# Koranic Schools in Senegal : A real barrier to formal education?

André, Pierre and Demonsant, Jean-Luc

Université de Cergy-Pontoise, CEPS/INSTEAD

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# Koranic Schools in Senegal :
# A real barrier to formal education ?[☆]

Pierre André[a], Jean-Luc Demonsant[b]

*[a]Université de Cergy-Pontoise, THEMA,*
*F-95000 Cergy-Pontoise, France*
*[b]CEPS/INSTEAD,*
*L-4364 Esch-sur-Alzette, Luxembourg*

**Abstract**

This paper studies the substitution between secular formal education and informal religious education for Senegalese households. We use the timing of the opening of formal schools to estimate whether Koranic and formal education systems compete for the children's time. Adapting the diff-in-diff strategy in Duflo (2001), we assess the effect of school openings on Koranic and formal schooling. Our estimates show that formal school openings increase formal education attainment, especially in rural areas. We then estimate that an additional formal school decreases the time spent in Koranic schools for boys. In rural areas, it decreases the likelihood of pursuing long Koranic schooling by 20 percentage points (p.p.). In urban areas, it decreases the probability to go to Koranic school by 5 p.p. This proves that, while both school systems are independent in terms of organization and pedagogical content, they still compete for the children's time. This might increase the opportunity cost of formal primary school, and can narrow the political consensus around universal primary education.

**Keywords :** Koranic Schools, School demand, Senegal

**JEL classification :** D12, I28, O12

## 1. Introduction

Sahelian countries post among the lowest primary school enrollment rates in the world. In these Muslim countries, public education does not include religious teaching. So religious education takes place in the informal sector. The pervasive influence of Koranic schools in contemporary Senegal has been neglected by development planners and researchers.

Most of the recent literature in Economics focuses on the determinants of Koranic school enrollment. Two papers explain that Koranic school enrollment is influenced by group identity. Chen (2010) highlights that Koranic education improved insurance networks during the Indonesian economic crisis. In Nigeria, Dev, Mberu, and Pongou (2012) show Koranic education can contribute to cement ethnic groups, especially when ethnic networks are valuable on the labor market. Other authors emphasize the values transmitted in these schools. Asadullah and Chaudhury (2010) mention that females with Koranic education tend to favor the gender-based specialization in the household and democratic values. Both Asadullah, Chakrabarti, and Chaudhury (forthcoming) in Bangladesh and Auriol and Demonsant (2012) in Senegal refer to the need for the parents to reinforce their children's loyalty, by directing them towards Koranic education. In fact, elderly parents need their children's support due to the lack of a formal pension system.

Our present paper rather endeavors to analyze the articulation between the two school systems. Indeed, one major concern for policy makers is that religious education may compete against public education for children's time. In developed countries, a research stream studies whether some competition between religious and public education improves school quality.[1] Some papers try to measure this competition in South Asian countries. In Pakistan, Andrabi, Das, Khwaja, and Zajonc (2006) find that informal Koranic enrollment is lower in settlements with a formal primary school. This comparison faces nonetheless the classical endogeneity issues. In Bangladesh, Asadullah and Chaudhury (2013) find that primary schools created by NGOs increase enrollment in religious formal secondary schools. Of course, two school systems can be complementary between primary and secondary schools, and substitute between primary schools.

In Senegal, Koranic education can either be full-time or part-time, so that some children attend simultaneously formal and Koranic schools. Hence, the competition between formal and Koranic enrollments is not trivial : the timetables are in fact compatible. In addition, being taught any subject might improve cognitive skills, and in turn the learning ability in

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1. See Jepsen (2002) for a summary of US studies, Card, Dooley, and Payne (2010) for Canada.

other disciplines. So complementarity between Koranic and formal educations is conceivable : going to Koranic schools might help to learn in formal schools.

Testing whether this competition exists in Senegal is interesting for at least two reasons. First, it would imply that formal education has an additional opportunity cost for Senegalese households : Koranic education. Indeed, Senegalese Koranic schools do not provide formal skills as math, reading and writing.[2] Thus, children who enroll in Koranic school and do not enroll in formal school end up having no formal education. Second, Muslim brotherhoods have strong political ties in Senegal. Hence, the existence of a competition between formal and Koranic educations may narrow the political consensus around universal (formal) primary education.

In this paper, we estimate the effect of school openings on Koranic and formal school enrollments. We base our identification strategy on school opening dates. In fact, we identify the effect of school openings on education outcomes with a double difference strategy : we compare the difference in education outcomes between cohorts in communities with school openings, with the difference between the same cohorts in communities without school opening (or with a school opening at a different date not relevant for the cohorts in the sample). We find that a formal school opening increases formal school enrollment, and decreases Koranic school enrollment (as measured by the number of years in Koranic schools). This shows that Koranic school is a substitute to formal school for some parents.

Section 2 presents Islam and Koranic schools in Senegal. After describing our dataset, section 3 provides some descriptive statistics on Koranic school enrollment and estimates of its determinant. In section 4, we present our empirical strategy to study the possible substitution between Koranic and formal schooling followed by the results. The last section discusses the empirical issues. In conclusion, we discuss the link between this substitution and universal primary education.

## 2. The cultural context

### 2.1. Islam in Senegal

Muslims account for 94%[3] of the Senegalese population. It is important to bear in mind that the country is renowned today for its tolerant Islam.[4] Most Senegalese Muslims (90%)

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2. Actually, they read and write in Arabic, without understanding the language.

3. Source : CIA - The World Factbook : https ://www.cia.gov/library/publications/the-world-factbook/geos/sg.html

4. Some isolated confrontations between Muslim factions have been reported. Most have involved a recent Islamist movement locally known as "Ibadou", which has been spreading among the urban elite (educated in

are members of Sufi brotherhoods (known in Arabic as "tariqah", "confrérie" in French). There are two main Islamic brotherhoods in Senegal, namely the Tijanyyah and the Muridiyyah, and they represent over 80% of Senegalese Muslims.

The Senegalese brotherhoods are purely religious organizations. While they do not directly participate in elections, some of them have strong political ties (see, e.g., Creevey, 1980, Villalon, 1995). Brotherhoods are used to give implicit or explicit voting instructions (*ndiggels* in Wolof : see Villalon, 1995, Salzbrunn, 2002, Thiam, 2010 or Antil, 2010). Thiam (2010) reports a voting share for Wade in Tuba of 85% in the 2007 presidential election (vs. a national average of 55%), following a Murid voting instruction. [5]

Although it reportedly ranks second in size, the Muridiyyah is the most active brotherhood and is particularly successful at attracting urban youth. The brotherhood is economically powerful, has strong commercial networks and there is important redistribution between its members. For example, Murids are reported to be involved in informal trade around touristic places in cities like Paris, Rome or New-York,(World Bank, 1999) and in illegal migration channels. [6] Tuba, their holy city, [7] is an impressive illustration of the brotherhood's economic success : the modern city rose up out of the peanut fields, built by remittances from disciples all around the world. It is now probably the second largest city in Senegal, with over 450,000 inhabitants in 2002 according to the Population census.

*2.2. Koranic schools in Senegal*

As public schools offer little or no religious education, children are mostly taught religious knowledge in (informal) Koranic schools. This section gives a short presentation of the Koranic schools in Senegal.

Although they are often perceived as institutions that put children on the streets begging, Koranic schools actually encompass a broader reality. Senegalese Koranic schools take a variety of forms. Informal Koranic schools have no rigid pedagogic curriculum in Senegal as in neighboring countries, but the teaching is usually purely religious. The few exceptions are not considered as "Koranic schools" in this paper – see the description of Franco-Arab schools thereafter. The ultimate aim of these schools is to prepare the children to become good Muslims. Elementary teaching begins with learning the Koran by heart without unders-

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the Gulf for the most part). It is considered as more fundamentalist than the rest of the Islamic factions in the country. However, there is, to our knowledge, no reliable source to provide accurate information on the extent of this phenomenon.

5. Similarly, Creevey (1980) mentions the role of brotherhoods in the victory of the first president Senghor.

6. See for instance Lacomba (2000) about Murid networks in Spain.

7. It is the birthplace of the brotherhood's founder, Sheikh Ahmadou Bamba, and is located in the groundnut basin in the region of Diourbel, about 90 miles East of Dakar.

tanding it. Although students are taught to read and write Koranic verses, they rarely master Arabic, begging the question as to what skills are actually transmitted. Pupils also learn basic prayers, and Muslim traditions.

The organization of Koranic schools is very heterogeneous. Some pupils attend Koranic school part-time, and go to a formal school on school days, while others attend Koranic school full time, and cannot attend formal school. While there is no official tuition fee, parents are expected to help their children's Koranic master as much as they can. As a consequence, curricula, organization and density of Koranic schools are highly endogenous to the local context.

The most visible part of Koranic schools in Senegal are the boarding schools. In this case, as tuition in traditional Koranic schools is usually "officially" free, and Koranic masters cannot afford to feed all their pupils, Talibes (Koranic school students in Wolof) are fed by neighbors. It is indeed a common practice for some families to feed some Talibes. However, it is also very common to see Koranic students begging for food at traffic lights in some areas (especially downtown Dakar). It is very hard to obtain accurate estimates of the number of children fostered out to Koranic masters. A recent household survey in Senegal estimates that children fostered out to Koranic masters represent approximately 1% of boys aged 15 or under (see Beck, 2009). This leads to a rough approximation that 5% of boys' Koranic schooling takes place in Koranic boarded schools.[8]

Franco-Arab schools ("écoles franco-arabes" similar to "madrasas" in other contexts) are a recent attempt to modernize Senegalese Koranic schools. Their development since the 1950s, is an endeavor to balance formal and religious schooling. While Franco-Arab schools grew fastly in the 2000s (Gandolfi, 2003), they were anecdotic in 2003, when the data used in this paper were collected. At that date, there were only 9 Franco-Arab public schools in Senegal (Villalon and Bodian, 2012) and few private ones (as we will explain in the empirical section). We decided to consider the (little amount of) Franco-Arab education as formal, as their curricula covers reading, writing, and math.[9]

### 2.3. Relations between Koranic and formal schools

The first reason why Koranic school and formal schools may compete is the opportunity cost of children's time. Timetables of Koranic school and formal schools are usually compatible when needed. However, combining both educations may be difficult, especially when a child

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8. We estimate that boys aged 15 have spent on average 2.5 years in Koranic school, and assume they have spent 1% of their time in boarding Koranic schools following Beck (2009).
9. In some Franco-Arab schools, pupils even take the national exams (Gandolfi, 2003).

is additionally expected to work at home.

Koranic schools may have comparative advantages. Sending children to Koranic school may have economic returns. Indeed, inter-personal links with Koranic classmates can be useful given the economic power of Koranic brotherhoods in the informal economy. For example, the economic success of the Murids makes Murid Koranic schools potentially useful.

