Regional Heterogeneity Shapes Access to Primary Education in Uganda

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Abstract:

Despite Uganda being among the first sub-Saharan countries to introduce universal primary education in 1997, approximately 6% of children aged 9–11 had never attended school as of 2014. A thorough examination of a 10% sample from the latest Uganda Population and Housing Census (2014) dataset underscores notable spatial disparities. We compared the outcomes of separate logistic regression analyses conducted for the Karamoja subregion, the remaining parts of the country, and the entire country. Our multilevel analyses reveal that the influence of household heads' education and wealth on school enrollment emerges as a consistent factor. However, while girls in Karamoja and boys in the rest of Uganda were significantly more likely to have never been enrolled in school, gender was not a significant factor in the national model. Gender-specific expectations and limitations vary, which must be taken into account by policymakers. Our analysis challenges the relevance of national models, and consequently, many national-level findings, in a setting characterized by significant subnational diversity.

Keywords:

Education
School enrollment
Spatial inequalities
Poverty
Gender
Multilevel model
Sub-Saharan Africa
Uganda

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1. Introduction

Following the international conferences in Jomtien in 1990 and Dakar in 2000, access to primary education has become a political priority for many countries around the world [1,2]. In the 1990s, a large proportion of school-age children in sub-Saharan Africa were not in school, particularly girls [3]. Over the last few decades, national and international public policies have supported the increase in school enrolment by specifically targeting girls. Universal access to quality education is one of the Millennium Development Goals, as well as one of the Sustainable Development Goals. Globally, gender equality in access to primary and secondary education was achieved in 2014, as stated by UNESCO [4]. In

sub-Saharan Africa, UNESCO data show that 20% of children of primary school age were not in school in 2019, compared with 47% in 1990. For the same sub-continent, the gender parity index increased from 0.83 in 1990 to 0.95 in 2019 [2]. Today, several African countries such as Senegal [5] and other countries with high enrolment rates [6] have achieved parity or even better enrolment rates for girls at the primary level.

Uganda was one of the first countries in sub-Saharan Africa to introduce universal primary education (in 1997), followed by universal secondary education (in 2007). In one year, from 1996 to 1997, primary school enrolment increased from around 3 million to almost 5.3 million [7]. Both the 2002 and 2014 population censuses highlighted that gender parity had been achieved in primary education [8]. Research from the Demographic and Health Surveys confirms that parity has been achieved since 2011. They also reveal higher dropout rates for boys [6].

Yet despite the Global Out-of-School Initiative launched in 2010 by UNICEF and the UNESCO Institute for Statistics [9], 12.5% of children aged between 6 and 12 were not in school in 2014. Almost 20 years after the introduction of universal primary education, 10% of school-age children had never attended school and 2.5% had already dropped out [8].

Most studies consider out-of-school children from an overall perspective, without differentiating between children who have never been to school (non-enrolment) and those who have dropped out. However, Lewin [10] considers that these two situations are distinct reasons for exclusion from the school system. They therefore require specific research. The keys to understanding why children do not attend school are not necessarily those that explain why they drop out. To our knowledge, there is no nationally representative study of the determinants of non-enrolment in Uganda. This article seeks to better understand why, at the time of the last census, one in ten Ugandan children had never attended school.

Several previous studies have analyzed school performance in Uganda [11,12]. Others have looked at conditions of access and equity in primary education [13–16] and secondary education [17,15]. However, these studies have not specifically explored the issue of non-enrolment. In sub-Saharan African countries, non-enrolment is generally linked to the source of income, place of residence, parent's marital status, disability, social stigma, and other vulnerabilities [10]. According to a recent study [18], financial constraints remain a major cause of school drop-out, but only moderately determine non-enrolment. However, these results are not representative of the entire Ugandan population. In addition, they concern out-of-school children aged between 6 and 12, an age group that overestimates the number of out-of-school children because of the phenomenon of late school enrolment (after the age of 6), which is particularly marked in rural areas.

Deep inequalities persist in the country. For several decades, development indicators (particularly in education) in the Karamoja region have contrasted with the rest of the country [19]. With its episodes of insecurity and pastoral way of life, the region has seen the failure of many development programs [20,21]. Over time, various initiatives have been taken to benefit school-age children in Karamoja, the most important of which was the Alternative Basic Education for Karamoja project, set up in 1998 to facilitate access to primary education for children from pastoralist families [22,23]. The literature has identified explanatory factors for non-enrolment that are specific to individuals and households (poverty, negative perceptions of school), as well as to school provision (absenteeism, poor quality of teachers, long distances to school, violence in schools) and the emergence of casual employment in the mining sector [19,23,24].

This paper seeks to assess the extent to which national models and indicators reflect Uganda's spatial heterogeneity. A 10% sample of the 2014 population census [25] is analyzed in depth to obtain nationally representative results. The population census data gather information on the schooling of all household members: enrolment and attendance. This is exhaustive data, making it possible to capture small sub-populations and produce localized studies for specific sub-populations. This individual-level database is merged with district-level data extracted from the Department for Education's annual data publication [25]. This document provides a detailed description of administrative data on key indicators of school provision.

Can non-enrolment be attributed to the specific characteristics of children and their households? Or is

it linked to characteristics of school provision, such as the inadequacy of educational services? Are educational needs being met? Does gender condition school enrolment? Are the answers to these questions consistent across the country?

The aims of this article are: (1) to assess the proportion of children who have never attended school using descriptive data analysis and mapping; (2) to examine the links between individual, household, and district characteristics and the probability of not attending school in Karamoja and the rest of the country using logistic regressions; (3) to explore the different determinants of not attending school, taking into account heterogeneity within the country, using multilevel modeling.

After describing the data, initial analyses of non-enrolment were carried out to compare the Karamoja region with the rest of Uganda. This comparison between regions reveals the contradictory effect of a fundamental variable: the child's gender. Analysis at the national level masks this reality by denying the effect of this characteristic. To better model non-enrolment by taking into account variations between districts, we then carried out multilevel analyses.

