N m'a faamu[*]

Boosting Learning Through Bilingual Education: Evidence from Mali

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Abstract

Despite increased school enrollment across Sub-Saharan Africa, learning outcomes remain critically low, partly due to the persistent use of colonial languages as the primary medium of instruction. This paper evaluates the long-term impacts of Mali's 1999 national bilingual education reform, which introduced 11 local languages into the primary school curriculum as languages of instruction. Exploiting spatial variation in policy implementation and using a difference-in-differences approach with commune-level data, the study finds that exposure to bilingual education significantly improves local language literacy by 30% and French literacy by 10%—and increases school attendance by 5 percentage points. These gains are especially pronounced among women and in areas with lower student-teacher ratios. Contrary to concerns over national cohesion, the policy does not exacerbate ethnic tensions. The findings contribute to the literature on bilingual education, large-scale policy implementation, and the political economy of language in development, suggesting that integrating local languages into education systems can enhance human capital without undermining nation-building.

[*] "I don't understand" in Bamanakan

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1 Introduction

Learning outcomes in Sub-Saharan Africa (SSA) remain alarmingly low despite significant increases in school enrollment over recent decades (UNESCO, 2013). The 2018 PASEC assessment revealed that nearly 60% of students lacked fundamental mathematics and reading skills (PASEC, 2020).[1] This disconnect between educational access and actual learning highlights the multiple barriers impeding human capital development in the region. While recent research has primarily addressed supply-side constraints, including inadequate educational resources and teacher capacity (Bold et al., 2017; Glewwe and Muralidharan, 2016), less attention has been devoted to the critical role of the language of instruction in the quality of education.

The widespread use of non-native languages for instruction represents a significant yet understudied barrier to effective learning across SSA. As of 2022, eighteen African countries continue to use colonial languages as their official instructional medium beginning in the earliest grades (Col, 2024). The remaining countries have largely adopted bilingual education systems, where teachers initially deliver content in local languages while gradually transitioning to foreign languages, the colonial language, throughout the primary cycle. This progressive approach begins with instruction primarily in the vehicular languages before increasing the use of the foreign language until it becomes the exclusive medium of instruction by the end of primary school. A large literature in linguistics highlighted the benefits of learning in the mother tongue (Benson (2002) and Cummins (2000); see Rolstad, Mahoney, and Glass (2005) and Sakaryalı, Bal, and Yıldırım (2024) for meta-analysis reviews). Indeed, when the linguistic distance between a child's mother tongue and the foreign language used as the medium of instruction is significant, as is often the case in Africa, effective learning is hindered because a foundational understanding in a familiar language is essential for cognitive development (UNESCO, 2016). Only a few papers in economics have investigated this issue and causally estimated the effect of the language of education on learning and economic returns to years of education. In a randomized controlled study in Cameroon, (Laitin, Ramachandran, and Walter, 2019)

[1]14 countries were part of the last PASEC (*Programme d'Analyse des Systèmes Educatifs de la CONFEMEN*) evaluation, making it one of the largest international tests in SSA.

show that grades 1 and 3 students taught in the local language had more than one standard deviation better test scores in math and English. The same conclusions were drawn from two field experiments in South Africa (Mohohlwane et al., 2023). However, no study focuses on a bilingual education program at scale. The only policy extensively studied is the introduction of Oromo in the primary education system in Ethiopia, instead of Amharic (Ramachandran, 2017; Seid, 2016). They also found that mother tongue instruction increases school attendance, but they do not exploit a radical change from a colonial language to a local one.

This paper provides some of the first empirical evidence on the long-term effects of a national bilingual education policy on human capital accumulation. I exploit local variation in the implementation of Mali's 1999 linguistic education reform, leveraging granular commune-level data to estimate the causal of bilingual instruction on human capital accumulation. Mali is one of the last SSA countries where primary school enrollment is still insufficient. Learning levels are also extremely low with only 30% of the adult population literate in 2020. Until 1999, French was the only language of instruction in primary schools, despite a high linguistic diversity with 63 living languages, including 57 stable and institutionalized (Eberheard, Simons, and Fennig, 2025). In 1999, the Ministry of Education enforced a nationwide reform of the primary education system that introduced 11 national languages as medium of instruction. Previous experiments have well documented this reform.

Using school-level information on the languages used at school from the 2011 national census, I estimate the bilingual education supply at the commune level as the share of schools offering bilingual education (BE) over the total number of schools. Exploiting the local variation of this ratio at the commune level, I use a difference-in-difference strategy comparing birth cohorts in high-intensity BE communes to birth cohorts in low-intensity BE ones before and after the implementation of the reform. I rely on the 2018 LSMS survey to have an accurate and tested measure of human capital accumulation.

I find that individuals with greater exposure to the linguistic reform demonstrate a 10% higher likelihood of French literacy and 30% higher local language literacy in adulthood. School attendance also increases by 5 percentage points. I further show that changes in school supply do not drive these effects, and thus can be attributed to the BE aspects of the reform. I provide suggestive evidence that the positive effects are concentrated on women. Qualitative studies on the topic pinpoint that girls are less exposed to the official language before primary education (Benson, 2005; Hovens, 2002). Importantly, the effectiveness of bilingual education is significantly enhanced when combined with adequate educational resources, notably lower student-teacher ratios. These findings remain robust across alternative difference-in-differences specifications, including those that relax the treatment homogeneity assumption or account for treatment timing variations.

One of the main obstacles to introducing local languages in education is political will, as a large literature documented the association between linguistic fragmentation and underdevelopment (Alesina and La Ferrara, 2005; Laitin and Ramachandran, 2022). Using Afrobarometer data, I show that bilingual education in Mali did not harm the nation building process by exacerbating ethnic feelings.

This paper contributes to four strands of literature. First, it provides new empirical evidence on the learning benefits of bilingual education. While previous research demonstrates substantial returns to primary education in sub-Saharan Africa, particularly for women (Montenegro and Patrinos, 2014; Psacharopoulos and Patrinos, 2004), little is known about the effectiveness of alternative teaching approaches, such as bilingual education. This study takes an important first step by examining adult learning and schooling outcomes, suggesting avenues for future research on long-term wage effects. Additionally, it moves beyond simply measuring years of education by incorporating a quality dimension through its analysis of literacy in multiple languages.

Second, I contribute to the recent and growing literature evaluating policies at scale. Implementation is critical to understanding the differential impacts of education programs (Angrist and Meager, 2023). However, scaling up successful interventions remains challenging. Evidence on nationwide bilingual education policies shows mixed results due to implementation difficulties (Piper, Zuilkowski, and Ong'ele, 2016). This study adds to the literature by documenting evidence from a successfully scaled-up policy intervention.[2]

Third, I provide additional evidence on an understudied beneficial educational intervention. A recent meta-analysis finds that mother tongue instruction shows promising

[2]Part of this success can be explained in the importance of piloting that was put into the preparation of this reform (Ba, 2009).

results in controlled experimental settings (Evans and Mendez Acosta, 2021). Bilingual education should be considered alongside other educational resources (Glewwe and Muralidharan, 2016; Mbiti et al., 2019), as I show that effectiveness depends on maintaining appropriate student-teacher ratios. Further research is needed to identify other complementarities that may explain the success or failure of scaled bilingual education programs.

Finally, this paper fits into the nation building literature in Africa, by looking at a policy that promoted local languages.

This paper is organized as follows. In Section 2, I document the context surrounding the 1999 reform. Section 3 details the data used for the empirical analysis. Section 4 presents the conceptual framework. I explain the main empirical strategy in Section 5 and show the results in Section 6. Finally, I address the main concerns and perform additional robustness checks in Section 7.

2 Bilingual education and the 1999 reform in Mali

2.1 Historical background

There is a long-lasting history of bilingual education in the country that started right after the independence.[3] In 1960, experiments started using local languages to expand schooling for adults who did not attend school under colonial rule (UNESCO, 1963). Following positive results from these experiments, it expanded to primary education at the onset of the 1980s (Ba, 2009; Diarra, 2020).

The first pilots of bilingual education combining French and another local language in primary schools started in the late 1970's (see Section A.1 for more details). They expanded gradually from Segou to the other regions, and from the use of only Bamanankan to the introduction of other local languages in education. Even though the impact on test scores was limited to null (Maurer, 2007; Skattum, 2010; Traoré, 2001), these experiments provided crucial insights for policymakers during the 1999 expansion of the bilingual education program.

[3] During the colonization period, like any other country under the French administration, the official language of education and administration was French, and the use of the local languages in the schooling environment was severely punished (De Gaston, 2011).