There may also be cultural reasons why parents send their children to Koranic schools and not to formal schools. Some Senegalese see the state as a legacy of colonization and, by contrast, see Islam as closer to Senegalese traditions. Indeed, Islam has been a way to mobilize the Senegalese against the colonizers during the 19th century. However, this tends to neglect the fact that Senegal has been independent for over 50 years now. Using a lexical and morphosyntactic analysis of semi-structured interviews, Huet-Gueye and de Léonardis (2005) show how this view can be expanded to the competition between Koranic schools and formal schools. They find that the divide between "traditionalists" and "modernists" clearly shapes Koranic and formal schooling choices. Remarkably, the Senegalese call their public formal schools "French schools" more than 50 years after the independence.

The fact that some parents choose between formal and Koranic education may also have political consequences. The Senegalese Muslim brotherhoods often intervene in the political arena (see section 2.1). If Senegalese households need to make a clear-cut choice between Koranic and formal educations, the brotherhoods may not strongly support universal primary education. Instead, they may favor the religious education of their followers. Tuba, claiming 500,000 inhabitants, has banned state primary schools, to avoid any "westernization" of the city (Guèye, 2002). We did not find any evidence that brotherhoods actively lobby against formal education outside of Tuba. However, politicians clearly seek for the brotherhood's voting instructions, and this might soften their incentives to promote formal education.

## 3. Data and descriptive statistics on Koranic schooling

### 3.1. The dataset

In this paper, we use the EBMS dataset.[10] It is a national household survey conducted in Senegal in 2003 covering 1,800 households in 60 communities. The data collected contain retrospective information on the (formal) education of household members and their relatives

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10. EBMS is a survey of household education and well-being in Senegal : *"Education et Bien-être des Ménages au Sénégal"*. This survey was designed by a team of researchers from Cornell University, USA and from LEA-INRA, France, and conducted in association with the Centre de Recherche en Economie Appliquée (Dakar, Senegal). The authors would like to thank Christelle Dumas and Sylvie Lambert for making the data available.

(parents, siblings and children), including retrospective information on the formal school career. It also includes information on the living conditions : possession of durable goods, employment status, health, etc. The survey also includes unique (to our knowledge) information on Koranic schooling, with data on Koranic school length for each household member aged between 5 and 21. It does not include any other information on Koranic school career, and in particular no retrospective information. Details and descriptive statistics of the variables used in this paper are given in the appendix.

The EBMS survey was designed to resurvey some of the pupils that took school attainment tests during the previous PASEC Senegal survey.[11] The PASEC survey randomly selected 20 second grade pupils from 99 primary schools in 1995. The households in the neighborhoods of 60 schools surveyed by PASEC were resurveyed in the EBMS. In each of these neighborhoods, EBMS surveyed the maximum number of households with at least one PASEC child (up to 20). Other households in the school catchment area (village or neighborhood in urban areas - called communities hereafter) were surveyed, to reach a total of 30 households in each community. All the information used in this survey was collected during the EBMS survey. The descriptive statistics of all the variables used in the analysis are in Table A.1 in the appendix.

This particular sampling design has several impacts on inference issues. First, there has been a school since 1995 in each community. As a result, Koranic school enrollment is observed provided formal schooling is also available. This tends to underrepresent remote areas where there were no primary schools until recently. Second, PASEC households are in our sample because they enrolled a child in second grade for the 1995/1996 school year. Consequently, recently formed households are probably underrepresented in our sample. Households with very low preferences for formal schooling may also be underrepresented. Finally, children included in the PASEC school panel are excluded from the analysis in order to avoid further selection bias.

In sum, our sample is clearly not representative of the Senegalese population. This can cause a selection bias in our estimations if the selection process is related to our main variables. We believe this can be at least partially tested. In reality, the tests presented in section 5.4 failed to detect any endogenous selection.

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11. PASEC is an education system analysis program : *"Programme d'Analyse des Systèmes Educatifs de la CONFEMEN"* (created in 1991 following the Jomtien Conference on *Education for All*). CONFEMEN is the oldest organization in the union of French-speaking countries : *"Conférence des Ministres de l'Education ayant le français en partage"* set up in 1960. PASEC conducted a panel survey in Senegalese primary schools between 1995 and 2000. This panel included school attainment tests. For further information on the PASEC Programme, see *http : //www.confemen.org/*

FIGURE 1: Joint distribution of formal school enrollment and length of Koranic school for boys and girls
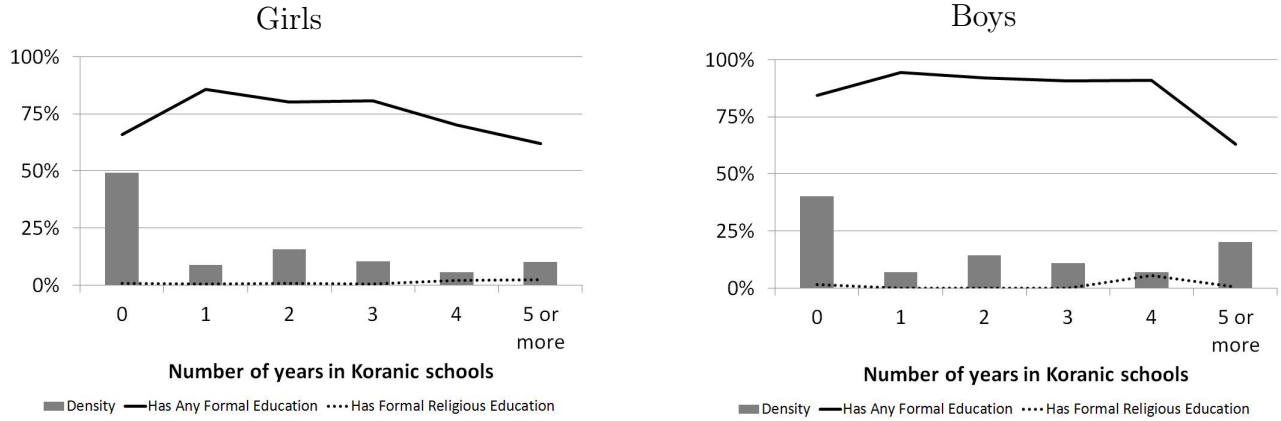
Note : 1752 observations (Girls 15 to 21 y. o.)    Note : 780 observations (Boys 18 to 21 y. o.)

## 3.2. Statistics on Koranic school enrollment

Figure 1 shows the distributions of the length of Koranic school for girls and boys. We focus on age groups having seemingly completed their Koranic education (see Figure A.1 and explanations in the appendix for more details). We observe, in our sample, that approximately half of the girls and 40% of the boys have never attended Koranic school. The majority of children who went to Koranic school attended it for two to three years. Only 15% of the girls and 27% of the boys attend Koranic school for more than three years.

Figure 1 also shows the formal school access rate as a function of years of Koranic school completed. The children who have never been to Koranic school have a lower formal school enrollment rate than those who have a few years of Koranic schooling. A total of 66% of the girls with no Koranic education and 85% of the girls with one year of Koranic education have attended formal school (respectively 84% and 94% for boys). However, the proportion of children having attended formal school decreases significantly after three years of Koranic schooling for girls and four years for boys.

Nevertheless, Figure 1 does not give any precise information about the potential substitution between Koranic education and formal education. Indeed, the demand for Koranic education and the demand for formal education are likely to be highly correlated. For instance, some children, especially girls, could well be excluded from any schooling system for financial reasons. One robust result we obtain though, is that Koranic schooling and formal education are far from being incompatible : 39% of the girls and 49% of the boys have attended both.

Additionally, Figure 1 gives the enrollment rate in religious formal education, which includes both Franco-Arab and Christian schools. Religious formal enrollment appears to be negligible in our sample. 1% of the children have ever attended a religious formal primary

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school among the last two primary schools they ever attended.[12]

## 3.3. Determinants of Koranic schooling

Before studying the substitution between Koranic and formal schooling it is interesting to study what motivates Koranic schooling.

We estimate different specifications for the determinants of Koranic school enrollment for girls and boys in Table 1. We include in the sample all girls aged 15 to 21, and all boys aged 18 to 21, as we observed in Figure 2 that they have probably finished their Koranic schooling. We estimate two specifications of a probit model for the determinants of attending a Koranic school in columns 1 and 4. We run an OLS model predicting the number of years in Koranic school in columns 2, 3, 5, and 6. The specifications in columns 3 and 6 include the number of siblings. Information on siblings is only provided when the father is in the same household as the child. So the sample size is accordingly smaller in columns 3 and 6. Standard economic theories summarized recently by Glewwe (2002) and Orazem and King (2008) give insights on the factors affecting the demand for education. The framework is mainly based on the seminal work of Becker (1967) : the costs and benefits of education determine the level of education demanded.

Concerning the benefits of Koranic education, learning religion is probably the main reason why children enroll in Koranic school. The preferences for religious education are probably strongly heterogeneous, and the data do not include any proxy for this. We nevertheless observe that ethnic group is a strong determinant of Koranic schooling, which might be explained by differences in preferences for religious education. The main ethnic group in Senegal, Wolof, is taken as a reference. Two ethnic groups attend Koranic school significantly less : the Serer and the Diola. The average number of years of Koranic schooling is between 0.5 and 1 year lower respectively for Serer and Diola girls (with a sample average of 1.6 years of Koranic schooling) and between 0.8 and 1.4 years lower for Serer and Diola than Wolof boys (average : 2.4 years). The Soninké ethnic group (and to some extent the Pulaar) posts higher Koranic school attendance among both boys and girls.

Most of the variance explained in Table 1 can be attributed to ethnic groups. For example, specifications 2 and 5 explain 10.9% of the variance for boys and 6.3% for girls. Regressing the number of years spent in Koranic school on ethnic groups only explains 7.9% of the variance for boys and 4.6% for girls. Comparatively, regressing the highest grade attended in formal school on the ethnic groups explains 1.4% of the variance for boys and 2.9% for girls. This underlines

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12. 3% of the sample attended more than two primary schools.