2. Non-enrolment in Uganda

This section describes the Ugandan school system and defines non-enrolment, as well as its historical and geographical dimensions. Despite an increasing decline in the number of children who have never attended school, the proportion of children deprived of basic education remains higher in the north and north-east of Uganda than in the center and west of the country.

2.1. The Ugandan education system and trends in non-enrolment

The Ugandan education system is divided into four levels: primary education, secondary education, commercial, technical and vocational education, and higher education. There are seven years of primary education for pupils aged between 6 and 12, followed by four years of lower secondary education and two years of upper secondary education. At the end of primary school, pupils sit a school-leaving examination. If they pass, they receive a certificate of primary education. Pupils with the best marks are admitted to secondary school. After primary school, it is also possible to follow a three-year vocational course at a technical school. After secondary school, pupils can go on to university, a teacher training college, or commercial, technical, and vocational institutes [26].

The 2014 population census provides more detailed information on household members than on people in specialized institutes, living in hotels, or homeless at the time of the census. Consequently, the analyses carried out in this article concern ordinary households only. Institutions such as hospitals and prisons are excluded from the database. On the other hand, boarding school children are included, since boarding school pupils are dependent on the households of their parents or guardians, as are those living in particular contexts, such as refugee camps.

The data show that at the official entry age for primary education (6 years), many children are not yet enrolled in school, particularly the youngest (**Figure 1**). At the youngest ages, there are fewer cases of children dropping out of school than not. Most drop-outs occur after the age of 10, although they remain marginal. At the primary level, young children outside school are therefore mainly children who have never been enrolled in school.

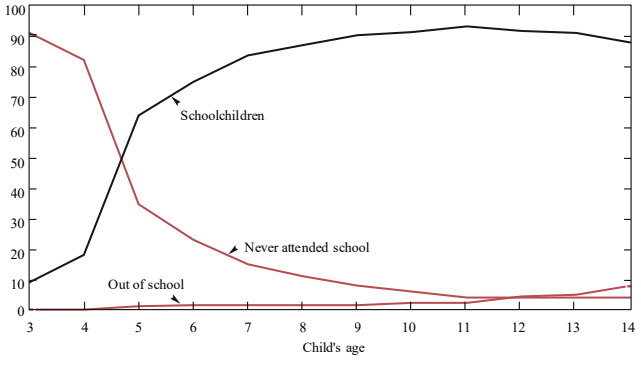

Figure 1. Non-enrolment and drop-out rates between the ages of 3 and 14, Uganda, 2014 (Source: Authors' calculations based on a 10% sample from the 2014 Population and Housing Census)

This study focuses on children aged between 9 and 11 in order to take into account cases of late entry into the school system while remaining within the primary education age range. Although Ugandan primary school officially ends at the age of 12, the age range chosen is capped at 11, so as to allow comparisons with other African

countries where primary education ends at the age of 11.

According to census data, the proportion of children who have never been to school has fallen from 27% in 1991 to 6% in 2014 (**Figure 2**). This remarkable progress is inseparable from the universal primary education program implemented in January 1997. The year 1997 was notable for the surge in school enrolments compared with the previous year. By 2002, the proportion of children aged between 9 and 11 who had never been to school had fallen to around 8%. However, over the following decade, rates of non-attendance fell only slightly, or even stagnated. The 2014 census shows that the proportion of children aged 9 to 11 never attending school is relatively low (5.9%) and similar for boys and girls [5,27,28].

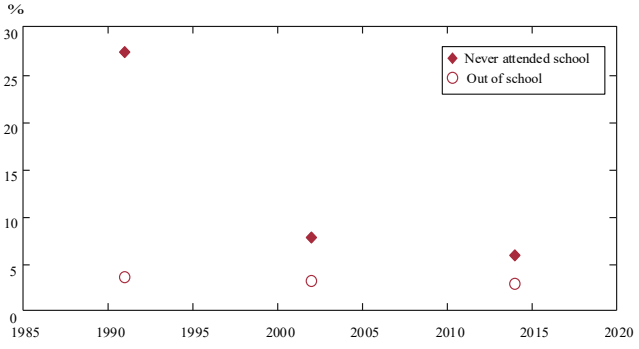

Figure 2. Non-enrolment and out-of-school children aged 9–11, Uganda, 1991–2014 (Source: Authors' calculations based on 10% samples from the 1991, 2002, and 2014 population and housing censuses)

2.2. Children who have never been to school: a spatial approach

According to a previous study, there is a significant gap between enrolment in certain districts of north-eastern Uganda and enrolment in the rest of the country [29]. The out-of-school rates calculated by the district confirm that the proportions of children who have never attended school are not uniform across the country (**Figure 3**). Specific factors seem likely to be associated with (non-)enrolment. Many districts in the north and north-west of Uganda, and some in the west and east, have out-of-school rates well above the national average (10% to 20%). In particular, the northwest of the country stands out with rates of over 60% in six of the seven Karamoja districts (**Figure 3**), in stark contrast to the rest of the country.