2.2 The 1999 bilingual education reform

Expansion. In 1999, the Ministry of Education passed a law to scale up the bilingual education experiment to all public primary schools as an essential component of the PRODEC (*Programme Décennal de Développement de l'Education*), a countrywide educational reform aiming at expanding primary schooling coverage (Loua, 2017).[4] The bilingual education reform was implemented at the school level at the start of the 2001 school year. In similar contexts, demand has been shown to be one of the main obstacles in the expansion of bilingual education (Piper, Zuilkowski, and Ong'ele, 2016; Ramachandran and Rauh, 2022). However, because of the information campaign that took place in 1999, community demand was high at the onset of the reform.[5] In 2002, there were 2,110 bilingual classes, and 666 schools with at least one bilingual track throughout the country. The bilingual curriculum was available in 11 additional languages (Bamanankan, Songhay, Tamasheq, Soninke, Dogon, Fulfude, Bomu, Syenara, Mamara, Bozo, and Khassonke) and counted 121,734 enrolled students. After a rapid expansion in the early 2000s, the number of bilingual schools peaked at 2,530 in 2005, representing around one-third of the total number of schools. Since then, a lack of funding and political will yield to a stagnation and even decrease in this number for the most recent years. Nowadays, bilingual education has leveled out at around 25% of the primary schools.

Organization. Qualitative evidence points to a demand-led bottom-up process. To open a bilingual education track in a school, local leaders had to ask the local committee in charge of scaling up bilingual education. In collaboration with the community, this committee would choose the main language to be spoken in the bilingual class by the teachers and students as the language of instruction. Schools would receive textbooks in the selected language, and teachers would follow a short additional training course to deal with this new curriculum (20 days in theory) (MEN, 2003).

[4]The main objective of this reform was to build schools massively, starting from where it was most needed to the other places (African Development Bank Group, 2003). Consequently, school supply increased rapidly, from 2,600 schools in 1998 to almost 10,000 in 2008.

[5]To boost the demand for bilingual education, information sessions were organized at the district level, and short information messages were displayed through 34 local radios (MEN, 2003)

Implementation. Official reports document the mixed quality of the policy expansion. In practice, the vast majority of teachers received an additional training (Diarra, 2013a).[6] However, little is known about the quality of this training because Malian bilingual education expansion followed a very decentralized process (Ba, 2009). Reports also point to the long delay in the textbook provision (MEN, 2003), due to the long printing process.

Curriculum content. Bilingual education is a pedagogical approach that relies on knowledge of the familiar local language to ease the transition to the foreign language (Mohohlwane et al., 2023). In practice, students are expected to spend the first years of primary education learning the basics of writing and reading, as well as other subjects such as Mathematics, in the local vehicular language.[7] At the same time, teachers introduce French progressively to finish at the end of the primary cycle with French-only instruction. Table A.1 details the use of French and the local language for every grade as given in the official curriculum: during the first two years, the curriculum is mainly in the local language chosen. The next two years, French is gradually introduced, so that at the end of grade 4, half of the curriculum is taught in French and the other half in the local language. During the last two years preceding the secondary cycle, French becomes the dominant language. Officially, French remains the only language of instruction in the secondary cycle of primary education, as well as in secondary and tertiary education cycles.

3 Data

3.1 Roll-out of the bilingual education program

To document the progressive expansion of the bilingual education policy throughout the country after its first implementation in 2001, I exploit a census done in 2011 by linguistics experts on behalf of the Ministry of Education (Diarra, 2013b). This census covers all schools that were declared officially as "bilingual" at the 2011 school start and

[6] In 2000, 9 training centers were created. In 2001, 26 centers were operating with 3.775 teachers trained. In 2002, this number went up to 34 centers with 3.608 additional teachers trained (MEN, 2003)

[7] Figure A.1 shows an example of a textbook for grade 1 students, fully written in Bamanankan.

reports at the school level whether the bilingual curriculum is still used, or was abandoned for the French-only curriculum.[8] Out of the 3,784 bilingual schools that opened since 2001, 83% still had a bilingual education track in 2011.

Because of the civil war at the time of the data collection, the census took place only in the Bamako, Kayes, Koulikoro, Segou, and Sikasso regions, accounting for only one third of the Mali territory. Figure A.3 depicts visually this coverage. However, as 78% of the population lives in these regions, I argue that this census covers a large fraction of the school supply, reducing the external validity threat for this study (INSTAT-Mali, 2017).

Figure A.9 shows the evolution of the number of bilingual schools from 1994 to 2011.[9] Before the 2000s, the bilingual education supply was close to zero. After the official introduction of bilingual education in the curriculum in 2000, the proportion of bilingual schools progressively increased to reach 25% of all primary schools.

Qualitative evidence points that community schools were more likely than other schools to adopt the bilingual education curriculum (Diarra, 2020). These specific public primary schools are opened as a result of a community initiative; their number rapidly grew during the 1990s as a result to the low school supply. Using the name of the school in the 2011 census, I find that only 5% of the bilingual schools are community schools.[10]

3.2 Population census

School supply. Using census data from 1998 and 2009, I can construct a panel dataset on school supply at the commune level.[11] I use this information to create an indicator of exposure to bilingual education at the commune level: the ratio between the number of bilingual schools as officially listed in the bilingual education census, and the total number of schools.

[8] If the school still has a bilingual class, the census reports whether it is used for all grades or only the first ones.

[9] Table A.3 details which geographical level, information available, and source used for bilingual education supply for every year presented in Figure A.9.

[10] I consider a school as a community school if it is labeled as such in its name: with the words “"EC” or “communautaire”. Hence, this number is a lower bound of the true fraction of community schools among the bilingual education supply.

[11] I thank Flore Gubert for providing the panel dataset on the public infrastructures that were used in Chauvet et al. (2015)

Figure A.9 provides an overview of the evolution over time of the school supply: the number of schools improved rapidly during the 2000s. Indeed, one of the main objectives of the PRODEC was to build more schools to match the increasing demand. As shown in Figure A.23, the rapid expansion of school supply is not correlated with an increased provision of bilingual education at the village level. I address this issue and further discuss about this potential confounder in 7.1.

Commune characteristics. The main level of the analysis of this study is at the commune level.[12] Using the 2009 census data, I derive some characteristics of communes that I expect to be essential when analyzing the efficiency of bilingual education.

First, I compute a simple linguistic Herfindahl-Hirschman index using the number of speakers for every language at the commune level.[13] I also use the main language spoken in the community as a proxy for the language chosen to be the new language of instruction for the first grades.

Then, I measure the potential demand for education by taking the ratio of the number of children who are the right age to be enrolled in a primary school, i.e., those between 7 and 12, to the total number of schools at the commune level.

3.3 Human capital

Measurement of literacy. I am interested in the impact of bilingual education on human capital accumulation. I use literacy as a proxy for education quality. Literacy is a widespread but poorly measured indicator in many surveys as it is often overestimated. For instance, in the Demographic and Health Surveys (DHS) in developing countries, the respondent is automatically considered as literate after a certain point in education years, usually after the primary cycle (Sandefur, 2017). However, in many sub-Saharan countries,

[12]Information scarcity in the data does not allow me to perform the same analysis at the village level. Moreover, even if these data were to be available, the identification strategy would rely on a strong assumption, which is that people go to the school of their village, and do not go to a neighboring school. Substantial evidence shows that people are willing to go to other schools to match their preferences (Ramachandran and Rauh, 2022).

[13]The administrative system in Mali is decomposed as follows: a region is composed of a set of districts, a district includes different communes, and a commune aggregates various villages.

the Learning-Adjusted Years of Schooling (LAYS) indicates that literacy requires more than just finishing primary education when accounting for the quality of schooling (World Bank, 2024). Moreover, this indicator is still self-reported by respondents in many widely used surveys and censuses, which may be prone to other sources of bias. I use the 2018 Living Standards Measurement Study (LSMS) by the World Bank in 2018 to overcome this issue. Indeed, the LSMS survey provides an objective measure of literacy based on actual testing of writing and reading skills in French, the local vehicular language, and another language.

Other outcomes. Besides literacy, I also consider a broad set of educational outcomes: school attendance, completion of primary education, and whether the respondent has a primary school diploma.[14] I do not consider the number of school years as the linguistics literature documents two opposite mechanisms that could affect the time spent at school (Benson, 2002): bilingual education affects positively the retention rate of students, but it is also expected to decrease the repetition rate. Moreover, as the youngest birth cohort in my sample turned 15 in 2018, some may not have completed education at the time of the survey.

4 Theory of change

4.1 Primary hypotheses (PH)

PH1: Bilingual education increases learning. I expect to observe positive long-term effects of bilingual education on the accumulation of human capital, partly through better learning. The literature has shown in highly controlled and limited settings that learning in a familiar language increases literacy in both the local language and the foreign one (Benson, 2002; Cummins, 2000; Mohohlwane et al., 2023). Learning begins from the first moment of primary education, rather than being delayed until students develop proficiency in the language of instruction. Furthermore, past evidence points that bilingual

[14] In Mali, primary education starts at the age of 7 officially, for 6 years for the first primary cycle and 3 years for the second primary cycle. At the end of this first cycle, until 2010, students passed an exam called the *Certificat d'études primaires* (CEP) to pass to the second primary cycle.

education connects better writing and speech (Hovens, 2002).[15]

PH2: Bilingual education increases schooling. Bilingual education is expected to increase school attendance and, to some extent, the number of schooling years. Indeed, bilingual schools can attract students compared to monolingual ones when the language used at school is close to the home language (Ball et al., 2024). It also reduces the repetition rate and drop-out, leading to higher promotion rates (Patrinos and Velez, 2009).