TABLE 1: Determinants of Koranic school enrollment for girls and boys

| | Girls aged 15 to 21 | | | Boys aged 18 to 21 | | |
|---|---|---|---|---|---|---|
| | Has ever attended Koranic school (probit) | Number of years in Koranic school (OLS) | Number of years in Koranic school (OLS) | Has ever attended Koranic school (probit) | Number of years in Koranic school (OLS) | Number of years in Koranic school (OLS) |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Age | -0.063** | -0.051+ | -0.105** | -0.042 | -0.080 | -0.016 |
| | (0.016) | (0.028) | (0.035) | (0.047) | (0.098) | (0.141) |
| Rural | -0.220 | -0.159 | -0.060 | -0.125 | 0.279 | -0.082 |
| | (0.138) | (0.225) | (0.208) | (0.179) | (0.356) | (0.427) |
| Wealth (Possession of durable goods) | 0.177** | 0.257** | 0.412** | 0.106 | 0.586** | 0.639+ |
| | (0.055) | (0.087) | (0.120) | (0.073) | (0.182) | (0.354) |
| Father's Education | 0.031 | 0.005 | -0.038 | 0.030 | -0.160* | -0.182 |
| | (0.028) | (0.051) | (0.054) | (0.038) | (0.065) | (0.110) |
| Mother's Education | 0.045 | 0.062 | 0.022 | -0.011 | -0.128 | -0.175 |
| | (0.028) | (0.062) | (0.072) | (0.050) | (0.118) | (0.181) |
| The household's head works in the formal sector | -0.088 | -0.338* | -0.654** | -0.013 | -0.087 | -0.096 |
| | (0.090) | (0.134) | (0.180) | (0.121) | (0.281) | (0.364) |
| The household's head is farmer | 0.107 | 0.085 | -0.028 | 0.019 | -0.043 | 0.135 |
| | (0.124) | (0.224) | (0.276) | (0.189) | (0.366) | (0.483) |
| Ethnic group : Pulaar | 0.080 | 0.108 | 0.675* | 0.195 | 0.867* | 0.759 |
| | (0.132) | (0.255) | (0.294) | (0.149) | (0.427) | (0.487) |
| Ethnic group : Serere | -0.482** | -0.784** | -0.440+ | -0.907** | -1.377** | -1.301** |
| | (0.157) | (0.212) | (0.240) | (0.143) | (0.309) | (0.457) |
| Ethnic group : Dioola | -0.673** | -0.973** | -0.392 | -0.501** | -0.790* | -1.016* |
| | (0.216) | (0.252) | (0.380) | (0.181) | (0.353) | (0.450) |
| Ethnic group : Mandingue | 0.047 | 0.161 | 0.350 | 0.085 | 0.283 | 0.562 |
| | (0.223) | (0.360) | (0.300) | (0.290) | (0.560) | (0.661) |
| Ethnic group : Soninke | 0.657* | 1.403* | 1.992** | 0.315 | 0.587 | 1.876+ |
| | (0.295) | (0.593) | (0.512) | (0.324) | (1.295) | (1.085) |
| Ethnic group : Others | 0.010 | 0.169 | 0.719 | 0.013 | -0.347 | -0.476 |
| | (0.207) | (0.396) | (0.601) | (0.308) | (0.587) | (0.547) |
| First born (same father) | | | -0.794+ | | | -0.013 |
| | | | (0.413) | | | (0.932) |
| First born (same father) * (age in 2003 - 18) | | | 0.247* | | | -0.403 |
| | | | (0.113) | | | (0.331) |
| Number of siblings (same father) | | | -0.010 | | | -0.071* |
| | | | (0.024) | | | (0.035) |
| First born * Number of siblings (same father) | | | 0.161** | | | 0.143 |
| | | | (0.056) | | | (0.138) |
| Observations | 1,680 | 1,673 | 783 | 747 | 746 | 424 |
| $R^2$ | | 0.063 | 0.113 | | 0.109 | 0.136 |
| log-likelihood | -1082 | | | -454.1 | | |

Notes : OLS estimations. Dependent variables : see column headings. Cohort and communities dummies included in all regressions. Robust standard errors clustered by community-cohort in parentheses. * significant at 10% ; ** at 5% ; *** at 1%.

the probable fact that culture strongly determines Koranic schooling. The differences between ethnic groups in Koranic school enrollment may be an illustration of the differences in the valuation of religion, or of the values transmitted by Koranic schools. This may be partially explained by religious brotherhood effects, since ethnic group and brotherhood affiliation are somewhat related (e.g., the founder of the Muridiyyah was Wolof, thus the Wolof are often Murids). Unfortunately, we do not observe brotherhoods in the data to further explore this.

Religious skills associated with Koranic school are not easy to define, and may depend on the context. The quality of Koranic schools is very variable, according to Senegalese people themselves. As the Koranic school system is not centralized, the local quality of Koranic education may depend on the context. Yet the data at hand do not provide any information on that. However, in addition to religious knowledge, the economic returns to Koranic school may be one of the motives for Koranic school enrollment. As mentioned earlier, Koranic school may provide networks which can be valuable on the (informal) job market (World Bank, 1999). Again, Table 1 does not control for these mechanisms. It is nevertheless worth noting that there are probably lower (or no) returns to Koranic school enrollment in the formal sector. This could explain why girls are less likely to be enrolled in Koranic schools when the household head works in the formal sector. In addition, boys have shorter Koranic school careers when the father has a higher formal education. It could be that a long Koranic school career is incompatible with a long formal school career. Additionally, the values parents want to transmit to their children may be less "traditional" when the family is involved in the formal sector.

Some Senegalese consider the Koranic education of their firstborn matters more. Indeed, the firstborns could transmit religious values to their siblings. Firstborns have not systematically more Koranic education according to columns 3 and 6 in Table 1. Instead, firstborn girls pursue longer Koranic studies when they have many siblings. Obviously, the role of the firstborns' Koranic education can increase with the number of siblings. At the same time, parental preferences for family size may also reflect religious preferences or other family characteristics. Firstborn boys do not have more Koranic education according to column 6.

The cost of Koranic school may be especially difficult to bear under credit constraints. However, the financial costs of Koranic school may be very heterogeneous. Indeed, many Koranic schools do not have any official fees. Instead, the social norm is that households help Koranic masters. This social norm is probably softened when households face strong credit constraints. In addition, boarding Koranic schools may even have negative costs in some cases, when the child is fed through begging. The effects of credit constraints on Koranic school enrollment are therefore undetermined. Table 1 does not include any proxy for the heterogeneity of implicit

or explicit costs of Koranic schools between households. We nevertheless observe that boys and girls from wealthier households pursue longer Koranic studies. Similarly, boys with more siblings pursue shorter Koranic studies. A direct interpretation is that the Koranic education of many siblings can be too costly, and/or that family size is correlated with poverty.

Finally, the coefficient of age is negative and significant for girls. This means that younger girls have spent more time in Koranic schools, which is probably a sign of recent expansion of Koranic school enrollment. This effect is attenuated for firstborn girls. The Koranic education of the firstborns matters more for many Senegalese, so initial levels of Koranic education for the firstborns were probably higher.

## 4. Substitution between Koranic and formal schooling

### 4.1. Identification strategy

This section presents the main results of the paper. Our identification strategy is based on the opening of formal schools. Equations (1) present our estimations of interest :

$$
\begin{cases}
Formal\ School_{cai} = f\left(\alpha Nb\ Schools_{ca} + X_{cai}\beta^f + \lambda_c^f + \gamma_a^f + \varepsilon_{cai}^f\right) \\
Koranic\ School_{cai} = f\left(\delta Nb\ Schools_{ca} + X_{cai}\beta^k + \lambda_c^k + \gamma_a^k + \varepsilon_{cai}^k\right)
\end{cases}
\tag{1}
$$

Note : $f$ is a parametric function, which varies with the dependent variable (this allows to write probit models and OLS the same way : $f$ is the identity for the OLS ; $f(u) = \mathbb{1}(u > 0)$ for probit models).

$Formal\ School_{cai}$ denotes the formal school achievement of child $i$, from community $c$ and of age $a$. $Koranic\ School_{cai}$ is the Koranic school achievement of this child. The variable of interest is $Nb\ Schools_{ca}$ : the number of formal schools in community $c$ available for the children of age $a$ in 2003 (age in 2003 defines a cohort, called cohort $a$ thereafter). Its definition is not obvious, as school entry ages are not uniform in Senegal. More details about this are provided in the next section. However, this variable could be endogenous for at least two reasons : schools are not randomly located, and the number of schools tends to increase over time. Therefore, the specification includes a set of community dummies ($\lambda_c^f$ and $\lambda_c^k$) and a set of age-group dummies ($\gamma_a^f$ and $\gamma_a^k$), in order to control for this potential endogeneity. $X_{cai}$ are the control variables of child $cai$.

The intuition behind the specification in model (1) is straightforward. We control for age and community dummies, so the model is identified with the community-specific age profile of school enrollments. $\alpha$ and $\delta$ answer whether this community-specific profile is correlated with the number of schools available for a given age-group in a given location. Hence $\alpha$ answers a simple question : does an additional formal school promote formal education ? The significance of $\delta$ determines whether an additional formal school promotes Koranic education.

Our estimation can be interpreted as a double difference : we measure whether the differences in school enrollment between cohorts within communities are correlated with school openings in these communities. Simplifying the argument, we compare in each community children who are too old to have benefited from the opening of schools (cohort O) with the younger ones (cohort Y). In communities where a school opened, we expect the difference in school enrollment between cohorts O and Y to be higher than in the rest of the country, and measure it with $\alpha$.

Model (1) estimates the effect of formal school openings on the "consumption" of formal and religious education. We can consider religious and formal educations as two goods in the household's consumption set. Let us assume that $Nb\ Schools_{ca}$ is a useful proxy for variations in the "price" of formal education. In the standard microeconomic theory, the effect of a decrease of the price of formal education on Koranic education is called a cross-price effect.

Cross-price effects include two different economic mechanisms : the substitution and income effects. The substitution effect is straightforward. When a formal school opens, the relative price of formal education to Koranic education decreases, so some children shift from Koranic to formal education. The income effect can also be easily interpreted in our case. Again, assume that a formal school opens : for children who would have gone to formal school anyway, travel time decreases, so that the time constraint is relaxed. As a result, this additional time endowment can be reallocated to other activities, including Koranic school. The sign of this latter effect is almost certainly known : it is positive for normal goods, and human capital is probably a normal good in the Sahelian context. So the time spent in Koranic schools increases as the budget and/or time constraints are relaxed. Our economic intuition is that this effect is negligible in our setting.

The policy question in this paper is to what extent both education systems compete in Senegal. Hence, the question is whether Koranic and formal school enrollments are substitutes. We assume that both forms of educations are normal goods in Senegal. Hence, if the opening of formal schools decreases Koranic schooling, there is substitution between both school enrollments (and the substitution effect overrides the presumably negligible income effect).