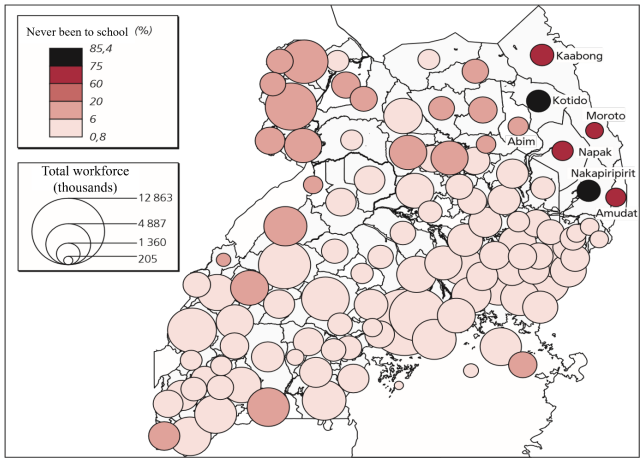

Figure 3. Proportion of children aged 9–11 who have never attended school, by district, Uganda, 2014 (Source: Authors' calculations based on a 10% sample from the 2014 Population and Housing Census; authors' design using the Magrit application (http://magrit.cnrs.fr) with a manual discretization of the data)

Table 1 compares the school enrolment status of children in Karamoja with the rest of Uganda in 2014. It shows that 68% of children in Karamoja had never enrolled in school, compared to only 4% (on average) of children in other regions. This corroborates the findings of the 2016 household survey, which found that the net primary school enrolment rate was 37% in Karamoja, almost half the national average of 79% [30]. Children from Karamoja represent only 2.7% of our total sample, yet they account for almost a third of non-enrolment nationally. It is therefore essential to understand the unique situation of these children.

3. Determinants of non-enrolment in Karamoja and the rest of Uganda

Using data from the 2014 population census, it is possible to identify the determinants of non-enrolment in the districts of Karamoja and the rest of Uganda. Unlike household surveys, a 10% sample of census data contains sufficient observations relating to children aged 9 to 11 to allow analysis at the district level. The explanatory variables are broken down at individual, household, and district levels, in line with previous work [31–33]. This section describes the explanatory variables, before presenting the results of a descriptive analysis. Several separate logistic regressions are then performed for Karamoja, for the rest of Uganda, and Uganda as a whole, to identify factors associated with the probability

Table 1. Enrolment status of children aged 9–11 in Karamoja and the rest of Uganda, 2014

Schooling status	Karamoja (%) (1)	Rest of Uganda (%) (2)	Uganda as a whole (%)	Number of children
Ever been to school	32	96	94	272,230
Never been to school	68	4	6	16,902
Total	100	100	100	289,132

Note: The x^2 test between (1) and (2) generates a value of $p < 0.001$

Source: Authors' calculations based on a 10% sample from the 2014 population and housing census

of not attending school. Due to the binary nature of the dependent variable, a logistic model is used [34].

3.1. Choice of variables

The characteristics of individuals and households are directly accessible in the census database. At the individual level, the variables selected are age (9–11 years), gender, orphan status, disability, and relationship to the head of household. In many African societies, children do not live exclusively within the household of their biological parents. The 2011 Demographic and Health Survey indicates that more than 25% of children aged between 9 and 11 do not live with their parents and that this percentage increases with age [35]. Some of these children are orphans taken in by other family members. Others are staying in households closer to better schools, while others are already working. In addition to these individual characteristics, household characteristics are also likely to influence access to the education system. The gender of the head of the household, his or her age, marital status, religion, and level of education are among the variables selected. The age of the head of household is classified into three categories (under 35; 35 to 59; 60 and over), to examine its impact on school enrolment. Other variables related to the household in general, its structure, its level of wealth, and its location: household size, number of children under five, main source of income, remittances received, wealth index, distance to nearest primary school, and whether the place of residence is rural or urban. Household size is divided into three groups: fewer than six people; six to nine people (the most common); and ten or more people. Previous studies have shown that there is a strong correlation between household wealth and school enrolment (particularly in terms of access to basic education), despite the universalization of primary education in sub-Saharan Africa [36]. In the absence of accessible data on household expenditure and resources, previous studies recommend the use of principal component analysis [37]. Households are divided into five wealth quintiles. The place of residence (urban or rural) can lead to disparities in the quality and distribution of schools, the supply of teachers, the nature and origin of household income, and other cultural and behavioral factors likely to affect access to education. Finally, distance from the nearest primary school may condition access to basic education, as most Ugandan children walk to school. This is considered as a continuous variable below.

The three district characteristics selected are assumed to represent the main contextual variables predisposing to access to primary education in Uganda [18,38]. They combine an indicator derived from the census and calculated for each district (proportion of household heads who have completed at least primary education), and two indicators measured by a Ministry of Education school census (ratio between the number of school-age children and the number of classrooms available; ratio between the number of pupils and the number of toilets available in the school compound, known as the pupil-to-toilet cubicle ratio). The first variable reflects the district's socio-economic context, while the other two serve as quantitative and qualitative approximations of school provision.

3.2. Striking regional disparities between Karamoja and the rest of Uganda

Table 2 reveals significant differences between Karamoja and the rest of Uganda, for all individual and household characteristics except the gender of the head of household. The differences observed in terms of age partly reflect the fact that the population of Karamoja is younger than that of the rest of Uganda, but also classic reporting biases:

the phenomenon of the attraction of round ages generates an over-representation of children aged 10 and household heads aged 60. In Karamoja, three quarters of children aged between 9 and 11 live in households where the head has no education. In contrast, in the rest of Uganda, most household heads have at least a primary education. Three-quarters of household heads in Karamoja identify themselves as Catholic, compared with 40% in the rest of the country. More than a third of heads of household in Karamoja declare a polygamous union, compared with 16% in the rest of the country. Finally, 84% of children in Karamoja live in "very poor" households, compared with only 19% in the rest of Uganda.

The three district characteristics also show disparities within the country (**Figure 4** and **Table 3**). The first two indicators show extreme values in Karamoja while highlighting significant variations across the country. The proportion of heads of household with primary education varies from 7% to 84%. It averages 17% in the Karamoja region, compared with 43% in the rest of the country. The ratio of school-age children per classroom fluctuates from 25 to 279, with an average of 140 in Karamoja compared with 52 in the rest of the country. The third variable at the district level, the ratio of pupils per toilet cubicle, ranging from 24 to 129, is more difficult to interpret. Several districts or groups of districts in the country have very high ratios. This variable does not differentiate Karamoja significantly. Schools in Karamoja appear to be better equipped for the number of children they cater to than schools in the rest of the country.