4.2 Secondary hypotheses (SH)

SH1: Women benefit more from bilingual education. Past evidence shows that girls benefit more from bilingual education than boys (Benson, 2002; Hovens, 2002). The primary mechanism behind these positive results is that girls are less exposed to the foreign language than boys in the home environment (O'Gara and Kendall, 1996). Hence, by bridging the gap between the school place and the home place, bilingual education yields higher human capital accumulation for girls (Benson, 2005).

SH2: Areas more linguistically diverse are less prone to positive returns to bilingual education. Which language to choose is a key implementation challenge in the context of a nation-wide bilingual education policy (Piper, Zuilkowski, and Ong'ele, 2016). In the case of the 1999 Malian reform, the vehicular language that replaces French in schools is chosen among the 11 national languages, all documented. Figure A.2 gives a broad picture of the distance existing between these languages: 9 languages out of 11 are from the same language family. However, even if the linguistic distance between the official language spoken in the school and the mother tongue may be reduced (Laitin and Ramachandran, 2022), community members speaking a minority language that would not be picked as the new language of instruction would still face the same understanding challenge. Hence, I expect that in a very linguistically diverse area, using only one local

[15] Another advantage is linked to a particular linguistic feature of Sub-Saharan Africa: the spread of "mixed" languages, also known as *creoles* or *pidgins*, that take words or structures from different local and foreign languages (Calvet, 2010). Learning a second language through a familiar language reduces the risk of code-switching (i.e., using words from another language in the middle of a sentence), allowing the skill to transfer quickly from one language to the other (Cummins, 2000).

language at school might exclude more students than in a linguistically homogeneous area, reducing the aggregated benefits of bilingual education.

SH3: Returns to bilingual education are higher in rural areas. Related to the previous hypothesis, I expect to see higher benefits of bilingual education in rural areas, as these are less linguistically diverse than cities. Urban areas concentrate different ethnolinguistic groups speaking different languages, where French can act as a *lingua franca* (Calvet, 2010).

5 Empirical strategy

5.1 Identification strategy

Difference-in-difference. I leverage the introduction of the reform at the 2000 school start and the heterogeneity in the coverage of bilingual education throughout the country to assess its impact on long-term educational outcomes. Using the year of birth of adult individuals assessed in the LSMS, I can infer when they started school. In that aspect, if they first went to school prior to the 2000 school year, it is unlikely that they were exposed to bilingual education (Figure A.9). The average age at school entry being 6.6 in the LSMS sample, I consider that individuals born in 1993 and before went only to monolingual schools (i.e., with French-only education). To avoid capturing other reforms' effects, I restrict the sample to 10 years around the reform implementation, namely individuals born from 1983 to 2003 aged 15 to 35 in 2018. Then, for each LSMS cluster, I map the supply of bilingual education using the 2011 census data on bilingual schools and 2009 census on school supply, and obtain a panel data set at the enumeration area level with the year of birth as the key time dimension.

Treatment definition. I define exposure to bilingual education (BE) at the commune c level as follows:

$$\text{Share of BE}_c = \frac{\text{Number of Bilingual Schools}_c}{\text{Number of Schools}_c}$$

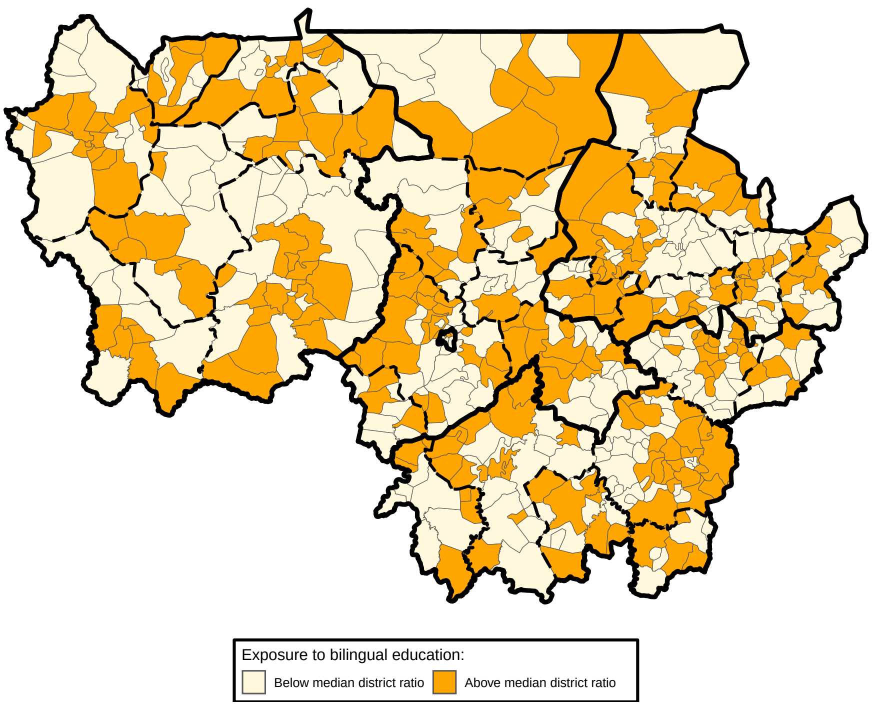
I include in the numerator all schools officially declared as bilingual education schools in the 2011 census, and in the denominator the school supply as given by the 2009 census.[16] By definition, the exposure measure is bounded between 0 and 1.[17]

Figure A.4 shows the share of bilingual schools among the total school supply at the commune level, along with the LSMS cluster localization. Bilingual education provision is not random, and follows a clear geographical pattern, with some districts and regions concentrating most of the bilingual education supply. Looking at the linguistic areas depicted in Figure A.5, I observe that the supply of bilingual education is high in locations where Bamanankan is the main language. As a result, I cannot use the national median exposure to bilingual education, i.e. the fraction of bilingual schools in the total school supply, as a threshold to categorize communes into low vs. high intensity, mimicking the design used in Duflo (2001). Instead, I use the median ratio of bilingual schools over the total number of schools within each district as a threshold and consider a commune with a ratio below this median as a low-exposed area. Similarly, I consider a commune with a fraction of bilingual education higher than the district median as highly exposed to bilingual education. Figure 1 displays the geographical coverage of the binary treatment.

Sample selection. One concern about the sample considered is that migration already took place at the time of the survey. In 2011, migration, both internal and external, was estimated to affect almost 20% of the population (Sougane, 2014). It may impact my empirical specification in two ways. First, I do not observe migrant who left the locality to live abroad. However, if anything, this should yield to a downward bias in the results: if bilingual education enhances learning skills particularly in French, then individuals who benefited significantly from the bilingual curriculum leveraged these new skills to migrate before the LSMS survey took place. Hence, the estimated effect would be a lower bound of the true effect of bilingual education. Second, I may attribute wrongly a high exposure to bilingual education to an individual who migrated after its childhood. The level at which

[16] I further consider the fraction of schools that dropped out of the bilingual curriculum in the section 7.2.

[17] Because the school supply is measured through the population census that took place 2 years prior to the 2011 bilingual education census, some ratios exceeded 1 for a few communes. For these communes, I bounded the ratio to 1.



Notes: Solid black lines represent the regional borders, dashed black lines represent the district borders, and gray lines represent the communal borders. The two colors indicate the treatment status at the commune level, as defined in Subsection 5.1. This figure maps only the following regions that are considered in the empirical analysis: Bamako, Kayes, Koulikoro, Segou, and Sikasso.

Figure 1: Map of the treatment status by commune

the analysis is done reduced this threat: 98.8% of individuals in the sample report to be born in the same commune.

5.2 Empirical specification

Two Way Fixed-Effects (TWFE). By leveraging the reform implementation timing and the differential exposure to bilingual education, I estimate the following regression:

$$Y_{i,y,c,d} = \alpha_1 \mathbb{1}[\text{y} \geq 1994]_{i,c,d} + \alpha_2 \mathbb{1}[\text{c} \in \text{BS}]_{i,c} + \beta \mathbb{1}[\text{y} \geq 1994]_{i,c,d} \times \mathbb{1}[\text{c} \in \text{BS}]_{i,c} + \theta_d + u_{i,y,c,d} \tag{1}$$

$Y_{i,y,c,d}$ is the outcome for individual i, born in year y, living in the commune c located in the district d. BS represents the set of communes considered as highly exposed to bilingual education relative to the median district ratio of bilingual schools. α_1 captures the effects of being born after 1994, i.e., starting school after the implementation of the bilingual education reform. α_2 isolates the differences in the outcome that might exist between communes with a high share of bilingual schools compared to communes with a low share. The coefficient of interest is β, which captures the effect of being highly exposed to bilingual education (BE) compared to low exposure after the reform. I use district-fixed effects θ_d to control for district unobservable characteristics and differences in bilingual education supply (Figure A.4). I use the LSMS cluster provided in the survey to cluster standard errors, and I use household weights also present in the survey.[18]

Testing key assumptions. Following the difference-in-difference literature, I test for the parallel trends (PT) and the no anticipation (NA) assumptions using an event study. To do so, I estimate the following regression:

$$Y_{i,y,c,d} = \sum_{t=1983}^{2003} \alpha_{1,t} \mathbb{1}[t = y_{i,c,d}] + \alpha_2 \mathbb{1}[\text{c} \in \text{BS}]_{i,c} + \sum_{t=1983}^{2003} \beta_t \mathbb{1}[t = y_{i,c,d}] \times \mathbb{1}[\text{c} \in \text{BS}]_{i,c} + \theta_d + u_{i,y,c,d} \tag{2}$$

The same definitions as in Equation (1) apply. t represents the year of birth and covers the period considered in this analysis, i.e. from 1983 to 2003. I allow the coefficient β_t

[18] Given that a commune is roughly equal to one LSMS cluster (except for Bamako), and that Bamako represents 60 clusters out of 325, I prefer using the LSMS cluster level rather than the commune level for clustering.

to vary in the pre and post-treatment period according to the year of birth y. I also implement multiple robustness tests in Section 7 to reinforce the credibility aspect of the PT and NA assumptions.