### 4.2. Main results

This section estimates the effect of school openings on school attendance. We estimate equation (1). This specification estimates the effect of the opening of new schools on formal and Koranic school achievements, controlling for community dummies and age-group dummies. The identification is therefore a diff-in-diff estimation. It relies on the correlation between the

TABLE 2: Enrollment Choices and school openings

| | | Formal school | | | | Koranic school | | | |
| | | Enrolled at least until : | | | Last Grade | Enrolled for at least : | | | Nb. of years |
| | | Grade 1 (Probit) | Grade 4 (Probit) | Grade 7 (Probit) | (OLS) | 1 Year (Probit) | 4 Years (Probit) | 6 Years (Probit) | (OLS) |
|---|---|---|---|---|---|---|---|---|---|
| Rural boys | Number of primary schools at age 8 | .123 (.047)*** | .152 (.051)*** | .155 (.082)* | 1.165 (.344)*** | -.06 (.072) | -.186 (.063)*** | -.196 (.098)** | -.548 (.358) |
| | Controls, Cohort and Community dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| | N | 662 | 720 | 666 | 720 | 681 | 695 | 544 | 709 |
| | log-likelihood or $R^2$ | -306.201 | -362.228 | -337.982 | .276 | -385.856 | -320.872 | -195.408 | .254 |
| Urban boys | Number of secondary schools at age 10 | .062 (.033)* | .071 (.023)*** | .031 (.034) | .372 (.214)* | -.047 (.023)** | -.031 (.045) | -.042 (.045) | -.385 (.215)* |
| | Controls, Cohort and Community dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| | N | 655 | 704 | 755 | 755 | 701 | 667 | 556 | 701 |
| | log-likelihood or $R^2$ | -179.252 | -254.768 | -415.173 | .28 | -392.495 | -352.098 | -222.234 | .199 |
| Rural girls | Number of primary schools at age 10 | .139 (.048)*** | .069 (.042) | .067 (.04)* | .905 (.295)*** | .041 (.046) | -.041 (.049) | -.073 (.036)** | .039 (.241) |
| | Controls, Cohort and Community dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| | N | 684 | 710 | 541 | 712 | 689 | 487 | 404 | 691 |
| | log-likelihood or $R^2$ | -324.465 | -337.422 | -181.435 | .414 | -352.14 | -209.552 | -94.484 | .247 |
| Urban girls | Number of secondary schools at age 12 | .027 (.02) | .042 (.023)* | -.036 (.03) | .131 (.225) | .002 (.032) | .006 (.026) | .023 (.027) | .046 (.178) |
| | Controls, Cohort and Community dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| | N | 712 | 772 | 772 | 772 | 730 | 687 | 401 | 730 |
| | log-likelihood or $R^2$ | -249.811 | -340.547 | -405.54 | .296 | -433.217 | -275.449 | -112.108 | .19 |

Notes : Probit models (average marginal effects reported) and OLS. Dependent variables : see each column heading. Robust standard errors clustered by community-cohort in parentheses. * significant at 10% ; ** at 5% ; *** at 1%. Control variables included in all regressions : wealth, household head works in the formal sector, household head is farmer, ethnic dummies, cohort and community dummies.

community-specific differences in education between cohorts and the opening of schools. The estimation of model (1) is given in Table 2.

In Table 2, columns 1 to 4 estimate the effect of the opening of formal schools on formal education. Columns 5 to 8 estimate their effect on Koranic education. In each case, we estimate three probit specifications, with different dependent variables : has ever been enrolled, completed fourth grade in formal school (or 4 years of Koranic school), completed 7th grade [13] (or 6 years of Koranic school). Table A.5 in the appendix displays comparable estimates for each grade in formal school and year in Koranic school. For these probit specifications, we report the average (in our sample) of the marginal effect of an additional formal school on school achievement. We also estimate in column 4 and 8 OLS specifications explaining the highest grade attended in formal school, and the number of years in Koranic school. Table 2 includes the specifications for each sample in a different line, namely : rural boys, urban boys, rural girls and urban girls.

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13. In the Senegalese formal school system, 7th grade is the first grade of secondary school.

Columns 1 to 4 in Table 2 basically check that formal school openings increase formal school achievement. This seems to be the case, and marginal effects are quite large. In rural areas, an additional primary school seems to increase the education levels of both boys and girls by approximately one year on average. For girls, it mostly increases the probability to start primary school (by nearly 15 percentage points). For boys, it shifts all the distribution of primary education, and increases the probability to reach the first grade of secondary school by approximately 15%. These effects are very large quantitatively. This probably means that formal school provision was very scarce in the villages surveyed in the 1990s. This is probably the reason why we have been unable to detect an effect of formal primary school openings on formal school attendance in urban areas : the provision of primary schools is probably less scarce in urban areas. Instead, we measure in Table 2 the effect of secondary school openings on formal school attendance.

Although the effect of a secondary school opening on formal school achievement is quantitatively smaller, it is still significant for boys in urban areas. We estimate that an additional secondary school increases formal school achievement by 0.4 grade approximately. Surprisingly, the marginal effect is larger for the access to 4th grade (7%) than for the access to the first grade of secondary school (7th grade, with 3%). This is not theoretically impossible : the possibility to enter secondary school may increase the option value of primary school enrollment in Senegal. In addition, there is an exam to enter secondary schools in Senegal, so that achieving primary school does not automatically give access to secondary school. However, this is likely to signal an overly optimistic behavior of Senegalese households. For girls however, we were unable to show any effect of secondary school openings on formal school attendance in urban areas. The opening of a secondary school at age 12 only has a significant effect at the 10% level and only on the probability to reach 4th grade.

Columns 5 to 8 in Table 2 estimate the effect of formal school openings on Koranic school achievement. For boys, we find that formal school openings decrease Koranic school achievement. In rural areas, it decreases the probability to spend at least 4 years and at least 7 years in Koranic school. Therefore, it seems to decrease long Koranic school careers. The OLS specification estimates that the total effect of an additional primary school on the number of years spent in Koranic schools is -0.5, but this is not statistically significant.

For urban boys, the effect of formal school openings on Koranic school enrollment is also statistically significant. Formal school openings seem to decrease the probability to start Koranic school, and to pursue a long Koranic school career. The effect of an additional formal school is quantitatively important (-0.4 years per additional school). It has to be compared

with the effect of an additional formal school on formal school achievement (+0.4 grade). This comparison is imperfect as grade repetition is very prevalent in Senegal : , with an annual rate of 15%, a child spends approximately 1.15 year per grade on average in formal schools. However, it means that a large part of the additional time spent in formal school due to a formal school opening has been diverted from Koranic school in urban areas.

On the contrary, we do not find any significant effect of formal school openings on the Koranic school attendance of girls. In the OLS specifications in column 8, the size of the estimated effects are approximately 10 times smaller than for boys. This is normal in urban areas, where formal school openings do not really seem to affect girls' formal school attendance.

In rural areas, a formal school opening does not seem to affect Koranic education : it only seems to affect the probability of spending more than 6 years in Koranic school. Given that it does not affect other levels of Koranic education (see Table A.5), this should not be taken into account.

## 5. Conceptual and empirical issues

### 5.1. Definition of formal schools available for a child

The definition of $Nb\ Schools_{ca}$ (the number of formal schools for the children of age $a$ in community $c$) is not trivial. Indeed, school entry ages are heterogeneous in Senegal. Therefore, when a primary school opened when a child $cai$ was 9, we do not know whether this school should be considered as relevant to her or not. The same applies for secondary schools. School entry age is variable, but in addition, grade repetitions increase further the variance of ages at the end of primary school [14]. On the top of that, primary school enrollment choices can depend on future educational possibilities, and in particular on the presence of a nearby secondary school.

In order to determine when a school opening affects a given child, we estimate equation (2) :

$$
\begin{aligned}
Formal\ School_{cai} =\ & \alpha_{p\tilde{a}} Nb\ Primary\ Schools_{ca\tilde{a}} + \alpha_{s\tilde{a}} Nb\ Secondary\ Schools_{ca\tilde{a}} \\
& + X_{cai}\beta^f + \lambda_c^f + \gamma_a^f + \varepsilon_{cai}^f
\end{aligned}
\tag{2}
$$

This is a modification of model (1) which takes into account the fact that the effect of an additional school on formal school achievement can be different depending on its ope-

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14. The annual rate of grade repetition is about 15% in Senegal, see Ministry of Education, Senegal (2005)

ning date (and includes both primary and secondary schools). In this specification, the dependent variable is the highest grade attended in formal school. *Nb Primary Schools*$_{ca\tilde{a}}$ (resp. *Nb Secondary Schools*$_{ca\tilde{a}}$ ) is the number of primary (resp. secondary) schools that opened when the children of cohort $a$ (in community $c$) was $\tilde{a}$ years old. In Figure 2, we plot the estimates of $\alpha_{p\tilde{a}}$ and $\alpha_{s\tilde{a}}$ in model (2) separately for urban boys, rural boys, rural girls and urban girls. In each graph of Figure 2 (Rural Girls, Urban Girls, Rural Boys, Urban Boys), we plot the coefficients $\alpha_{p\tilde{a}}$ and $\alpha_{s\tilde{a}}$ as a function of age $\tilde{a}$. Therefore, we plot the effect of an additional school opening when the child is of age $\tilde{a}$ on formal school achievement as a function of $\tilde{a}$. This function is expected to be positive and decreasing. It should be positive because a formal school opening should have a positive effect (or null) on formal school achievement. It should be decreasing because when a child is old when a school opens, she might have already left school or be already enrolled in an existing school, so that this new school opening hardly affects her.

We split the sample into urban and rural areas as the characteristics of the school system are different in both areas. In rural areas, the distance to primary school can be a problem, while the main problem in urban areas is probably that existing schools are overcrowded. This pattern is attenuated for secondary schools : secondary schools can be too far away even in urban areas. The effect of school openings can also potentially differ between girls and boys. Indeed, early adulthoods of boys and girls are known to differ. This is especially true in rural areas, where early marriages (often followed by school dropouts) are even more common among teenage girls. Additionally, the opportunity costs of primary school education are not the same : they are involved in different types of child labor, and Koranic education probably matters more for boys.

The curves in Figure 2 are easy to interpret for rural boys. Indeed, their school achievement increases if a primary school opens when they are 8 at most. The effect of a new primary school for a rural boy seems maximum when he was 4 years old at the school opening date, with nearly 3 additional grades of formal school per additional primary school. Hereafter, we arbitrarily choose that all primary schools opened at age 8 are relevant for rural boys. For the time being, *Nb Schools*$_{ca}$ is the number of primary schools at age 8.

For urban boys, the effect of new schools on educational achievement is lower. However, we observe that the effect of secondary schools that opened below age 12 is systematically positive, with approximately 0.5 to 1 additional grade for an additional secondary school. The point estimates are rarely significant in Figure 2 : they are only significant for secondary schools opening at age 10. We arbitrarily choose that all secondary schools opened at age 10 are relevant for both rural and urban boys for the time being.