It should be remembered that the Karamoja sample represents only 2.7% of the total sample. As a result, the distribution of the total sample (the country as a whole) is very close to that of the rest of Uganda, whatever the characteristics considered (**Table 2** and **Table 3**).

Table 2. Socio-demographic characteristics of children aged 9–11 in Karamoja, the rest of Uganda, and Uganda as a whole, 2014

	Karamoja (1)	Rest of Uganda (2)	Uganda as a whole	x^2 test (1) - (2)
Categorical variables (%)				
Characteristics of the child				
Age				
9 years old	31	34	34	***
10 years old	47	37	37	
11 years old	22	29	29	
Gender				
Male	48	51	51	***
Girl	52	49	49	
Orphan status				
Orphan	13	9	9	***
Non-orphan	87	91	91	
Relationship to head of household				
Child of the head of household	80	74	74	***
Other relationship	19	25	25	
No relationship	1	1	1	
Disability status				
Without disability	95	94	94	***
Disabled	5	6	6	
Characteristics of the head of household				
Education				
None	76	17	18	***
Primary education	13	57	56	
Secondary education	7	19	19	
Higher education	4	7	7	
Gender				
Male	77	78	78	*
Female	23	22	22	

Table 2 (Continued)

	Karamoja (1)	Rest of Uganda (2)	Uganda as a whole	x^2 test (1) - (2)
Age				
Under 35	23	19	20	***
35–59 years old	57	67	66	
60 and over	20	14	14	
Religion				
Catholic	77	38	39	***
Anglican	12	33	33	
Muslim	1	14	14	
Evangelical Christian (Pentecostal or regenerate)	3	10	10	
Other	7	5	4	
Marital status				
Never married	1	1	1	***
Married, monogamous	52	67	67	
Married, polygamous	36	16	16	
Widowed	9	10	10	
Separated/divorced	2	6	6	
Household characteristics				
Size (number of people)				
1–5	20	24	24	***
6–9	59	57	57	
10 or more	21	19	19	
Number of children under 5				
None	37	33	33	***
1	31	36	36	
2 or more	32	31	31	
Cash transfers received				
None	78	84	84	***
Yes, money	8	7	7	
Yes, goods	12	8	8	
Yes, money and goods	2	1	1	
Wealth index				
Very poor	84	19	21	***
Poor	6	22	22	
Average	4	22	22	
Rich	4	22	22	
Very rich	2	15	13	
Main source of income				
Subsistence farming	82	78	78	***
Business	4	8	8	
Salary	4	10	9	
Family, friends, institutional support	4	2	2	
Other	6	2	3	
Place of residence				
Urban	13	20	20	***
Rural	87	80	80	
Continuous variable				
Distance to nearest primary school (km)				
Mean value	5.61	2.76	2.84	
Standard deviation	8.34	3.53	3.78	
Number	7,970	281,162	289,132	

Significance: *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

Source: Authors' calculations based on a 10% sample from the 2014 population and housing census.

Table 3. Comparison between the districts of Karamoja, the rest of Uganda, and Uganda as a whole

	Karamoja		Rest of Uganda		Uganda as a whole	
	Average	**Standard deviation**	**Average**	**Standard deviation**	**Average**	**Standard deviation**
Proportion of heads of household who have completed primary education	0.17	0.13	0.43	0.13	0.43	0.13
Number of school-age children/ classroom ratio	140.28	64.63	51.70	16.87	57.24	30.93
Ratio of number of pupils/toilet cubicle	48.71	17.69	57.21	18.22	56.68	18.23
Number of districts	7		105		112	

Sources: Authors' calculations based on a 10% sample from the 2014 Population and Housing Census, and results from the 2014 Annual School Census (Department for Education, Science, Technology and Sport, 2014)