An additional key assumption made in the specification is the homogeneity of the treatment effect. This assumption is likely not to hold, as the treatment at the commune level is relative to a median value at the district level. In other words, I assign commune A in district 1, where 70% of schools are bilingual, to the low-exposure bilingual education group, while commune B in district 2, where only 20% of schools officially use local languages for instruction, is assigned to the high-exposure bilingual education group. This apparent contradiction occurs because the median ratio of bilingual education supply is 75% in district 1 but only 15% in district 2. I employ different strategies to show that this is unlikely to bias my estimate. First, I control for this by adding a fixed effect at the district level in Equation 1. Second, I test for treatment effect homogeneity by decomposing the impact of bilingual education according to the reference bilingual education supply at the district level. Finally, I exclude from the sample communes close to the district median, and check for any variation in the results. Both tests are presented in Section 6.4.

Another key assumption is that all units were treated at the same time in 2001. I release this assumption in Section 7.3 using data on bilingual education at the district level from 1994 to 2011 and robust imputation estimators from Borusyak, Jaravel, and Spiess (2024).

5.3 Descriptive statistics

Table A.4 describes the main outcomes for the sample, at the individual and the commune level. The sample contains 8.636 individuals, with half women and half urban. Less than 50% of the sample attended school, and the same fraction is literate in French (either writing or reading). Finally, only one individual out of 10 can write or read in the local language. Table A.5 gives additional insights about the significant differences between the sample of communes less exposed to bilingual education compared to communes highly exposed to it.

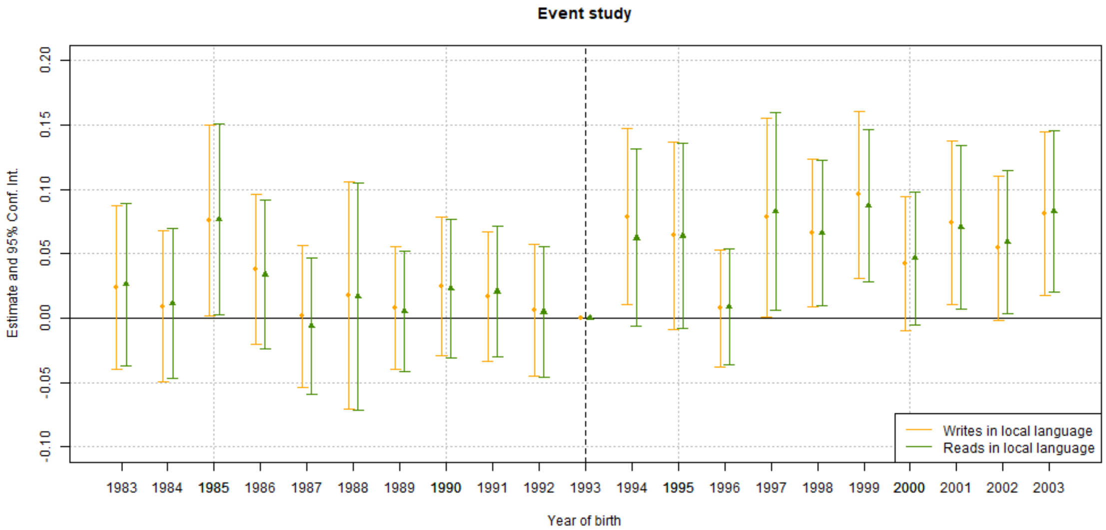
6 Results

6.1 Human capital accumulation (PH)

Learning. Figure 2 plots estimated coefficients from Equation 2 explaining BE effects on learning outcomes in the local language. It seems that introducing officially local languages in education has a significant, positive, and persistent impact on writing and reading in the vehicular language. Table 1 shows the TWFE results of estimating Equation 1: adults who had access to more bilingual schools when they were children are 4 percentage points (pp) more likely to be literate (both writing and reading) in their local language (Columns 1 and 2). Given that only 12% of the sample is literate in the local language, being more exposed to bilingual education increases learning by more than 30%. These first sets of results can be seen as a first stage: even if it is likely that teachers have already used local languages prior to their introduction in the curricula in 1999, its official enactment increased their use in the schooling environment, boosting literacy in the local language.

Figure A.10 shows that these skills in the local languages partially transferred to French for the exposed students. This linguistic mechanism has been documented by Cummins (2000). Columns 3 and 4 of Table 1 provide additional evidence on it: on average, the literacy skills increased by 5pp (i.e., a 10% increase of the literacy rate), both in writing and reading, with the introduction of the bilingual education reform. These results are less significant and smaller in magnitude than those for the local language. A potential explanation is that it is likely that some skills were not fully transferred from one language to the other because the children stayed at school for only 4 years.

In addition to literacy in the two languages, LSMS data provide the most appropriate variable for a placebo test: literacy skills in a language that is neither French nor the main language of the community. Indeed, introducing bilingual education should not affect this outcome at all, as this language is likely not to be used at all in bilingual schools in this area. Figure A.12 shows the event-study estimate and provides additional evidence supporting the identification strategy, as I do not observe any change in writing and reading skills after introducing bilingual education.



Notes: Point estimates and 95% confidence intervals are derived from an event study regression over the 1983-2003 birth cohorts from which I extracted only the estimates of the interaction terms. I use district fixed effects to capture variation in the median of bilingual education share across districts. To obtain these estimates, I perform two distinct regressions: one with whether the individual knows how to write in the local language as the dependent variable (in orange), and one with whether the individual knows how to read in the local language as the dependent variable (in green). I cluster the standard errors at the LSMS cluster level, which corresponds roughly to the commune level. Individuals born in 1993 are the last birth cohort to be taught entirely in French (i.e., not treated) represented by a black vertical dashed line.

Figure 2: Event study regression for literacy in the local language

Language tested	Local language		French	
Dependent Variables:	Writing	Reading	Writing	Reading
Model:	(1)	(2)	(3)	(4)
Variables				
Born after 1994	0.008	0.007	0.138***	0.137***
	(0.012)	(0.011)	(0.020)	(0.020)
High exposed commune	0.023	0.022	0.034	0.032
	(0.015)	(0.015)	(0.037)	(0.037)
Born after 1994 × High exposed commune	0.039**	0.039**	0.055*	0.054*
	(0.018)	(0.017)	(0.028)	(0.028)
Fixed-effects				
District FE	Yes	Yes	Yes	Yes
Fit statistics				
Mean of Y	0.123	0.118	0.489	0.484
Observations	8,636	8,623	8,636	8,633
R^2	0.04228	0.04123	0.15238	0.14913

Clustered (LSMS cluster) standard-errors in parentheses

*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Notes: All dependent variables are binary outcomes. The model estimated is a linear regression. The level of analysis is at the individual level, i.e. one observation is one person. The differences in the number of observations is related to missingness of the outcome of interest in the raw LSMS data. I use the weights given in the LSMS data, and cluster the standard errors at the enumeration area. Clustering at the treatment level, i.e. the commune, produces the same results.

Table 1: TWFE results on learning outcomes

Schooling. Introducing familiar languages to students makes school more attractive: as shown in the Column 1 of Table A.6, school attendance increased by 12% for cohorts that got access to more bilingual schools (+ 6pp). They are also more likely to have a primary-education diploma, suggesting that the duration of schooling could also be affected. However, I do not see any impact on the completion rate at the end of the primary education cycle. This result is aligned with the linguistics literature, which shows that reducing the linguistic distance between the home and the school environment incentivizes more parents to send their children to schools (Benson, 2004).

The pre-trend coefficients for all the outcomes are small and jointly non-different from zero (see Figures 2, A.10 and A.11). All these pieces of evidence prove that the assumption of parallel trends between communes that were more and less exposed to bilingual education once the reform was set holds.

6.2 Gender differentiation (SH)

Previous findings document that girls benefit more from bilingual education than boys, because they are less exposed to the colonial language in their early childhood (Benson, 2005). Figure 3 shows heterogeneity results by sex and provides evidence supporting this qualitative result. Women who had more access to bilingual schools as children are 8pp more likely to be literate in French and attend school. They are also 6pp more likely to complete primary education and get a diploma. Relative to the sample mean, it represents respectively an increase of 15% in the probability of being literate in French and attending school, and 20% in completing the first education cycle. In comparison, boys do not get any returns from introducing education in a familiar language. Figure A.13 displays graphically how girls catch up on boys thanks to bilingual education. While both girls and boys display similar levels of local language literacy, boys are still better off learning French even after introducing these local languages in primary schools.