FIGURE 2: Effect of the opening of primary and secondary schools on highest grade attended by age
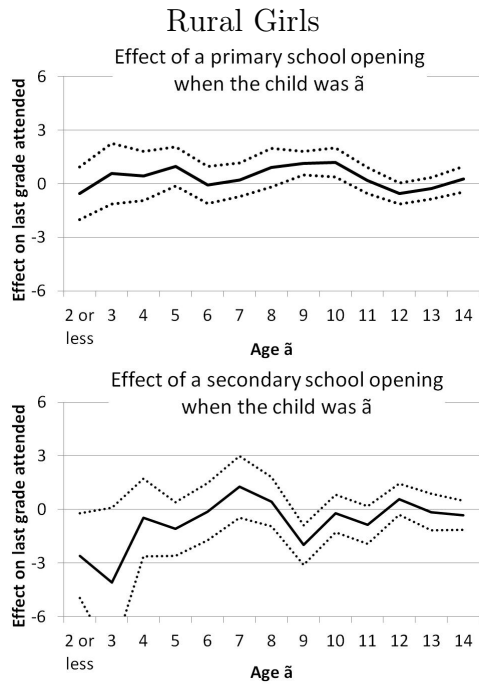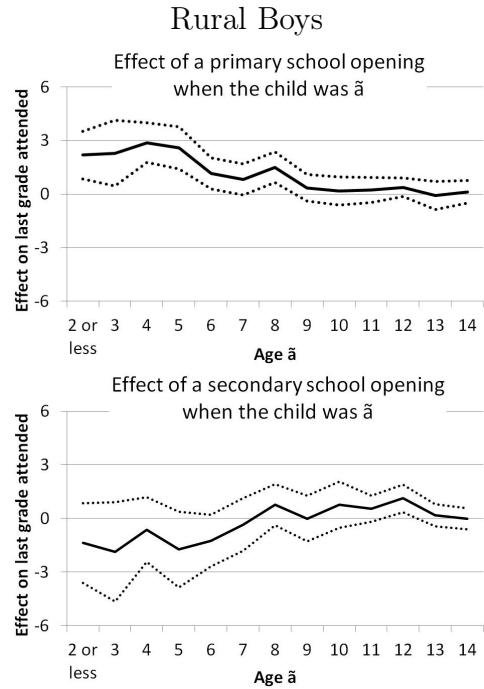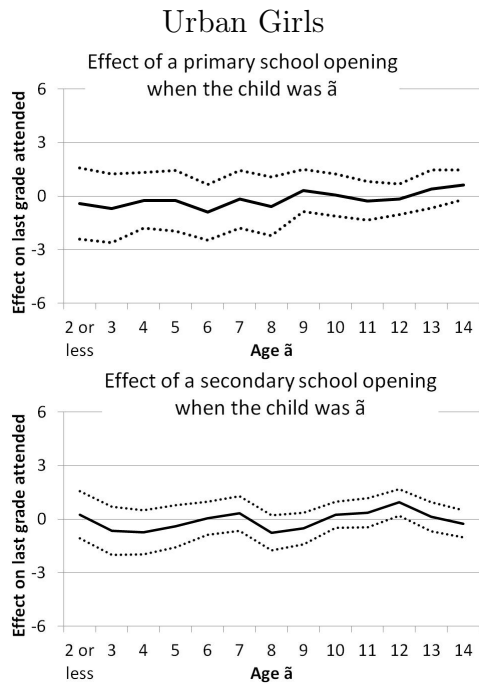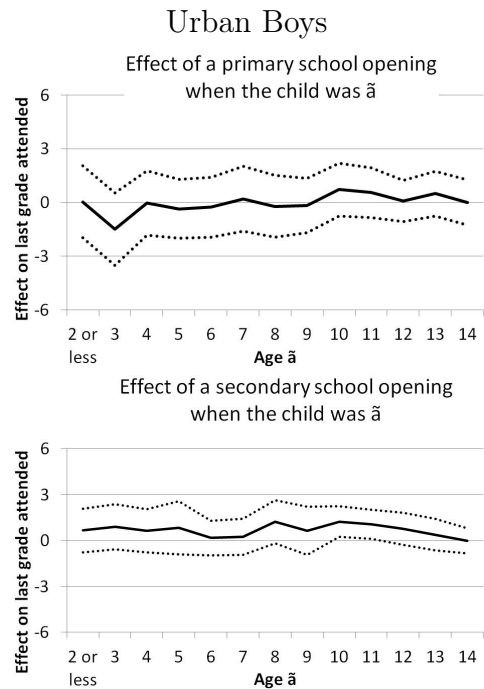
Notes for all graphs : The OLS coefficients of the effect of school openings on highest grade attended (see model (2)) is plotted against age. Robust confidence intervals at the 5% level clustered by community-cohort are given in dashed lines. Control variables : wealth, household head works in the formal sector, household head is a farmer, age, ethnic and community dummies.

For rural girls, Figure 2 is difficult to interpret. The effect of primary schools that opened below age 10 is often positive. Therefore, we choose that the number of primary schools opened at age 10 as our $Nb\ Schools_{ca}$ variable for rural girls.

For urban girls, we could not really interpret Figure 2. We choose that $Nb\ Schools_{ca}$ is the number of secondary schools opened at age 12, because this coefficient is the only significantly positive one.

Given the definition of $Nb\ Schools_{ca}$ above, we can identify the school openings relevant to our identification strategy. Rural primary schools that opened between 1990 and 1997 are crucial to us. Indeed, they opened when a part of our sample (aged 15 to 21 in 2003) was between 8 and 10. So they can help measuring the effect of $Nb\ Schools_{ca}$ in equation (1). They are included in $Nb\ Schools_{ca}$ for boys aged 21, and not for girls aged 15. Similarly, urban secondary schools that opened between 1992 and 1999 are crucial to our estimations.

Lastly, Table A.2 in appendix shows there is no recorded opening of religious school among these schools, which are mostly public. [15]

### 5.1.1. Robustness check : alternative definitions of formal schools available for a child

This specification check tests robustness of the results with other variables that could have been chosen instead based on Figure 2. Table A.7 in appendix tests the specifications of Table 2 with alternative definitions of explanatory variables.

For rural boys, we test two alternative specifications. In the first one, the variable "number of schools" is the number of primary school at age 4, which is the maximum of the curve for rural boys in Figure 2. In the other one, the variable for the number of schools is the average of the number of primary schools between age 4 and age 8. To clarify this specification, let us illustrate it in a community with a single primary school. For children aged less than 4 when the primary school opened, this variable takes value 1. For children aged 5 when the school opened, this variable takes value 0.8 (the school was opened 80% of the time between 4 and 8); it takes value 0.6 for children aged 6 when the school opened, and so on. Therefore, it assumes that the effect of the opening of a formal school is maximal for children aged 4 or less when the school opens; that this effect decreases linearly with age at school opening, and vanishes for children aged 9 or more when the school opened. Overall, these specifications confirm the positive effect of new primary schools on formal education. In addition, in both cases, new

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15. Besides, Table A.2 shows that the primary and secondary schools in the sample are rarely Franco-Arab. 6% of primary schools and 5% of secondary schools are religious schools, and the majority of them have unambiguous Christian names.

primary schools seem to decrease Koranic education, although this is less significant.

For urban boys, we also test two alternative specifications. In the first one, our "number of schools" variable is the number of secondary schools at age 13. In the other one, we use the average number of secondary schools between age 10 and age 13. In both specifications, the effect of new formal schools on formal education is positive and significant, and the effect of new formal schools on the probability to spend 4 years in Koranic school is negative and significant.

We test another alternative specification for rural girls, replacing the number of primary schools at age 10 by the number of primary schools at age 11. The results are very similar to previous ones.

## 5.2. Concerns about the common trend assumption

Our main estimation model, model (1), estimates the correlation between the number of schools available and the community-specific profile of school enrollment decisions. The control for community fixed effects ensures that endogeneity concerns are limited to the unobservable characteristics of communities varying between the cohorts of children. As a result,this identification strategy raises the same identification concerns as differences in differences : the common trend assumption.

As in the case of standard differences in differences, it is useful to look at the differences of observable characteristics between the "treatment group" and the "control group". In appendix, Table A.3 assesses the determinants of the number of school openings relevant to our identification strategy, similar to a "treatment intensity" in our case. There seems to have been more primary school openings in urban than in rural areas between 1990 and 1997. However, our main estimations are split into the rural and the urban subsamples. No other determinant of primary school openings is statistically significant. Among the determinants of secondary school openings, only the geographic dummies are statistically significant, and only in urban areas. Indeed, there seems to have been more secondary school openings in the South East of Senegal over this period. [16] For secondary schools in urban areas, there are signs of endogenous placement of school openings. In the end, communities with many school openings seem to be relatively similar to other communities.

Concerning the common trend assumption, the main reason why school supply may be correlated with school enrollment decisions is that socioeconomic development trends differ between localities. We find that an increase in the number of formal schools is correlated to

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16. Regions of Kolda, Tambacounda and Ziguinchor.

changes in school enrollment choices. One could be worried that this is due to differences in school choices trends between communities that are not directly caused by school openings. For example, when there is economic growth somewhere, the state may open more schools in the area. In that case, the changes in school enrollment choices may be due to economic growth itself (e. g., an increase in the economic activity and hence new job opportunities which increase expected returns to education), and not to the new schools.

However, if the trends in local school supply are correlated with the trends in local school demand, school supply is probably not reactive to school demand on a year-by-year basis. On the contrary, the reactions of school supply to school demand are probably slow. Thus, given that we estimate our model on 7 cohorts per community, testing whether the increase in local school supply is correlated with linear differences between the enrollments trends should solve most of this problem.

*5.3. Robustness check : controlling for community-specific time-trends*

We present here an alternative specification controlling for community-specific time-trends (or trends between cohorts). We found that an increase in the number of formal schools is correlated to changes in school enrollment choices. One could be worried that this is due to differences in economic development trends between communities that are not directly caused by school openings. We adapt our main model to add a community-specific (linear) trend to both equations of model (3) :

$$\begin{cases} Formal\ School_{cai} = f\left(\alpha Nb\ Schools_{ca} + X_{cai}\beta + \lambda_c^f + \gamma_a^f - g_c^f \times a + \varepsilon_{cai}\right) \\ Koranic\ School_{cai} = f\left(\delta Nb\ Schools_{ca} + X_{cai}\beta + \lambda_c^k + \gamma_a^k - g_c^k \times a + \varepsilon_{cai}\right) \end{cases} \quad (3)$$

In this model, $g_c^f$ and $g_c^k$ are community-specific linear trends between cohorts, respectively in formal and Koranic school attendance. However, the estimation of model (3) including all $g_c^f$ and $g_c^k$, shows little power in the estimates of the effects of school openings on attendance. Instead, we identify a simplification given by :

$$\begin{cases} Formal\ School_{cai} = f\left(\alpha Nb\ Schools_{ca} + X_{cai}\beta + \lambda_c^f + \gamma_a^f + \kappa^f \overline{Nb\ Schools}_c \times a + \varepsilon_{cai}\right) \\ Koranic\ School_{cai} = f\left(\delta Nb\ Schools_{ca} + X_{cai}\beta + \lambda_c^k + \gamma_a^k + \kappa^k \overline{Nb\ Schools}_c \times a + \varepsilon_{cai}\right) \end{cases} \quad (4)$$

In model (4), $\overline{Nb\ Schools}_c$ reflects the "school opening rate" in the community, and is the average number of schools which opened in the community (over the estimation sample). We

identify the coefficients $\kappa^f$ and $\kappa^k$ as corresponding to the part of the community-specific trend correlated to the average number of school openings in the community. The rest of the community-specific time trend ($g_c^f$ and $g_c^k$ in the model (3)) remains in the error term. The results of this estimation are given in Table A.6 in the Appendix. Overall, our estimates of the effect of school openings on school outcomes remain broadly unchanged. In addition, the coefficients for the correlation between the average number of school openings and the time trend in enrollment are rarely significant. In rural areas and for boys, the estimations that are significant show a negative correlation for the interaction between the average number of school openings and age. This would mean that in areas where a lot of schools open, older children have less formal AND Koranic education (controlling as much as we can for the specific effect of these school openings). First, this gives some (admittedly weak) support for the story where school tend to open in "booming" areas. Second, this does not seem to drive our main results, as we observe that school openings affect formal school and Koranic school enrollment decisions in opposite directions.