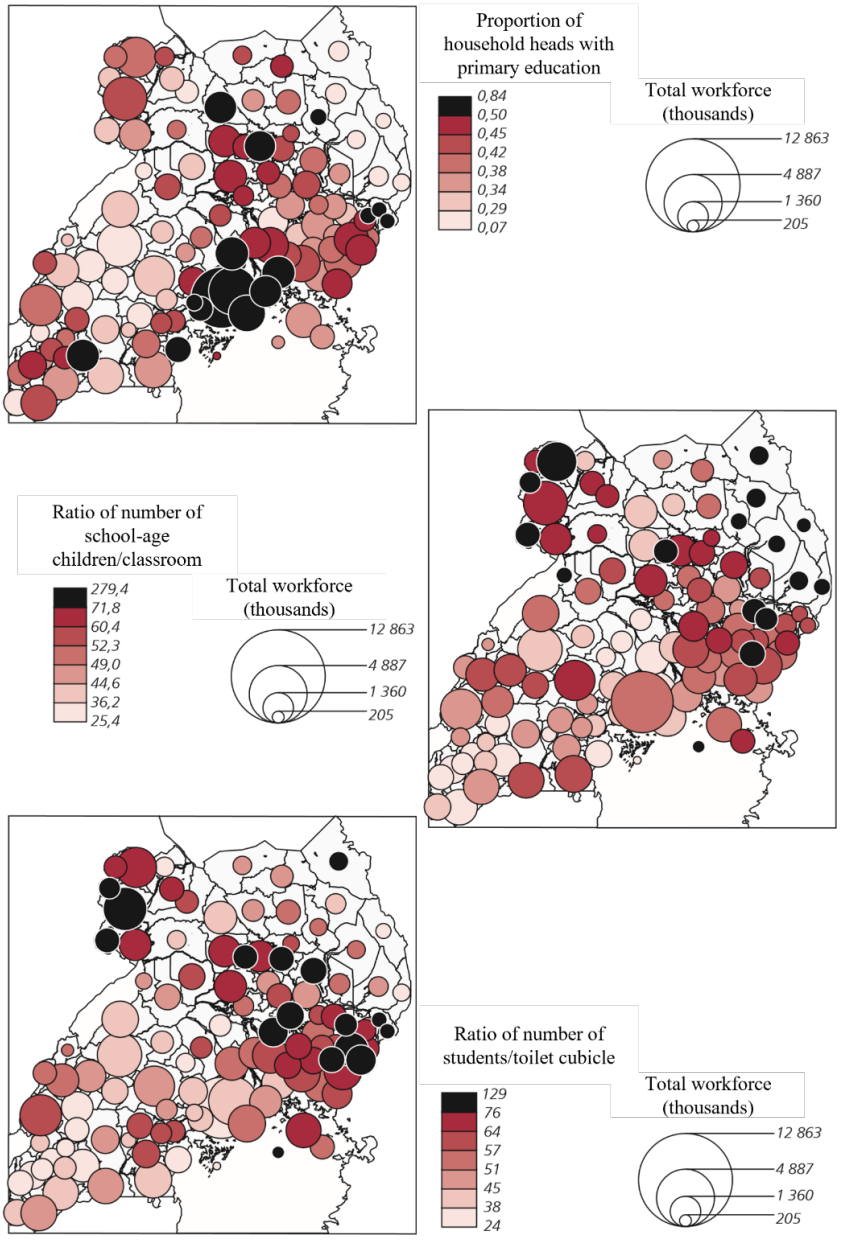

Figure 4. District characteristics related to school enrolment, Uganda, 2014 (Sources: Authors' calculations based on a 10% sample from the 2014 Population and Housing Census, and results from the 2014 Annual School Census (Department for Education, Science, Technology and Sport, 2014); authors' design using the Magrit application (http://magrit.cnrs.fr))

3.3. Remarkably different factors in non-attendance at school

The use of similar logistic regressions reveals marked disparities between the regions studied (**Table 4**). However, differences in sample size and the distribution of observations between Karamoja and the rest of Uganda mean that the results presented here should be interpreted with caution. All continuous variables have been standardized.

Table 4. Logistic regressions of the probability of not attending school in Karamoja, the rest of Uganda, and Uganda as a whole, 2014

Variables	Karamoja		Rest of Uganda		Uganda as a whole	
	Coef.		Coef.		Coef.	
Constant	2.746		0.890		0.562	
Individual / household characteristics						
Age (Ref. = 9 years)						
10 years	– 0.280	***	– 0.611	***	– 0.523	***
11 years	– 0.403	***	– 0.954	***	– 0.858	***
Sex (Ref. = Boy)						
Girl	0.379	***	– 0.092	***	– 0.032	
Orphan status (Ref. = Orphan)						
Non-orphan	0.003		– 0.147	***	– 0.142	***
Relationship to head of household (Ref. = Child)						
Other relationship	0.168	*	0.168	***	0.105	***
No relationship	1.457	**	1.005	***	0.904	***
Disability status (Ref. = No disability)						
Disabled	0.194		0.637	***	0.551	***
Education of head of household (Ref. = None)						
Primary education	– 1.462	***	– 0.804	***	– 1.021	***
Secondary education	– 2.041	***	– 1.080	***	– 1.259	***
Higher education	– 1.694	***	– 1.128	***	– 1.318	***
Gender of head of household (Ref. = Male)						
Female	– 0.393	***	– 0.230	***	– 0.224	***
Age of head of household (Ref. = 18-34 years)						
35-59 years old	– 0.256	**	– 0.103	***	– 0.150	***
60 and over	– 0.298	**	– 0.195	***	– 0.169	***
Religion of head of household (Ref. = Catholic)						
Anglican	– 0.202	*	– 0.215	***	– 0.390	***
Muslim	– 0.597		– 0.150	***	– 0.467	***
Evangelical Christian (Pentecostal or regenerate)	– 0.397	*	– 0.181	***	– 0.393	***
Other	0.159		– 0.039		– 0.131	**

Table 4 (Continued)

Variables	Karamoja		Rest of Uganda		Uganda as a whole	
	Coef.		Coef.		Coef.	
Marital status of head of household (Ref. = Never married)						
Married, monogamous	– 0.200		– 0.165	*	– 0.157	*
Married, polygamous	– 0.170		– 0.193	*	– 0.046	
Widowed	– 0.129		– 0.339	***	– 0.369	***
Separated/divorced	– 0.407		– 0.174	*	– 0.272	**
Number of household members (Ref. = 1–5)						
6–9	0.189	*	– 0.120	***	– 0.071	**
10 or more	0.259	*	– 0.046		– 0.015	
Number of children under 5 (Ref. = None)						
1	0.008		0.057	*	0.010	
2 or more children	– 0.224	**	0.037		– 0.050	
Cash transfers received (Ref. = None)						
Yes, money	0.191		– 0.120	**	– 0.008	
Yes, goods	– 0.048		– 0.024		0.077	*
Yes, money and goods	0.230		– 0.097		– 0.086	
Wealth index (Ref. = Very poor)						
Poor	– 0.736	***	– 0.309	***	– 0.532	***
Average	– 0.957	***	– 0.511	***	– 0.702	***
Rich	– 1.341	***	– 0.672	***	– 0.824	***
Very rich	– 1.179	***	– 0.890	***	– 0.858	***
Main source of income (Ref. = Subsistence)						
Company	– 0.372	*	– 0.080		– 0.049	
Salary	– 0.645	**	– 0.012		0.053	
Family, friends, institutional support	– 0.322	*	0.382	***	0.276	***
Other	– 0.281	*	0.277	***	0.349	***
Place of residence (Ref. = Urban)						
Rural	0.656	***	0.152	***	0.089	***
Distance to nearest primary school	0.074	***	0.101	***	0.078	**
Contextual variables						
Proportion of heads of household with primary education	– 0.868	***	– 0.111	***	– 0.454	***
Ratio of number of school-age children/classroom	– 0.125	***	0.319	***	0.430	***
Ratio of number of pupils per toilet	– 0.217	***	0.043	***	– 0.016	

Significance: *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

Sources: Authors' calculations based on a 10% sample from the 2014 Population and Housing Census, and results from the 2014 Annual School Census (Department for Education, Science, Technology and Sport, 2014)

3.3.1. Individual characteristics

The effect of a child's gender on non-enrolment varies from region to region. In Karamoja, the probability of not attending school is significantly higher for girls than for boys, unlike in the rest of the country. However, this variable is not significant at the national level. Young children are more likely to be out of school than older children. In some cases, therefore, the age of entry to school remains high (10–11 years) in Karamoja and in the rest of Uganda.