Another difference related to gender can be observed at the parental level: whether the mother is educated or not matters a lot for the efficiency of the new bilingual curriculum (see Figure A.14). The mechanism at play relates to the fact that mothers have been shown to invest more in their daughters' human capital compared to fathers (Dizon-Ross and Jayachandran, 2023).[19] With a bilingual curriculum, they seem to be even more invested as they are more familiar with the language now spoken at school and in the textbooks. This is quite a novel result as the interaction between mother investment and bilingual education has not yet been documented in the literature.

6.3 Urban/rural status (SH)

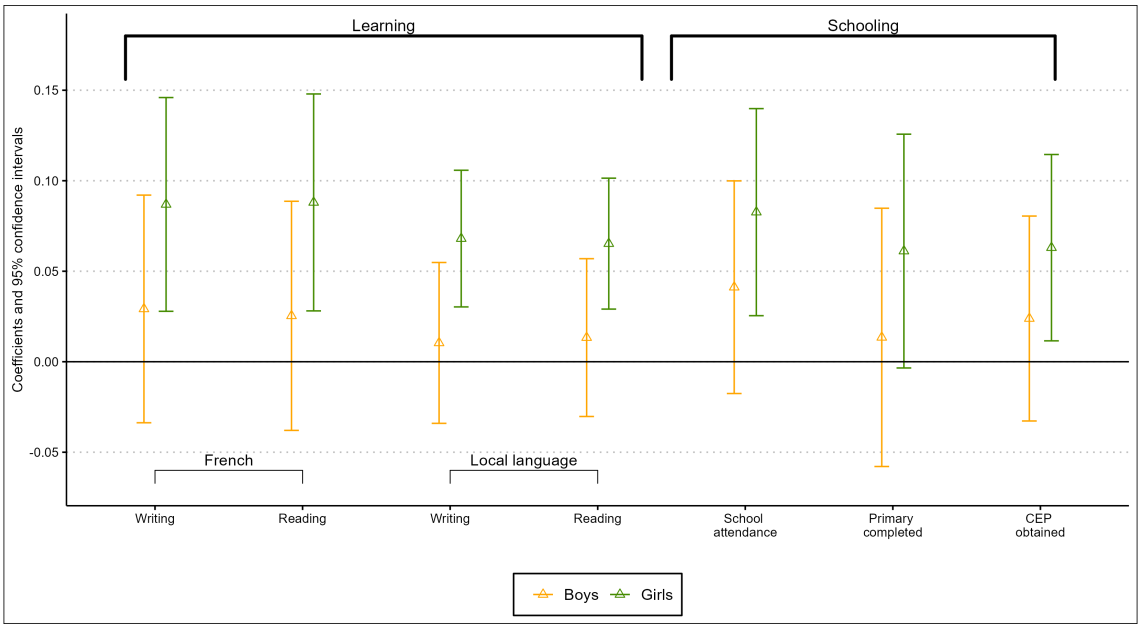
Linguistic diversity. Following the theory of change detailed in Section 4.2, I expect that the impact of bilingual education is proportional to the people it targets, i.e., the share of students speaking the local language chosen to the new language of instruction. I look at this by dividing the sample into quartiles of linguistic diversity at the commune level. [20]. Empirical results in Figure A.16 do not present a straightforward picture. Looking at the size of the main linguistic group leads to the same results Reynal-Querol (2002): linguistic diversity does not seem to matter when explaining the differential impacts of the reform.

The choice of language might still be important regardless of the linguistic diversity of the community. In particular, as shown in Figure A.5, Bamanankan is the mother tongue of 4,000,000 speakers in Mali, and the second language of a further 10,000,000, acting as a lingua franca between the different linguistic communities. However, Figure A.17 shows that areas with Bamanankan-dominant speakers do not drive the positive impacts of bilingual education. Therefore, neither the diversity nor the dominant language seems to be a key feature for a successful bilingual education curriculum.

Urbanization. I also explore whether rural households benefit more from introducing local languages, as hypothesized in Section 4.2. I do not observe in Figure A.18 any differential effect for schooling and learning skills in the official language; even if literacy in the local languages seems to increase more in urban areas, the coefficients are not statistically different from each other.

[19] Results for father's education are shown in Figure A.15 and points that educated fathers are not key actors in the bilingual education curriculum implementation.

[20] Linguistic diversity is computed as the Herfindahl-Hirschman index, using the fraction (s) of speakers of all mother tongues reported in the 2009 census: $1 - \sum s^2$.



Notes: Point estimates and 95% confidence intervals are derived from a TWFE linear regression on several outcomes: (1) and (2) are writing and reading literacy in French, (3) and (4) in the local language, and (5) (6) and (7) are school achievements indicators. I use district fixed effects to capture the fact that the median of bilingual education share varies across districts. I cluster at the LSMS cluster level, which corresponds roughly to the village level. To obtain heterogeneous effects, I interact the DiD coefficient in Equation 1 with sex.

Figure 3: TWFE coefficient estimates of bilingual education effects, by sex

I refine the definition of urbanization by looking at road access instead of city areas as defined in the LSMS survey. Exploiting road maps from Müller-Crepon (2023) and Müller-Crepon, Hunziker, and Cederman (2021), I look at the cluster's distance from the closest road as they were built in 2000, and use a 10-kilometer cutoff (see Figure A.6).[21] Heterogeneity results are shown in Figure A.19. Unexpectedly, positive impacts of using local languages of instruction on education are concentrated in areas with better road access. These findings invalidate the assumption made in Section 6.2: bilingual education is not a policy feature for rural areas only.

6.4 Relaxing the homogeneous treatment effect assumption

In recent years, the difference-in-differences estimation strategy has garnered significant attention, leading to substantial methodological advancements through the development of various estimators (see Callaway and Sant'Anna (2021) and Chaisemartin and D'Haultfœuille (2022) for a non-exhaustive survey of the recent literature). In particular, these papers have shown that an important underlying assumption regarding the validity of the TWFE estimator is treatment effect homogeneity. Given the nature of the treatment under consideration, this assumption is unlikely to hold.

One of the main recent updates in the difference-in-difference literature relates to continuous treatment definition, instead of relying on a binary measure (Callaway, Goodman-Bacon, and Sant'Anna, 2024). Because of the spatial correlation of the share of bilingual education, using this estimator is not recommended.[22] Indeed, comparing different levels of bilingual education provision would capture just a geographical area fixed effect, as shown in Figure A.7.

Another way to test this assumption is to look at heterogeneity according to the median share of bilingual schools at the district level, used as a reference point to create the binary treatment detailed in Section 5. I divide my sample in quintiles of this ratio and show the

[21] Urban status and whether the cluster is located within a 10-kilometer distance from a road are positively and significantly correlated, with a correlation coefficient of 0.47 (and a standard error of 0.05). Additionally, the bilingual education treatment variable is not correlated with better road access.

[22] The same conclusion applies when considering using bins of treatment. This econometric strategy relies on the assumption that within bins (i.e. categories of bilingual education supply in which every commune receive a close amount of treatment), the treatment effect is homogeneous.

results in Figure A.20 for all outcomes. The first result is that for all quintiles of median BE provision, the treatment effect is either null or positive. The second result is that the positive impact of bilingual education seems to be concentrated in the middle quintiles (in which the reference point varies between 15 and 75% of bilingual schools). This can be easily understood: outside of these boundary ratios, the share of bilingual schools is either low or too high to represent a credible alternative option to French-only schools. In the first case, students are faced with an education market overwhelmingly dominated by monolingual education, while in the second case, the market is largely dominated with bilingual education.

Then, I test an alternative treatment definition: instead of using the median ratio of bilingual schools at the district level, I take the median at the regional level. Similarly, I use region fixed-effects instead of district fixed-effects. I see in Table A.8 that the coefficients do not vary much from Tables 1 and A.6. The standard errors are predictably larger due to reduced precision in the estimation strategy. The main discrepancy from the previous results is about the literacy skills in the local languages, suggesting that the TWFE might overestimate impact of bilingual education provision on literacy in the local language.

Finally, I take into account the continuum of bilingual education supply by looking at how far the commune is from the district median, i.e., the cutoff point. Indeed, comparing communes well below the median and communes well above the median should provide more striking results than communes that are close to the cutoff point. To test for this hypothesis, I exclude from my sample all the communes within 10 percentage points from the median point.[23] Results are presented in Table A.9. As expected, I find stronger results for this subsample. For the subsample of communes where the bilingual education supply is close to the district median, I find no significant effects and smaller coefficients. This suggests that provision of bilingual education in these areas is less significantly different between the treatment and control group (i.e., respectively, communes above and below the district median of bilingual education supply).

[23]It corresponds roughly to the 25th and the 75th percentile of the distribution of the bilingual education supply at the commune level.