## 5.4. Potential selection bias

This paper is based on the estimation of (1) on the EBMS sample described in section 3. The fact that this sample is not nationally representative might be a problem, as the composition of our sample may be related to education history of the individuals. For example, if girls marry earlier when they are uneducated, some girls from households with low demand for education may have already left the sampled households in places where there were no schools nearby. This can be a problem in our main estimations. However, this may have two testable consequences : the observables and the number of observations can be related to $Nb\ Schools_{ca}$.

First, observable characteristics of the individuals could be correlated with $Nb\ Schools_{ca}$. For instance, in the example cited above, there could be fewer girls with low parental education when $Nb\ Schools_{ca}$ is small. Formally, this can be tested with model (5) :

$$Nb\ Schools_{ca} = X_{cai}\beta^{s1} + \lambda_c^{s1} + \gamma_a^{s1} + \varepsilon_{cai}^{s1} \qquad (5)$$

We estimate equation (5) in Table 3. This Table shows no sign that the composition of our sample is significantly different when $Nb\ Schools_{ca}$ is higher (at least based on observable characteristics), as the F-test are not significant.

Second, the number of observations could be affected by $Nb\ Schools_{ca}$.

$$Nbobs_{ca} = \alpha^{s2}Nb\ Schools_{ca} + \bar{X}_{ca}\beta^{s2} + \lambda_c^{s2} + \gamma_a^{s2} + \varepsilon_{ca}^{s1} \qquad (6)$$

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TABLE 3: Partial correlation between $Nb\ Schools_{ca}$ and the observable variables

| | | Rural Boys Number of primary schools at age 8 | Urban Boys Number of secondary schools at age 10 | Rural Girls Number of primary schools at age 10 | Urban Girls Number of secondary schools at age 12 |
|---|---|---|---|---|---|
| Asset index | | -.01 (.02) | .006 (.036) | .009 (.026) | .008 (.033) |
| Father's education | | .006 (.006) | -.002 (.01) | .002 (.01) | .001 (.007) |
| Mother's education | | -.027 (.016)* | -.028 (.018) | .013 (.018) | -.013 (.011) |
| | Peul | -.048 (.027)* | .087 (.058) | -.061 (.038) | .006 (.036) |
| Ethnic groups (ref : Wolof) | Serere | -.006 (.028) | .032 (.044) | -.056 (.03)* | -.04 (.037) |
| | Dioola | -.003 (.036) | .106 (.114) | .033 (.054) | -.066 (.156) |
| | Mandingue | .021 (.032) | .096 (.13) | -.039 (.048) | .007 (.083) |
| | Others | -.018 (.036) | -.089 (.07) | .018 (.059) | -.084 (.065) |
| Head is farmer | | -.041 (.021)* | .012 (.1) | -.005 (.027) | .04 (.112) |
| Head works in the formal sector | | -.004 (.037) | -.011 (.044) | -.095 (.061) | -.01 (.029) |
| Cohort and Community dummies | | Yes | Yes | Yes | Yes |
| N | | 730 | 760 | 718 | 792 |
| **Joint significance of the** | **F-statistic** | **1.028** | **1.054** | **1.198** | **.454** |
| **coefficients shown here** | **p-value** | **.421** | **.4** | **.294** | **.917** |

Notes : OLS estimations. Dependent variables : see column headings. Cohort and communities dummies included in all regressions. Robust standard errors clustered by community-cohort in parentheses. * significant at 10% ; ** at 5% ; *** at 1%.

In equation (6), $Nbobs_{ca}$ is the number of selected observations (i.e. observations in our sample) by community-cohort, $\bar{X}_{ca}$ is the average of $X_{cai}$ in the community-cohort. Table A.4 in appendix gives the estimation of equation (6). The number of observations is not statistically different when $Nb\ Schools_{ca}$ is greater.

## 6. Conclusion

We use a unique Senegalese national household survey with information on formal and Koranic schooling to analyze the link between the two education systems. We first focus on the determinants of Koranic schooling and one interesting result is that ethnic group variables are a strong determinant of both initial enrollment and length of Koranic education. This is consistent with the idea that Koranic schooling decisions are embedded in a cultural context.

The main contribution of this paper is the estimation of the substitution between Koranic education and formal education. Our empirical strategy is to estimate the response to the openings of formal schools. We find that formal school openings increase the highest grade attended in formal schools, and decrease the number of years in Koranic school. Therefore, both education systems seem to compete for the children's time : formal and Koranic educations are substitutes for boys, despite the fact that their curricula have virtually no intersection.

This result shows an improvement of the formal school system shifts the education demand towards the formal one, which is encouraging for the second millennium goal. However, the existence of a substitute to formal education in Senegal can make it more difficult for this country to achieve universal primary education for at least two reasons. First, it can decrease the demand for formal education, as it increases the opportunity costs of formal education. In particular, formal school enrollment can be especially vulnerable to decreases in the quality of education. However, reaching universal primary education probably requires a vast improvement of the Senegalese formal school system anyways, and these opportunity costs might become negligible if the formal school system improves. Second, the political clout of Muslim brotherhoods in Senegal might lead politicians to defend religious education over the formal one.

These last two remarks question the desirability of formal school for the most conservative parts of the Senegalese society. Whether some aspects of the curricula of formal schools (e.g. teaching the language inherited from the colonization, orientation towards the formal sector and the absence of religious teaching) make them less desirable for them remains an open question. The recent boom of Franco-Arab schools illustrates that some Senegalese prefer the incorporation of religion in formal schools.

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# Appendices

**Variable definitions**

*Has ever attended formal school.* takes value 1 if the child has ever been enrolled in a formal school and 0 otherwise.

*Last grade attended.* is self-declared.

*Has ever attended Koranic school.* takes value 1 if the child has ever been enrolled in A Koranic school and 0 otherwise.

*Number of years in Koranic school.* is self-declared.

*Age.* is self-declared and probably approximative. For example, there are more individuals aged 20 than 19 and 21 in the sample.

*Rural.* takes value 1 if the community is rural and 0 if it is urban.

*Wealth (Possession of durable goods).* is a composite indicator for possession of durable goods, obtained by a principal component analysis.

*Formal Religious Education.* takes value 1 if the child has been to a religious primary schools in either of the last 2 primary schools. 3% of the children had more than 2 primary schools.

*Father's education.* takes value 1 if the father never went to school, 2 if he began but did not finish primary school, 3 if he finished primary school but did not began secondary school, etc.

*Mother's education.* takes value 1 if the mother never went to school, 2 if she began but did not finish primary school, 3 if she finished primary school but did not began secondary school, etc.

*The household head works in the formal sector.* takes value 1 if the household head declares working in the formal sector, 0 otherwise.

*The household head is farmer.* takes value 1 if the household head declares working in any agricultural activity, 0 otherwise.

*Ethnic groups.* are self declared. Fulbe and Halpulaar are grouped together in the Pulaar group.

TABLE A.1: Descriptive statistics for the variables of this paper

| Variable | Mean | Std. Dev. | Min. | Max. | N |
|---|---|---|---|---|---|
| Has ever attended formal school | 0.754 | 0.431 | 0 | 1 | 3129 |
| Last grade attended | 5.072 | 3.671 | 0 | 13 | 3105 |
| Has ever attended Koranic school | 0.572 | 0.495 | 0 | 1 | 2985 |
| Number of years in Koranic school | 1.998 | 2.53 | 0 | 16 | 2975 |
| Age | 17.691 | 1.952 | 15 | 21 | 3129 |
| Wealth (Possession of durable goods) | 0.151 | 0.966 | -1.479 | 2.82 | 3123 |
| Rural | 0.478 | 0.5 | 0 | 1 | 3129 |
| Father's education | 2.257 | 1.973 | 1 | 8 | 3065 |
| Mother's education | 1.583 | 1.232 | 1 | 8 | 3060 |
| The household head works in the formal sector | 0.297 | 0.457 | 0 | 1 | 3129 |
| The household head is farmer | 0.298 | 0.457 | 0 | 1 | 3129 |
| Ethnic group : Wolof | 0.364 | 0.481 | 0 | 1 | 3129 |
| Ethnic group : Pulaar | 0.218 | 0.413 | 0 | 1 | 3129 |
| Ethnic group : Serere | 0.174 | 0.379 | 0 | 1 | 3129 |
| Ethnic group : Dioola | 0.058 | 0.235 | 0 | 1 | 3129 |
| Ethnic group : Mandingue | 0.135 | 0.342 | 0 | 1 | 3129 |
| Ethnic group : Soninke | 0.015 | 0.12 | 0 | 1 | 3129 |
| Number of primary schools opened at age 8 | 3.142 | 2.49 | 0 | 12 | 3129 |
| Number of secondary schools opened at age 10 | 2.572 | 2.992 | 0 | 11 | 3129 |
| Number of primary schools opened at age 10 | 3.335 | 2.53 | 1 | 12 | 3129 |
| Number of secondary schools opened at age 12 | 2.768 | 3.14 | 0 | 12 | 3129 |
| Number of boys in the community-cohort | 3.768 | 2.322 | 0 | 13 | 413 |
| Number of girls in the community-cohort | 3.809 | 2.251 | 0 | 12 | 413 |

Notes : All children aged 15-21 are in the sample, unless specified. This is the sample for the main results (including Table 2)

*Number of primary schools opened at age a.* is the number of primary schools cited in the community questionnaire opened before child $i$ reaches age $a$.

*Number of boys in the community-cohort.* is the number of boys born in community $c$ and of age $a$ in 2003.

*Number of girls in the community-cohort.* is the number of girls born in community $c$ and of age $a$ in 2003.