Orphanhood affects the likelihood of children not attending school in large parts of Uganda. It is a major barrier to access to basic education in the rest of the country, but not in Karamoja. Children of the head of household are less likely to be out of school than other children in the household, let alone children not related to the head of household. A disability does not significantly increase the probability of being out of school in Karamoja, unlike in the rest of the country.

3.3.2. Household characteristics

When the head of household is a woman, the probability of not attending school is lower than when the head of household is a man. The coefficient associated with this variable, which is significant in all cases, is higher in Karamoja than in the rest of Uganda. The probability of not attending school is lower when the head of household is older. This factor is also stronger in Karamoja.

Children of educated household heads are less likely to be out of school than children of uneducated household heads. This highlights the intergenerational disadvantage of children of uneducated parents, particularly in Karamoja. Religion has a markedly significant effect in the rest of the country, where the probability of not attending school is higher for children from Catholic households. In Karamoja, where Catholicism predominates, religion is less significant. In the rest of Uganda, children of widowers are less likely to be out of school than other children, regardless of marital status.

In Karamoja, the marital status of the head of the household and the size of the household had no significant effect on non-attendance at school. In the rest of Uganda, medium-sized households (6–9 people) are less likely to be out of school than smaller households.

Household wealth is closely linked to non-attendance at school. This link is even stronger in Karamoja, where most households are considered to be very poor. The relationship between the source of household income and non-enrolment is less clear. In the rest of Uganda, only certain marginal categories are significant (help from family, friends or institutions; other sources). Receipt of remittances and the nature of these do not appear to have a significant influence on school attendance.

The probability of not attending school is higher in rural areas than in urban areas. The coefficients associated with this variable are much higher in Karamoja, reflecting the difficulties experienced by rural children in this region. Finally, proximity to a state primary school reduces the probability of non-enrolment.

3.3.3. Contextual variables

In Uganda, in districts where the proportion of educated heads of household is high, the probability of not attending school is lower, and this is particularly marked in Karamoja. High ratios of the number of school-age children per classroom and the number of pupils per toilet cubicle increase the probability of non-enrolment in large parts of the country. However, an inverse relationship is observed in Karamoja, where non-enrolment is associated with low ratios. The effect of the first ratio suggests that, in most of the country, an insufficient number of classrooms may hinder school enrolment. In Karamoja, on the other hand, children appear to be enrolled in places with fewer classrooms per number of children. Although there is a need to increase the number of classrooms in Karamoja, the lack of premises does not explain the lack of schooling. In Karamoja, in contrast to the rest of the country, a lower availability of toilets per number of pupils reduces the probability of non-enrolment.

Although the main determinants of non-enrolment are, in all cases, the relationship to the head of the household, the level of education of the head of the household, and the wealth index of the household, the models for Karamoja and the rest of Uganda paint heterogeneous pictures that also differ from the model aggregated at the national level. The results for the country as a whole are close to those for the rest of the

country, which includes 97.3% of children aged between 9 and 11. However, several coefficients stand out. Differences in sign or significance are even observed for several variables, such as the child's gender (not significant in the model implemented at the national level), remittances received, and factors relating to school provision. As far as these variables are concerned, the results at the national level differ from those for Karamoja and the rest of Uganda. They therefore do not describe the situation in Karamoja or the rest of Uganda, and raise questions about the validity of analyses carried out at the national level in the development of public policy.

4. Better modelling of non-enrolment at the national level

Most studies using national demographic data sets are limited to multivariate analyses at the national level. However, the logistic regression models described above highlight the importance of spatial heterogeneity. Designing relevant public policies requires better modelling of the role of certain specific variables. This objective, together with the hierarchical nature of education data, justifies the use of a multilevel model. The latter extends the logistic regression model [33] by taking into account variability between districts.

4.1. Rationale and method

The proportion of children who have never attended school varies significantly between districts. While it is below the national average of 6% in most of the central and western regions of the country, it significantly exceeds this average in the northern and north-western regions.

To assess the value of a multilevel analysis, the estimation of an empty multilevel model (without covariates) is used to measure the variance v between level 2 units (districts). The intraclass correlation is calculated by applying the following formula, following Bringé and Golaz [33]:

$$\rho = \frac{\sigma^2}{\sigma^2 + \pi^2/3} \quad (1)$$

The empty model reveals an inter-district variance of 1.372 for Uganda as a whole, corresponding to an intra-class correlation of 29%. In other words, district characteristics explain almost a third of the model.

These results confirm the value of multilevel modelling. Variables are introduced progressively, group by group: individual variables specific to the child, then household variables, and finally contextual (district) variables. The possible interactions between the child's sex and the district are then modelled in two distinct ways: first by directly introducing an interaction between the child's sex and a district variable, then by allowing the effect of the child's sex to vary between districts.

4.2. Taking account of the hierarchical structure of the data

When individual variables are introduced into the empty model, the variance between districts increases from 1.372 to 1.423 (**Table 5**). Multilevel modelling commonly shows smaller variances between variables within groups than between them [39]. The effect of the child's sex is therefore fairly homogeneous within districts but varies considerably between districts.