7 Robustness checks

7.1 School construction

The main objective of the PRODEC reform was to increase school supply by massively building schools. Figure A.8 maps the growth rate of the school supply at the commune level: the building effort was widespread across the Southern regions of Mali, and did not target one specific area.

Expansion of school supply can be a confounder of the impact of bilingual education, as the 1999 reform included both components. I test for this hypothesis first by looking at the correlation between bilingual education supply and the growth rate of school supply in Figure A.23. I do not find any evidence that communes where more schools were built during this period were also communes with more bilingual schools.[24] Second, I examine the differential effects of bilingual education intensity across communes with varying exposure to school construction programs. I find that introducing a bilingual curriculum was effective where less schools were built during the first decade of the 2000s (Figure A.22). This evidence suggests that the two components of Mali's 1999 education reform—bilingual curriculum and school construction—were implemented independently across different regions of the country.

7.2 School characteristics

Continuity in the bilingual education curriculum. Leveraging data on bilingual status from the 2011 school census, I identify schools that maintained local language instruction to estimate the differential impacts of the reform along this dimension. In communes where schools rapidly abandoned the bilingual curriculum after initial implementation, the expected effects would be minimal or absent. This outcome is predictable because if schools quickly reverted from bilingual to French-only instruction, no birth cohort would have experienced full exposure to bilingual education throughout all primary grades as originally intended.

Figure A.25 presents a comparative analysis of bilingual education effects between

[24] A formal t-test between the treatment variable and the growth rate of the school supply gives the same results, with a correlation coefficient of -0.0094 (p-value: 0.0097).

communes where at least one school abandoned the bilingual program and those where schools maintained the language reform implementation.[25] Of the 167 communes analyzed, 100 experienced at least partial reversion from bilingual to monolingual (French-only) instruction in their schools. As hypothesized, positive learning and schooling outcomes are concentrated in areas with a continuous implementation of the linguistic education reform.

Number of students per school. Using 2011 administrative data on student enrollment and teacher staffing per district, I examine how classroom conditions influence reform outcomes. Table A.26 shows that the benefits of bilingual education are concentrated in communes with lower student-teacher ratios. This finding suggests that the effectiveness of bilingual instruction may depend significantly on classroom resources and teacher capacity.

7.3 Staggered analysis

District-level data on bilingual education expansion (see Table A.3) enables a staggered difference-in-difference analysis using the Borusyak, Jaravel, and Spiess (2024) imputation estimator.[26] I define treatment year as when a district exceeds its median share of bilingual education over the years, creating time variation from 1994 to 2005. Figure A.24 shows writing skills outcomes at the district level (n=28), which yields less precise estimates than the commune-level analysis (n=167). Despite this limitation, results confirm two key findings: parallel trends hold in the pre-treatment period, and bilingual education positively impacts writing skills in both French and local languages (significant at 10%), with stronger effects in local languages.[27] As expected, effect sizes are smaller than in the TWFE commune-level analysis due to reduced precision in identifying affected popu-

[25] The median switching rate at the potential cutoff point is zero, making the intensive and extensive margin analyses equivalent in this context.

[26] Following the procedure suggested in Roth et al. (2023), I prefer the imputation estimator over the Callaway and Sant'Anna (2021) as event studies displayed in Figures A.10, 2 and A.11 show that we should not worry about violation of the parallel trends assumption, and I do not expect important serial correlation between birth cohorts.

[27] Results hold for the writing skills in the local language when I take a 95% confidence interval.

lations.

7.4 Other robustness tests

Communes far from the median.

Migration. I further investigate whether bilingual education had differential effects based on individuals' migration history. Figure A.27 shows that only non-migrants experienced significant benefits from bilingual education. Those who had previously migrated showed no measurable improvements in literacy outcomes following the reform. This finding suggests that educational continuity and consistent exposure to the bilingual program may be critical factors in its effectiveness, with disruptions caused by migration potentially limiting the reform's impact.

Restrict the sample to villages far from the communal borders. Nearly half of all communes are located within 2km of neighboring commune boundaries.[28] Residents in these border areas could potentially enroll their children in schools across commune lines. When analyzing only communes situated at least 2km from borders, as shown in Table A.12, the coefficients are not significant anymore because of a loss of statistical power, but extremely close to what I find in Tables 1 and A.6, strengthening the original findings.

No effect on the no-school subsample. Mali remains one of sub-Saharan Africa's countries with significant schooling challenges, with half the sample never attending school. As expected, Figure A.28 confirms the bilingual education reform had no effect on literacy skills among non-attendees.

Potential confounders. I also examine potential confounders that could affect the treatment variables. Specifically, I assess whether bilingual education influences (i) migration patterns or (ii) school entry age. If bilingual education fosters migration, my sample

[28] I take the Euclidean distance between the LSMS cluster and the border of the closest commune as my main measure of distance. I do not consider the random displacement of GPS points in my analysis as a limitation, as the random offset procedure ensures that the enumeration area stays within the lowest administrative unit (Michler et al., 2022).

would be highly selective. Likewise, if it encourages earlier school enrollment, comparing individuals by birth year would become problematic. Table A.13 provide suggestive evidence that is unlikely to be the case. Indeed, there is no correlation between treatment assignment and either (i) birthplace in the commune or (ii) age at school entry among those who attended school.

8 Policy implications: at what cost?

8.1 Political costs

Language unification has been shown to be a key component in nation-building (Blanc and Kubo, 2023; Clots-Figueras and Masella, 2013). Consequently, one main obstacle to introducing local languages in education is political will from policymakers. The fear is that by promoting local languages at school, bilingual education policy would increase ethnic salience and threaten the national identity.

Using the last survey rounds from Afrobarometer survey (2018 and 2020), I give the first estimation of this political cost on nation-building. To do so, I retrieve for every enumeration area provided in the dataset its commune, and assign a treatment status according to the share of bilingual education in this area. A few questions in the Afrobarometer relate to ethnic identity, nation-building, and language. In particular, I look at two dimensions: salience of ethnicity and cultural practices. For the first outcome, I use two questions: (1) salience of ethnicity over national identity, and (2) preference for a neighbor from another ethnic group.[29] For the second outcome, I look at whether the respondent feels comfortable (1) wearing traditional clothes, and (2) speaking her mother tongue.

I estimate the same equation 1 and find evidence supporting that bilingual education does not harm nation-building. Regression results can be found in A.10. Figure A.21 displays the same results, relative to the outcome mean. Due to age and location restrictions, the sample size is significantly reduced, increasing the magnitude of any detectable

[29]For interpretation purposes, I dichotomize these two outcomes. Details about the dichotomization are given in the notes of Figure A.21 or Table A.10.

effect.[30] However, the global picture is clear: introducing local languages in education in Mali did not give rise to a strong political ethnic sentiment. It even increased by 10pp the probability the respondent chose national over ethnic identity. However, the nation-building process did not come at a cost of invisibilizing the different ethnic groups, as seen in the results on cultural practices.

The closest study to this topic finds that bilingual education (Catalan and Spanish) in Catalonia increased the Catalan feeling (Clots-Figueras and Masella, 2013), and no other study focuses on SSA. Hence, these preliminary findings shed light on other mechanisms that could be at play in SSA, limiting the diffusion of ethnic sentiment.

8.2 Cost analysis

Finally, I benchmark the estimated cost per student of bilingual education at scale in the case of Mali. To do so, I use World Bank reports to assess the implementation costs and get information on the target population (World Bank, 2000).[31] From the 1998 census, I infer that one-fourth of the primary school supply is affected by the reform at its onset in the early 2000s, representing roughly 350.000 students.[32] The estimated cost per targeted student is then \$10.6, well below the average cost of \$17.97 or the most effective interventions in SSA, in the recent review done by Angrist et al. (2023).

9 Conclusion

More and more African countries use local languages instead of colonial language as the main medium of primary education instruction. However, the literature on such at-scale policies is still scarce.

This paper estimates returns to bilingual education in Mali using implementation data

[30] As for the LSMS sample, I restricted the Afrobarometer sample 10 years around the reform. Also, because of the availability of data on bilingual schools, I only consider Southern Mali in this analysis.

[31] The total costs cover production and distribution of textbooks and teaching materials, the training of teachers, school principals, inspectors, and educational advisors, and the evaluation of students' and teachers' academic performance (\$3.55 million). This cost is estimated for 400 bilingual schools.

[32] I use the number of children between 7 and 12 from 2000 to 2002, as they are explicitly the targeted population in the report, i.e., individuals born between 1988 and 1995 in the 2009 census.

on current bilingual education. The impacts are high, both in terms of learning and schooling. Girls are the ones who benefit the most from these additional new languages of instructions.

These results have strong policy implications. In particular, they indicate that some requirements are needed for bilingual education to be efficient. Further research is needed to understand the complementarity between basic school inputs and bilingual curricula which would provide policymakers with more precise estimates of bilingual education's benefits under various implementation contexts.

References

African Development Bank Group (2003). *Projet D'appui au Programme Decennal de Developpement de l'Education (Education IV)*. Tech. rep.