TABLE A.2: Formal schools included in the sample

| | Primary schools | | Secondary schools | |
| | All schools opened in 2003 | Rural Primary Schools opened between 1991 and 1998 | All schools opened in 2003 | Urban Secondary Schools opened between 1993 and 2000 |
|---|---|---|---|---|
| Public school | 82% | 100% | 67% | 60% |
| Non-confessional private | 12% | 0% | 28% | 40% |
| Religious school (Christian or Muslim) | 6% | 0% | 5% | 0% |
| Number of schools | 224 | 17 | 153 | 15 |

## Additional Tables and Figures

Figure A.1 plots the average length of Koranic school against age in 2003. Two effects can explain the differences between the enrollment rates of the older and the younger cohorts. First, the proportion of children in the older cohort who have attended Koranic school only after data collection is smaller. Second, the difference in Koranic school enrollment between the two cohorts is affected if Koranic school enrollment decreases (or increases) over time. It is theoretically impossible to disentangle the two mechanisms with the data at hand. However, we observe that the number of years spent in Koranic school does not increase after 18 years old for the boys and 15 years old for the girls. Consequently, we make the following assumption : girls over 15 and boys over 18 have finished their Koranic schooling. Some estimations are based on the sample of all children aged 15 to 21. They bear the risk of having the being contaminated by incomplete Koranic education.

FIGURE A.1: Length of Koranic school and age in 2003



29
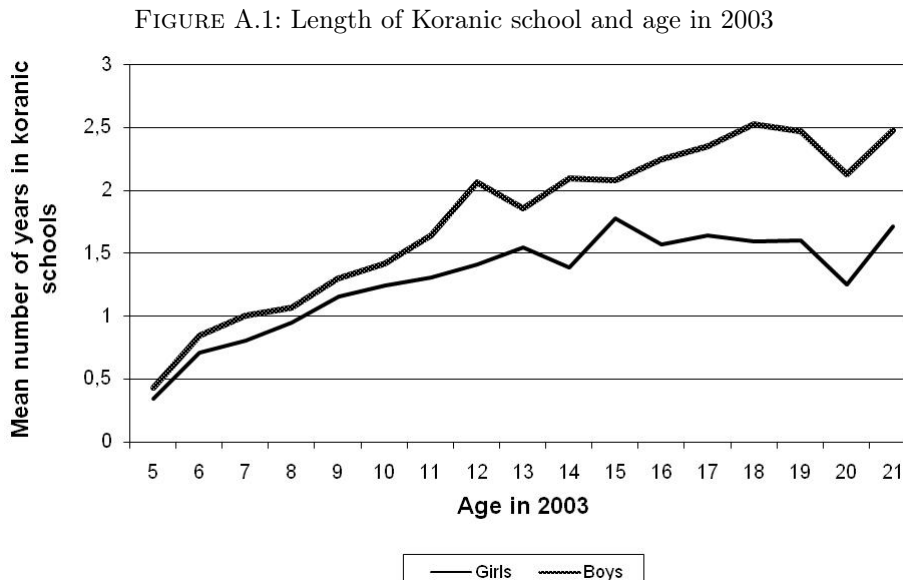
TABLE A.3: Determinants of the number of schools openings

| | Number of primary schools opened between 1990 and 1998 | | Number of secondary schools opened between 1992 and 2000 | |
| --- | --- | --- | --- | --- |
| | Full Sample | Rural | Full Sample | Urban |
| Rural community | -2.052 (.72)*** | | -.514 (.819) | |
| Community Mean asset index | -.122 (.273) | .217 (.526) | -.011 (.253) | -.235 (.587) |
| Community Mean education index | -.582 (.408) | -.475 (.95) | -.148 (.425) | -.824 (.713) |
| Distance to hospital | .052 (.17) | -.321 (.372) | .145 (.168) | -.117 (.234) |
| Distance to health center | -.318 (.765) | -.637 (.776) | .163 (.914) | $a$ |
| Community has electricity | .262 (.574) | -.568 (.615) | .714 (.566) | $a$ |
| Community has tap water | .116 (.656) | .435 (.775) | -.255 (.67) | $a$ |
| log(population) of city or village | -.006 (.13) | $b$ | -.006 (.166) | -.171 (.327) |
| Number of primary schools in 1991 | -.114 (.083) | .263 (.377) | | |
| Number of secondary schools in 1993 | | | .087 (.07) | .198 (.112)* |
| | | | | |
| Joint significance of the coefficients shown here | 14.819 | 3.339 | 4.301 | 3.856 |
| Corresponding p-value | .096 | .765 | .891 | .57 |
| | | | | |
| Region group dummies$^c$ | Yes | Yes | Yes | Yes |
| Joint significance for these dummies | 5.116 | 1.657 | 3.588 | 28.651 |
| Corresponding p-value | .402 | .798 | .61 | .00003 |
| | | | | |
| N | 57 | 32 | 57 | 28 |
| $R^2$ | .331 | .312 | .331 | .626 |
| Joint significance of the full model | 26.825 | 7.75 | 10.461 | 88.525 |
| Corresponding p-value | .02 | .736 | .728 | 1.05e-14 |

Notes : OLS estimations. Dependent variables : see column headings. Bootstrapped standard errors in parentheses. * significant at 10% ; ** at 5% ; *** at 1%.

$a$ : Does not vary between urban communities

$b$ : Not available for every community. We ran regressions adding this explanatory variable on the selected sample, and obtained similar results.

$c$ : Due to small sample size, we had to group the administrative regions of Saint-Louis, Louga and Matam ; of Kaolack, Diourbel and Fatick ; and of Ziguinchor and Kolda.

TABLE A.4: Correlation between the number of observations by community-cohort and the number of schools

| | Boys | | Girls | |
|---|---|---|---|---|
| | Rural areas | Urban areas | Rural areas | Urban areas |
| Number of primary schools at age 8 | .676<br>(.419) | | | |
| Number of secondary schools at age 10 | | .119<br>(.453) | | |
| Number of primary schools at age 10 | | | .034<br>(.349) | |
| Number of secondary schools at age 12 | | | | .559<br>(.352) |
| Control variables, Cohort and Community Dummies | Yes | Yes | Yes | Yes |
| N | 217 | 196 | 217 | 196 |
| $R^2$ | .499 | .295 | .41 | .352 |

Notes : Probit model. Dependent variables : number of observations by community-cohort for cohorts aged 15-21 in 2003. Heteroskedasticity-robust standard errors in parentheses. * significant at 10% ; ** at 5% ; *** at 1%. Control variables included in all regressions : community-cohort average of wealth, household head works in the formal sector, household head is a farmer, ethnic dummies, cohort and community dummies.

TABLE A.5: Regressions with all education levels

| | | Year 1 (Probit) | Year 2 (Probit) | Year 3 (Probit) | Year 4 (Probit) | Year 5 (Probit) | Year 6 (Probit) | Year 7 (Probit) | Year 8 (Probit) | Year 9 (Probit) | Last Year (OLS) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Rural boys — Formal education** | Number of primary schools at age 8 | .123 (.047)*** | .16 (.053)*** | .205 (.048)*** | .152 (.051)*** | .099 (.061) | .088 (.068) | .155 (.082)* | .162 (.092)* | .061 (.069) | 1.165 (.344)*** |
| | Control variables and dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| | N | 662 | 654 | 668 | 720 | 720 | 720 | 666 | 645 | 598 | 720 |
| | log-likelihood or $R^2$ | -306.201 | -309.775 | -314.393 | -362.228 | -387.132 | -419.558 | -337.982 | -296.499 | -226.123 | .276 |
| **Rural boys — Koranic education** | Number of primary schools at age 8 | -.06 (.072) | -.091 (.074) | -.108 (.065)* | -.186 (.063)*** | -.146 (.064)** | -.196 (.098)** | -.129 (.095) | | | -.548 (.358) |
| | Control variables and dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | | | Yes |
| | N | 681 | 681 | 695 | 695 | 654 | 544 | 526 | | | 709 |
| | log-likelihood or $R^2$ | -385.856 | -385.726 | -375.747 | -320.872 | -273.269 | -195.408 | -144.506 | | | .254 |
| **Urban boys — Formal education** | Number of secondary schools at age 10 | .062 (.033)* | .064 (.034)* | .062 (.029)** | .071 (.023)*** | .078 (.035)** | .03 (.037) | .031 (.034) | -.001 (.039) | .017 (.033) | .372 (.214)* |
| | Control variables and dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| | N | 655 | 679 | 704 | 704 | 755 | 755 | 755 | 755 | 755 | 755 |
| | log-likelihood or $R^2$ | -179.252 | -192.353 | -218.717 | -254.768 | -327.309 | -386.432 | -415.173 | -415.336 | -353.497 | .28 |
| **Urban boys — Koranic education** | Number of secondary schools at age 10 | -.047 (.023)** | -.079 (.032)** | -.079 (.019)*** | -.031 (.045) | -.012 (.039) | -.042 (.045) | -.068 (.056) | | | -.385 (.215)* |
| | Control variables and dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | | | Yes |
| | N | 701 | 701 | 701 | 667 | 648 | 556 | 456 | | | 701 |
| | log-likelihood or $R^2$ | -392.495 | -408.991 | -406.303 | -352.098 | -295.72 | -222.234 | -154.243 | | | .199 |
| **Rural Girls — Formal education** | Number of primary schools at age 10 | .139 (.048)*** | .142 (.049)*** | .048 (.042) | .069 (.042) | .07 (.044) | .106 (.046)** | .067 (.04)* | .077 (.044)* | .082 (.048)* | .905 (.295)*** |
| | Control variables and dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| | N | 684 | 681 | 710 | 710 | 710 | 710 | 541 | 433 | 327 | 712 |
| | log-likelihood or $R^2$ | -324.465 | -324.208 | -335.828 | -337.422 | -341.883 | -330.29 | -181.435 | -124.638 | -63.072 | .414 |
| **Rural Girls — Koranic education** | Number of primary schools at age 10 | .041 (.046) | .048 (.047) | .025 (.047) | -.041 (.049) | -.011 (.052) | -.073 (.036)** | -.04 (.034) | | | .039 (.241) |
| | Control variables and dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | | | Yes |
| | N | 689 | 677 | 572 | 487 | 442 | 404 | 276 | | | 691 |
| | log-likelihood or $R^2$ | -352.14 | -347.469 | -285.925 | -209.552 | -160.551 | -94.484 | -57.348 | | | .247 |
| **Urban Girls — Formal education** | Number of secondary schools at age 12 | .027 (.02) | .037 (.021)* | .032 (.019)* | .042 (.023)* | .072 (.023)*** | .066 (.026)** | -.036 (.03) | -.052 (.035) | -.065 (.03)** | .131 (.225) |
| | Control variables and dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| | N | 712 | 705 | 754 | 772 | 772 | 772 | 772 | 772 | 772 | 772 |
| | log-likelihood or $R^2$ | -249.811 | -259.816 | -299.094 | -340.547 | -378.111 | -415.632 | -405.54 | -387.372 | -337.982 | .296 |
| **Urban Girls — Koranic education** | Number of secondary schools at age 12 | .002 (.032) | -.0001 (.035) | -.021 (.028) | .006 (.026) | .022 (.022) | .023 (.027) | .008 (.024) | | | .046 (.178) |
| | Control variables and dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | | | Yes |
| | N | 730 | 730 | 730 | 687 | 592 | 401 | 401 | | | 730 |
| | log-likelihood or $R^2$ | -433.217 | -432.987 | -365.211 | -275.449 | -193.161 | -112.108 | -97.358 | | | .19 |

Notes : Probit models (average marginal effects reported) and OLS. Dependent variables : see each column heading. Robust standard errors clustered by community-cohort in parentheses. * significant at 10%; ** at 5%; *** at 1%. Control variables included in all regressions : wealth, household head works in the formal sector, household head is farmer, ethnic, cohort and community dummies.