When all the variables are included (full multilevel model), the variance between districts falls to 0.345 (**Table 5**). The intraclass correlation thus falls from 29% to 9.5%. This shows that the variables added to the model help to explain two-thirds of the differences between districts.

The coefficients obtained for district characteristics differ significantly from those of the logistic regression model. Nevertheless, the logistic model does not overestimate their effects, contrary to what is often observed [33]. Thus, multilevel modeling makes the coefficient for the ratio of the number of pupils per toilet cubicle slightly negative and significant, close to the results obtained for the Karamoja region.

In the full multilevel model, the characteristics most strongly associated with non-attendance at school remain the same as those obtained with the logistic model. The youngest children, living in the poorest households, with no family ties to the head of household, or with a head of household with little education, have a reduced chance of attending school. Some variables have a weaker or less significant effect, such as religion and remittances received. The coefficients associated with the religion of the head of household are much lower than in the logistic

Table 5. Determinants of children not attending school multi-level model, Uganda, 2014

	Proportion (%)	Empty model	Individual model	Model with household characteristics	Full model
Fixed parameters					
Constant		- 3.057***	- 2.610***	- 1.370***	- 1.475***
Individual characteristics					
Sex (Ref. = Boy)					
Girl	49		– 0.062***	– 0.047**	– 0.047**
Age (Ref. = 9 years)					
10 years old	37		– 0.554***	– 0.585***	– 0.585***
11 years old	29		– 0.902***	– 0.906***	– 0.906***
Orphan status (Ref. = Orphan)					
Non-orphan	91		– 0.118***	– 0.104***	– 0.104***
Relationship to head of household (Ref. = Child)					
Other relationship	25		0.150***	0.162***	0.162***
No relationship	1		0.816***	1.029***	1.028***
Disability status (Ref. = No disability)					
Disabled	6		0.615***	0.603***	0.603***
Household characteristics (treated as individual variables)					
Education of head of household (Ref. = None)					
Primary education	56			– 0.885***	– 0.882***
Secondary education	19			– 1.195***	– 1.192***
Higher education	7			– 1.266***	– 1.265***
Gender of head of household (Ref. = Male)					
Female	22			– 0.283***	– 0.282***
Age of head of household (Ref. = Under 35)					
35–59 years old	66			– 0.108***	– 0.108***
60 and over	14			– 0.163***	– 0.162***
Religion of head of household (Ref. = Catholic)					
Anglican	33			– 0.124***	– 0.127***
Muslim	14			0.003	– 0.000
Evangelical Christian (Pentecostal or Regenerate)	10			– 0.079**	– 0.081**
Other	4			0.072	0.069
Marital status of head of household (Ref. = Never married)					
Married. monogamous	67			– 0.199**	– 0.199**
Married. polygamous	15			– 0.211**	– 0.212**
Widowed	10			– 0.323***	– 0.323***
Separated/divorced	6			– 0.195**	– 0.194**
Number of household members (Ref. = 1–5)					
6–9	57			– 0.076***	– 0.077***
10 or more	19			0.014	0.011
Number of children under 5 (Ref. = None)					
1				0.038	0.039
2 or more children				0.017	0.017
Money transfers received (Ref. = None)					
Yes, money	7			– 0.027	– 0.027
Yes, goods	8			0.004	0.004
Yes, money and goods	1			0.019	0.015

Table 5 (Continued)

	Proportion (%)	Empty model	Individual model	Model with household characteristics	Full model
Wealth quintile (Ref. = Very poor)					
Poor	21			– 0.342***	– 0.340***
Average	22			– 0.520***	– 0.518***
Rich	22			– 0.665***	– 0.662***
Very rich	15			– 0.909***	– 0.901***
Main source of income (Ref. = Subsistence)					
Company	8			– 0.123***	– 0.123**
Salary	9			– 0.129**	– 0.125**
Family. friends. institutional aid	2			0.243***	0.244***
Other	3			0.175***	0.176***
Place of residence (Ref. = Urban)					
Rural	80			0.294***	0.290***
Distance to nearest primary school				0.096***	0.095***
Characteristics of the district					
Proportion of heads of household with primary education					– 0.310***
Ratio of school-age children to classrooms					0.476***
Ratio of number of pupils/toilet cubicle					– 0.100*
Random variables					
Variance (constant)		1.372***	1.423***	0.920***	0.345***

Significance: *** p < 0.001, ** p < 0.01, * p < 0.05

Sources: Authors' calculations based on a 10% sample from the 2014 Census of Population and Housing and the results of the 2014 annual school census (Ministère de l'Éducation, des Sciences, de la Technologie et des Sports, 2014)

model. The Anglican and Evangelical religions are the only ones to significantly reduce the chances of not attending school, compared with the Catholic religion. The multilevel models do not attribute a significant effect to remittances received, whereas according to the logistic model, children from households receiving remittances were more likely to be out of school. For these two variables, significant contrasts within districts could explain these observations.

Three characteristics are more closely linked to non-enrolment in the multilevel models than in the simple logistic regression model: the child's gender, the household's source of income, and the place of residence. The multilevel models estimate a lower probability of non-enrolment for girls than for boys. This result is very close to the results obtained by the logistic model for the rest of the country, and opposite to those obtained for the Karamoja region. Furthermore, the probability of not attending school is lower when the household income comes from a business or a wage than when it comes from subsistence farming. The educational disadvantage of the children of subsistence farmers in Uganda has been documented previously [7,40]. However, the coefficient associated with subsistence farming households was not significant in the logistic regression model. Finally, according to the multilevel model, the probability of not attending school is greater in rural areas than in urban areas. In all these cases, the comparison between Karamoja and the rest of Uganda highlighted significant disparities between the districts in these two parts of the country.