Alesina, Alberto and Eliana La Ferrara (Sept. 2005). "Ethnic Diversity and Economic Performance". en. In: *Journal of Economic Literature* 43.3, pp. 762–800. DOI: 10.1257/002205105774431243.

Angrist, Noam and Rachael Meager (2023). "Implementation Matters: Generalizing Treatment Effects in Education". en. In: *SSRN Electronic Journal*. DOI: 10.2139/ssrn.4487496.

Angrist, Noam et al. (2023). "Improving Learning in Low- and Lower-Middle-Income Countries". en. In: *Journal of Benefit-Cost Analysis* 14.S1, pp. 55–80. DOI: 10.1017/bca.2023.26.

Ba, Oumar Issiaka (2009). *Une histoire de l'enseignement au Mali - Entre réforme et réticences*. L'Harmattan. La Sahélienne.

Ball, Mary-Claire et al. (July 2024). "Effective bilingual education in Francophone West Africa: constraints and possibilities". en. In: *International Journal of Bilingual Education and Bilingualism* 27.6, pp. 821–835. DOI: 10.1080/13670050.2023.2290482.

Benson, Carol (Apr. 2004). "Do We Expect Too Much of Bilingual Teachers? Bilingual Teaching in Developing Countries". en. In: *International Journal of Bilingual Education and Bilingualism* 7.2-3, pp. 204–221. DOI: 10.1080/13670050408667809.

— (2005). *Girls, educational equity and mother tongue-based teaching*. Tech. rep. UNESCO Office Bangkok, Regional Bureau for Education in Asia, and the Pacific.

Benson, Carolyn J. (Dec. 2002). "Real and Potential Benefits of Bilingual Programmes in Developing Countries". In: *International Journal of Bilingual Education and Bilingualism* 5.6. Publisher: Routledge _eprint: https://doi.org/10.1080/13670050208667764, pp. 303–317. DOI: 10.1080/13670050208667764.

Blanc, Guillaume and Masahiro Kubo (2023). "French". en. In: *SSRN Electronic Journal*. DOI: 10.2139/ssrn.4636225.

Bold, Tessa et al. (Nov. 2017). "Enrollment without Learning: Teacher Effort, Knowledge, and Skill in Primary Schools in Africa". en. In: *Journal of Economic Perspectives* 31.4, pp. 185–204. DOI: 10.1257/jep.31.4.185.

Borusyak, Kirill, Xavier Jaravel, and Jann Spiess (Jan. 2024). "Revisiting Event Study Designs: Robust and Efficient Estimation". en. In: *Papers*. Number: 2108.12419 Publisher: arXiv.org.

Callaway, Brantly, Andrew Goodman-Bacon, and Pedro H. Sant'Anna (Feb. 2024). *Difference-in-differences with a Continuous Treatment*. en. Tech. rep. w32117. Cambridge, MA: National Bureau of Economic Research, w32117. DOI: 10.3386/w32117.

Callaway, Brantly and Pedro H. C. Sant'Anna (Dec. 2021). "Difference-in-Differences with multiple time periods". In: *Journal of Econometrics*. Themed Issue: Treatment Effect 1 225.2, pp. 200–230. DOI: 10.1016/j.jeconom.2020.12.001.

Calvet, Louis-Jean (1993). *Évaluation des écoles expérimentales en bambara dans la région de Ségou*. Tech. rep. République du Mali. Ministère de l'éducation de base. Institut pédagogique national.

— (2010). *Histoire du français en Afrique. Une langue en copropriété ?. Organisation internationale de la francophonie*. fr. Editions Ecriture.

Chaisemartin, Clément de and Xavier D'Haultfœuille (June 2022). "Two-way fixed effects and differences-in-differences with heterogeneous treatment effects: a survey". en. In: *The Econometrics Journal*, utac017. DOI: 10.1093/ectj/utac017.

Chauvet, Lisa et al. (Apr. 2015). "Migrants' Home Town Associations and Local Development in Mali: Migrants' HTAs and local development in Mali". en. In: *The Scandinavian Journal of Economics* 117.2, pp. 686–722. DOI: 10.1111/sjoe.12100.

Clots-Figueras, Irma and Paolo Masella (Aug. 2013). "Education, Language and Identity". In: *The Economic Journal* 123.570, F332–F357. DOI: 10.1111/ecoj.12051.

Col, Mathilde (2024). "Working Paper. Unveiling the global determinants and effects of bilingual education policies in Africa". In.

Cummins, Jim (2000). *Language, power, and pedagogy: bilingual children in the crossfire*. en. Bilingual education and bilingualism 23. Clevedon [England] ; Buffalo [N.Y.]: Multilingual Matters.

De Gaston, William (Oct. 2011). “Le signal communicationnel français face à la langue Évé : Pour une phénoménologie de la communication”. fr. In: *Communiquer. Revue de communication sociale et publique* 6. Number: 6, pp. 57–70. DOI: 10.4000/communiquer.452.

Diarra, Abdramane (2020). “Curriculum Bilingue dans l’enseignement fondamental au Mali : Etat des lieux de sa mise en œuvre”. PhD thesis. France: Université Grenoble-Alpes.

Diarra, Abou (2013a). *Etats des lieux du curriculum de l’enseignement fondamental au Mali.* Rapport final Curriculum OMAES.

— (2013b). *Etats des lieux du curriculum de l’enseignement fondamental au Mali.* Rapport final Curriculum OMAES.

Dizon-Ross, Rebecca and Seema Jayachandran (Dec. 2023). “Detecting Mother-Father Differences in Spending on Children: A New Approach Using Willingness-to-Pay Elicitation”. en. In: *American Economic Review: Insights* 5.4, pp. 445–459. DOI: 10.1257/aeri.20220159.

Duflo, Esther (2001). “Schooling and Labor Market Consequences of School Construction in Indonesia: Evidence from an Unusual Policy Experiment”. en. In: *The American Economic Review* 91.4, pp. 795–813.

Eberheard, David M., Gary F. Simons, and Charles D. Fennig (2025). *Ethnologue Global Dataset (eds. 2025).* Section: 2016-03-22 16:44:43.547.

Evans, David K and Amina Mendez Acosta (Jan. 2021). “Education in Africa: What Are We Learning?” In: *Journal of African Economies* 30.1, pp. 13–54. DOI: 10.1093/jae/ejaa009.

Glewwe, P. and K. Muralidharan (2016). “Improving Education Outcomes in Developing Countries”. en. In: *Handbook of the Economics of Education.* Vol. 5. Elsevier, pp. 653–743. DOI: 10.1016/B978-0-444-63459-7.00010-5.

Hovens, Mart (Oct. 2002). “Bilingual Education in West Africa: Does It Work?” en. In: *International Journal of Bilingual Education and Bilingualism* 5.5, pp. 249–266. DOI: 10.1080/13670050208667760.

Hutchison, J, Abdramane Diarra, and J Poth (1990). *Évaluation de l'expérimentation en langues nationales dans l'enseignement fondamental en République du Mali.* Tech. rep. USAID.

INSTAT-Mali (2017). *Enquête Modulaire et Permanente auprès des Ménages.*

Laitin, David D. and Rajesh Ramachandran (May 2022). "Linguistic diversity, official language choice and human capital". In: *Journal of Development Economics* 156, p. 102811. DOI: 10.1016/j.jdeveco.2021.102811.

Laitin, David D., Rajesh Ramachandran, and Stephen L. Walter (Oct. 2019). "The Legacy of Colonial Language Policies and Their Impact on Student Learning: Evidence from an Experimental Program in Cameroon". en. In: *Economic Development and Cultural Change* 68.1, pp. 239–272. DOI: 10.1086/700617.

Loua, Seydou (Sept. 2017). "Les grandes réformes de l'école malienne de 1962 à 2016". fr. In: *Revue internationale d'éducation de Sèvres* 75, pp. 34–40. DOI: 10.4000/ries.5917.

Maurer, Bruno (2007). *De la pédagogie convergente à une didactique intégrée.* L'Harmattan.

Mbiti, Isaac et al. (Aug. 2019). "Inputs, Incentives, and Complementarities in Education: Experimental Evidence from Tanzania*". en. In: *The Quarterly Journal of Economics* 134.3, pp. 1627–1673. DOI: 10.1093/qje/qjz010.

MEN (2003). *Projet d'Appui à l'Amélioration des Apprentissages dans les Ecoles Fondamentales (PAAA).* Tech. rep. Crédit n°3318 MLI. Ministère de l'Education Nationale - Secrétariat Général.

Michler, Jeffrey D. et al. (Sept. 2022). "Privacy protection, measurement error, and the integration of remote sensing and socioeconomic survey data". In: *Journal of Development Economics* 158, p. 102927. DOI: 10.1016/j.jdeveco.2022.102927.

Mohohlwane, Nompumelelo et al. (2023). "Reading Skills Transfer Best from Home Language to a Second Language". en. In: *CGD Working Paper. Washington, DC: Center for Global Development* 647.

Montenegro, Claudio E. and Harry Anthony Patrinos (Sept. 2014). *Comparable Estimates of Returns to Schooling around the World.* en. Policy Research Working Papers. The World Bank. DOI: 10.1596/1813-9450-7020.