TABLE A.6: Control for a correlation between the school opening rate in the community and community-specific trends in education

| | Formal school | | | | | | | | Koranic school | | | | | | | |
| | Enrolled at least until : | | | | | | Last Grade | | Enrolled for at least : | | | | | | Nb. of years | |
| | Grade 1 (Probit) | | Grade 4 (Probit) | | Grade 7 (Probit) | | (OLS) | | 1 Year (Probit) | | 4 Years (Probit) | | 6 Years (Probit) | | (OLS) | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Rural boys** | | | | | | | | | | | | | | | | |
| Number of primary schools at age 8 | .123 (.047)*** | .076 (.049) | .152 (.051)*** | .12 (.053)** | .155 (.082)* | .136 (.083)* | 1.165 (.344)*** | .95 (.36)*** | -.06 (.072) | -.117 (.074) | -.186 (.063)*** | -.207 (.064)*** | -.196 (.098)** | -.212 (.101)** | -.548 (.358) | -.775 (.389)** |
| Community mean of (Number of primary schools at age 8) * age | | -.016 (.01)* | | -.012 (.009) | | -.011 (.01) | | -.092 (.062) | | -.029 (.01)*** | | -.013 (.011) | | -.009 (.011) | | -.1 (.059)* |
| Control variables, Cohort and community dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 662 | 662 | 720 | 720 | 666 | 666 | 720 | 720 | 681 | 681 | 695 | 695 | 544 | 544 | 709 | 709 |
| log-likelihood or $R^2$ | -306.201 | -305.06 | -362.228 | -361.523 | -337.982 | -337.411 | .276 | .278 | -385.856 | -382.445 | -320.872 | -320.133 | -195.408 | -194.978 | .254 | .257 |
| **Urban boys** | | | | | | | | | | | | | | | | |
| Number of secondary schools at age 10 | .062 (.033)* | .058 (.034)* | .071 (.023)*** | .069 (.023)*** | .031 (.034) | .035 (.034) | .372 (.214)* | .349 (.209)* | -.047 (.023)** | -.05 (.024)** | -.031 (.045) | -.041 (.044) | -.042 (.045) | -.048 (.047) | -.385 (.215)* | -.432 (.205)** |
| Community mean of (Number of secondary schools at age 10) * age | | -.0009 (.002) | | -.0005 (.002) | | .001 (.003) | | -.007 (.018) | | -.001 (.003) | | -.002 (.003) | | -.001 (.003) | | -.013 (.014) |
| Control variables, Cohort and community dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 655 | 655 | 704 | 704 | 755 | 755 | 755 | 755 | 701 | 701 | 667 | 667 | 556 | 556 | 701 | 701 |
| log-likelihood or $R^2$ | -179.252 | -179.158 | -254.768 | -254.749 | -415.173 | -415.12 | .28 | .28 | -392.495 | -392.446 | -352.098 | -351.796 | -222.234 | -222.178 | .199 | .2 |
| **Rural girls** | | | | | | | | | | | | | | | | |
| Number of primary schools at age 10 | .139 (.048)*** | .116 (.051)** | .069 (.042) | .085 (.053) | .067 (.04)* | .058 (.05) | .905 (.295)*** | .766 (.367)** | .041 (.046) | .008 (.064) | -.041 (.049) | -.062 (.052) | -.073 (.036)** | -.093 (.045)** | .039 (.241) | -.018 (.261) |
| Community mean of (Number of primary schools at age 10) * age | | -.007 (.009) | | .004 (.009) | | -.003 (.007) | | -.038 (.062) | | -.01 (.01) | | -.006 (.01) | | -.005 (.006) | | -.016 (.046) |
| Control variables, Cohort and community dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 684 | 684 | 710 | 710 | 541 | 541 | 712 | 712 | 689 | 689 | 487 | 487 | 404 | 404 | 691 | 691 |
| log-likelihood or $R^2$ | -324.465 | -324.218 | -337.422 | -337.313 | -181.435 | -181.375 | .414 | .414 | -352.14 | -351.694 | -209.552 | -209.426 | -94.484 | -94.289 | .247 | .248 |
| **Urban girls** | | | | | | | | | | | | | | | | |
| Number of secondary schools at age 12 | .027 (.02) | .031 (.022) | .042 (.023)* | .037 (.025) | -.036 (.03) | -.055 (.033)* | .131 (.225) | .124 (.255) | .002 (.032) | -.003 (.035) | .006 (.026) | .014 (.031) | .023 (.027) | -.004 (.044) | .046 (.178) | -.047 (.195) |
| Community mean of (Number of secondary schools at age 12) * age | | .0009 (.002) | | -.001 (.002) | | -.004 (.003) | | -.001 (.019) | | -.0009 (.003) | | .001 (.002) | | -.006 (.006) | | -.017 (.013) |
| Control variables, Cohort and community dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 712 | 712 | 772 | 772 | 772 | 772 | 772 | 772 | 730 | 730 | 687 | 687 | 401 | 401 | 730 | 730 |
| log-likelihood or $R^2$ | -249.811 | -249.702 | -340.547 | -340.448 | -405.54 | -404.735 | .296 | .296 | -433.217 | -433.168 | -275.449 | -275.33 | -112.108 | -110.946 | .19 | .191 |

Notes : Probit models (average marginal effects reported) and OLS. Dependent variables : see each column heading. Robust standard errors clustered by community-cohort in parentheses. * significant at 10% ; ** at 5% ; *** at 1%. Control variables included in all regressions : wealth, household head works in the formal sector, household head is farmer, ethnic, cohort and community dummies.

TABLE A.7: Robustness check : regressions with alternative definitions of $Nb\ Schools_{ca}$

| | Formal school | | | | Koranic school | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | Enrolled at least until : | | | Last | Enrolled for at least : | | | Nb. of |
| | Grade 1 (Probit) | Grade 4 (Probit) | Grade 7 (Probit) | Grade (OLS) | 1 Year (Probit) | 4 Years (Probit) | 6 Years (Probit) | years (OLS) |
| **Rural boys** | | | | | | | | |
| Number of primary schools at age 8 | .123 (.047)*** | .152 (.051)*** | .155 (.082)* | 1.165 (.344)*** | -.06 (.072) | -.108 (.065)* | -.196 (.098)** | -.548 (.358) |
| Control variables, Cohort and community dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 662 | 720 | 666 | 720 | 681 | 695 | 544 | 709 |
| log-likelihood or $R^2$ | -306.201 | -362.228 | -337.982 | .276 | -385.856 | -375.747 | -195.408 | .254 |
| Number of primary schools at age 4 | .096 (.047)** | .059 (.046) | .135 (.065)** | .837 (.318)*** | .089 (.061) | .031 (.067) | -.171 (.095)* | -.178 (.363) |
| Control variables, Cohort and community dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 662 | 720 | 666 | 720 | 681 | 695 | 544 | 709 |
| log-likelihood or $R^2$ | -307.334 | -364.765 | -338.468 | .273 | -385.5 | -376.75 | -196.67 | .251 |
| Average number of primary schools between age 4 and age 8 | .131 (.062)** | .103 (.073) | .255 (.119)** | 1.449 (.57)** | .03 (.084) | -.025 (.083) | -.37 (.166)** | -.344 (.389) |
| Control variables, Cohort and community dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 662 | 720 | 666 | 720 | 681 | 695 | 544 | 709 |
| log-likelihood or $R^2$ | -307.003 | -364.412 | -336.911 | .275 | -386.16 | -376.805 | -194.789 | .252 |
| **Urban boys** | | | | | | | | |
| Number of secondary schools at age 10 | .062 (.033)* | .071 (.023)*** | .031 (.034) | .372 (.214)* | -.047 (.023)** | -.079 (.019)*** | -.042 (.045) | -.385 (.215)* |
| Control variables, Cohort and community dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 655 | 704 | 755 | 755 | 701 | 701 | 556 | 701 |
| log-likelihood or $R^2$ | -179.252 | -254.768 | -415.173 | .28 | -392.495 | -406.303 | -222.234 | .199 |
| Number of secondary schools at age 13 | .037 (.02)* | .072 (.017)*** | .052 (.026)** | .487 (.195)** | -.003 (.022) | -.044 (.02)** | -.047 (.029) | -.255 (.181) |
| Control variables, Cohort and community dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 655 | 704 | 755 | 755 | 701 | 701 | 556 | 701 |
| log-likelihood or $R^2$ | -179.912 | -252.594 | -413.921 | .283 | -393.385 | -407.182 | -221.437 | .198 |
| Average number of secondary schools between age 10 and age 13 | .057 (.03)* | .087 (.025)*** | .051 (.035) | .541 (.234)** | -.017 (.027) | -.076 (.025)*** | -.054 (.051) | -.333 (.28) |
| Control variables, Cohort and community dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 655 | 704 | 755 | 755 | 701 | 701 | 556 | 701 |
| log-likelihood or $R^2$ | -179.581 | -253.83 | -414.681 | .282 | -393.292 | -406.539 | -221.781 | .198 |
| **Rural girls** | | | | | | | | |
| Number of primary schools at age 10 | .139 (.048)*** | .069 (.042) | .067 (.04)* | .905 (.295)*** | .041 (.046) | .025 (.047) | -.073 (.036)** | .039 (.241) |
| Control variables, Cohort and community dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 684 | 710 | 541 | 712 | 689 | 572 | 404 | 691 |
| log-likelihood or $R^2$ | -324.465 | -337.422 | -181.435 | .414 | -352.14 | -285.925 | -94.484 | .247 |
| Number of primary schools at age 11 | .085 (.046)* | .039 (.036) | .068 (.036)* | .662 (.262)** | .003 (.037) | -.01 (.038) | -.073 (.029)** | -.113 (.205) |
| Control variables, Cohort and community dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 684 | 710 | 541 | 712 | 689 | 572 | 404 | 691 |
| log-likelihood or $R^2$ | -325.816 | -337.99 | -181.019 | .412 | -352.421 | -286.012 | -93.853 | .248 |

Notes : Probit models (average marginal effects reported) and OLS. Dependent variables : see each column heading. Robust standard errors clustered by community-cohort in parentheses. * significant at 10% ; ** at 5% ; *** at 1%. Control variables included in all regressions : wealth, household head works in the formal sector, household head is farmer, ethnic, cohort and community dummies.