4.3. How can the modeling of the child's sex be refined?

Our initial analyses revealed opposing effects of the child's sex on non-attendance at school: the probability of not attending school was greater for girls in Karamoja than in the rest of Uganda. The coefficients obtained for this characteristic were almost four times higher in Karamoja than in the rest of the country. The coefficients obtained for this characteristic were almost four times higher in the Karamoja region than in the rest of

the country. However, the logistic regression model for Uganda as a whole attributed a non-significant coefficient to the sex of the child, thus masking the marked effect of this characteristic at the regional level, especially for Karamoja. The multilevel random constant model, on the other hand, revealed a significant and negative coefficient. Overall, within Ugandan districts, the probability of not attending school is slightly higher for boys than for girls. These contradictions underline the need for a better-fitting model that would allow different coefficients to be assigned to the characteristic of the child's sex, and possibly coefficients of opposite signs, depending on the district under consideration.

Two methods are explored for this purpose. The first consists of a multilevel model with a random slope assigning a random coefficient to the sex of the child. The second introduces an interaction variable between the child's gender (an individual characteristic) and the ratio of the number of school-age children per classroom (a district characteristic). These two methods produce interesting results. The first produces a more marked estimated effect of the child's sex, as well as a measure of the inter-district variance linked to this characteristic. The second method reduces the overall variance to a greater extent and provides a more detailed analysis of the interaction between the child's gender and school provision at the district level. However, these results remain fairly close to those of the random constant multilevel model, which encourages us to opt for the latter, since it corresponds to the simplest complete multilevel model.

5. Conclusion

This article explores the determinants of non-enrolment of Ugandan children aged 9 to 11, estimating their relative effects using logistic and multilevel regressions. The data exploited are from the latest population census of Uganda [25]. Our results support the existing literature, while highlighting the low proportion of Ugandan children never enrolled in school (6%) compared to other African countries.

At the national level, all other things being equal, the main predictors of non-enrolment are the relationship between the child and the head of the household, the latter's level of education, and the household wealth index. Non-enrolment tends to decrease as the child's age increases. It is more likely for children with disabilities and orphans. The specific characteristics of the household are a determining factor when it comes to school attendance. Children are more likely not to attend school if they are not related to the head of household, or if they live with male heads of household who are under 30, Catholic, single, and uneducated. Non-enrolment is more likely for children from very small and very large households, the poorest households with no means of subsistence, and rural households. The latter are penalized a fortiori by the greater distance separating them from the nearest public primary school. Districts where the proportion of heads of household with primary education is low are more likely to be unschooled, as are those where school provision is inadequate. These results underline the predictive nature of both supply and demand factors.

As in many developing countries, there is a gap between the capital (Kampala) and the rest of the country. The Karamoja sub-region stands out in particular: almost 68% of children aged between 9 and 11 living there have never been to school. Only 17% of heads of household have completed primary education (compared with 43% in the rest of the country). Schools, on the other hand, appear to be better equipped with sanitation facilities. The region has one toilet cubicle for every 48 pupils (compared with one for every 57 pupils in the rest of the country). On the other hand, the supply of teachers and classrooms is limited, with a ratio of 140 school-age children per available classroom (compared with 52 per classroom in the rest of the country), reflecting the lack of investment in education in the region. The models used in this article take account of the heterogeneity between Karamoja and the rest of the country. They raise the question of the predictive capacity of models implemented at the national level in terms of non-enrolment. Is the national level appropriate for guiding effective public policies at the sub-national level? The use of multilevel analysis makes it possible to model the effect of a child's gender better than the aggregate models commonly used at the national level. Different multilevel models (with a random constant, a random slope, and a random constant with an interaction variable) make it

possible to refine the understanding of the role played by the child's sex and by the district's contextual variables. Although each of these models introduces specific and relevant elements, the simplest model (with a random constant) represents the best compromise between optimal fit and model complexity. Our results highlight the need for a systematic preliminary study of the spatial structure of the data, to take it into account in the methodology.

Relationship to the head of the household, the level of education of the head of the household, and the poverty level of the household strongly influence the probability of not attending school in Karamoja as in the rest of Uganda. However, other variables produce very contrasting effects depending on the region. In particular, the gender of the child has an opposing influence on school attendance in Karamoja and the rest of Uganda. However, the lack of significance of this variable at the national level suggests that girls and boys have equal access to education. This is in fact what some previous studies have concluded [6,8]. However, this conclusion does not hold true at the sub-national level. In most of the country, being a boy slightly increases the probability of not attending school. On the contrary, in the Karamoja region, being a girl greatly increases the probability of not attending school.

A gender gap favoring girls is frequently observed in high-income countries and African countries with high enrolment rates. This is often attributed to higher dropout rates among boys [6]. According to UNESCO [4], out-of-school boys of primary school age are more likely than girls to subsequently attend school. It is not known whether this applies to the age group used in this article (9–11 years). The under-enrolment of boys therefore needs to be the subject of more in-depth research. Concerning Uganda, several hypotheses can be put forward concerning health (boys may be more vulnerable than girls to disability and illness), social position (in many societies, young boys are seen as an embarrassment to their unmarried mothers and may therefore be sent away from home more often than girls) and economic expectations (in situations of great poverty, boys may be expected to work, orphaned boys may become responsible for their younger siblings).

In Karamoja, families are still reluctant to send their children to school, particularly their daughters. Such practices illustrate the need for sub-national public policies targeting girls when their primary education does not seem to be a priority within communities. These practices continue to prevail in other pastoralist communities, such as the Maasai in Tanzania [41] or the Tandroy in Madagascar [42]. Depending on the region in which the children live, gender-related expectations and constraints differ. Public policies should therefore take this into account. The same applies to many other variables. Any context of strong spatial heterogeneity calls into question the relevance of the models used at the national level and the validity of the results derived from them.

Disclosure statement

The authors declare no conflict of interest.

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