Müller-Crepon, Carl (July 2023). “State reach and development in Africa since the 1960s: new data and analysis”. en. In: *Political Science Research and Methods* 11.3, pp. 663–672. DOI: 10.1017/psrm.2021.60.

Müller-Crepon, Carl, Philipp Hunziker, and Lars-Erik Cederman (Feb. 2021). “Roads to Rule, Roads to Rebel: Relational State Capacity and Conflict in Africa”. EN. In: *Journal of Conflict Resolution* 65.2-3. Publisher: SAGE Publications Inc, pp. 563–590. DOI: 10.1177/0022002720963674.

O’Gara, Chloe and Nancy Kendall (1996). *Beyond Enrollment: A Handbook For Improving Girls’ Experiences In Primary Classrooms*. en. Tech. rep. ABEL.

PASEC (2020). *PASEC 2019. Qualité des systèmes éducatifs en Afrique Subsaharienne Francophone. Performance et Environnement de l’Enseignement-Apprentissage au Primaire.* Tech. rep. Programme d’Analyse des Systèmes Éducatifs de la CONFEMEN (PASEC).

Patrinos, Harry Anthony and Eduardo Velez (Nov. 2009). “Costs and benefits of bilingual education in Guatemala: A partial analysis”. en. In: *International Journal of Educational Development* 29.6, pp. 594–598. DOI: 10.1016/j.ijedudev.2009.02.001.

Piper, Benjamin, Stephanie S. Zuilkowski, and Salome Ong’ele (Nov. 2016). “Implementing Mother Tongue Instruction in the Real World: Results from a Medium-Scale Randomized Controlled Trial in Kenya”. en. In: *Comparative Education Review* 60.4, pp. 776–807. DOI: 10.1086/688493.

Psacharopoulos, George and Harry Anthony Patrinos (Aug. 2004). “Returns to investment in education: a further update”. en. In: *Education Economics* 12.2, pp. 111–134. DOI: 10.1080/0964529042000239140.

Ramachandran, Rajesh (Oct. 2017). “Language use in education and human capital formation: Evidence from the Ethiopian educational reform”. en. In: *World Development* 98, pp. 195–213. DOI: 10.1016/j.worlddev.2017.04.029.

Ramachandran, Rajesh and Christopher Rauh (Dec. 2022). “The Imperium of the Colonial Tongue? Evidence on Language Policy Preferences in Zambia”. en. In: *Journal of African Economies* 32.1, pp. 52–80. DOI: 10.1093/jae/ejac002.

Reynal-Querol, Marta (Jan. 2002). “Political systems, stability and civil wars”. en. In: *Defence and Peace Economics* 13.6, pp. 465–483. DOI: 10.1080/10242690214332.

Rolstad, Kellie, Kate Mahoney, and Gene V. Glass (Sept. 2005). "The Big Picture: A Meta-Analysis of Program Effectiveness Research on English Language Learners". en. In: *Educational Policy* 19.4, pp. 572–594. DOI: 10.1177/0895904805278067.

Roth, Jonathan et al. (Aug. 2023). "What's trending in difference-in-differences? A synthesis of the recent econometrics literature". en. In: *Journal of Econometrics* 235.2, pp. 2218–2244. DOI: 10.1016/j.jeconom.2023.03.008.

Sakaryalı, Özge, Mazhar Bal, and Yakup Yıldırım (Oct. 2024). "Investigating the Relationship Between Mother Tongue Education and Creativity: A Systematic Review at the K-12 Level". en. In: *Sage Open* 14.4, p. 21582440241307806. DOI: 10.1177/21582440241307806.

Sandefur, Justin (2017). *How USAID's Demographic and Health Surveys Overestimate Literacy around the World and How to Fix That.*

Seid, Yared (Dec. 2016). "Does learning in mother tongue matter? Evidence from a natural experiment in Ethiopia". In: *Economics of Education Review* 55, pp. 21–38. DOI: 10.1016/j.econedurev.2016.08.006.

Skattum, Ingse (Jan. 2010). "L'introduction des langues nationales dans le système éducatif au Mali : objectifs et conséquences". fr. In: *Journal of Language Contact* 3.1, pp. 247–270. DOI: 10.1163/19552629-90000013.

Sougane, Arouna (2014). "Migrations et transferts : un état des lieux". fr. In: *Le Mali contemporain*. Ed. by Joseph Brunet-Jailly, Jacques Charmes, and Doulaye Konaté. IRD Éditions, pp. 613–642. DOI: 10.4000/books.irdeditions.21263.

Traoré, Samba (2001). "La Pédagogie Convergente : son expérimentation au Mali et son impact sur le système éducatif". fr. In: *UNESCO, Bureau International d'Education.* Monographies-Innodata.

UNESCO (1963). "Impulsions nouvelles à l'éducation". In.

— (2013). *The Global Learning Crisis. Why every child deserves a quality education.* Tech. rep.

— (2016). *If you don't understand, how can you learn?* Policy Paper.

World Bank (2000). *Document d'évaluation du projet d'appui a l'amélioration des apprentissages dans les écoles fondamentales.* Tech. rep. 1960 1 -MLI.

World Bank (2024). *World Bank Development Indicators*. Publisher: Washington, D.C. : The World Bank.

Appendix

A Context

A.1 History of bilingual education prior to the 1999 policy

First generation experimental schools. In 1979, 4 schools opened a class using bilingual education in Bamanankan only, the main vehicular language in Mali (Calvet, 1993; Traoré, 2001). Teachers used the local language only in the first four years of primary education. Positive evaluations of the bilingual program at the beginning of the experiment led to its rapid expansion. A few years later, almost 100 schools operated in the four main languages: Bamanankan, Songhay, Tamasheq, and Fulfulde (Hutchison, Diarra, and Poth, 1990; Skattum, 2010). Lack of monitoring, teacher training, and sufficient budget led to the end of the first experimentation at the beginning of the 1990s (Skattum, 2010).

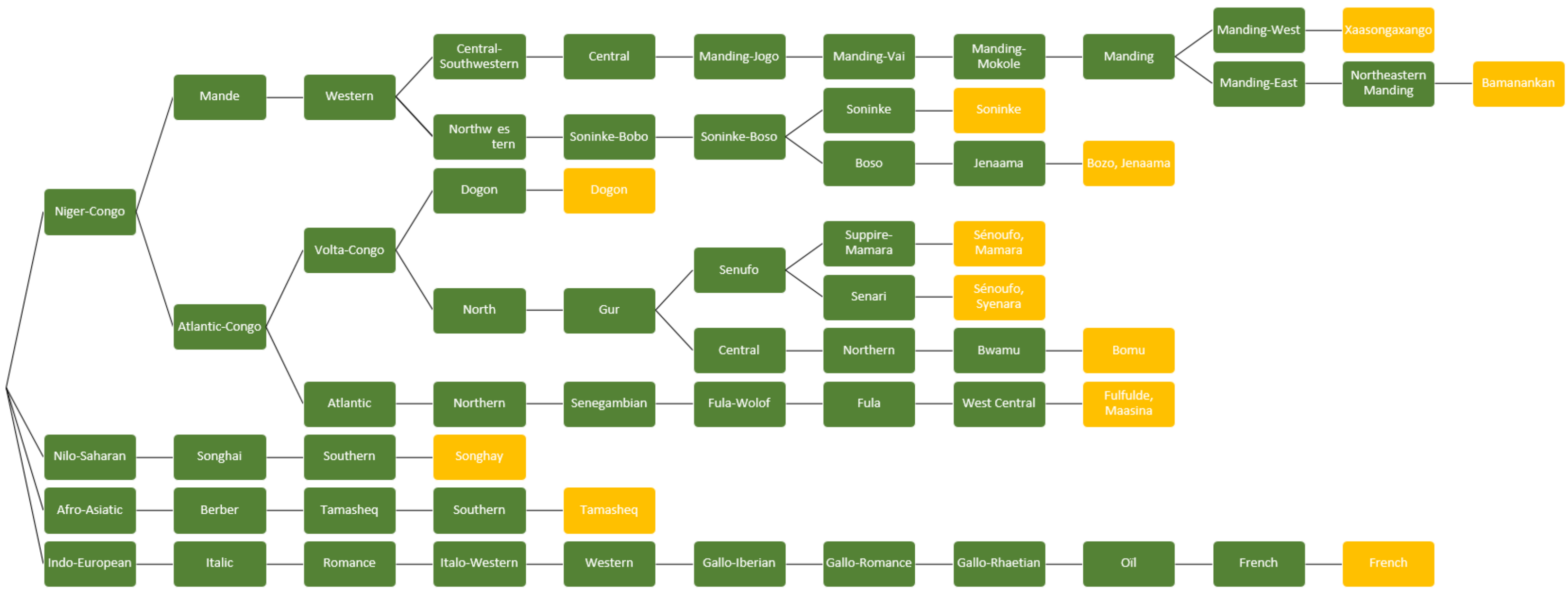
The *Pédagogie Convergente*. This new experiment, developed and piloted by a Belgian linguistics center (the CIAVER[33]), started in 1987 with two classes in Segou in Bamanankan. After a positive evaluation of the pilot, it rapidly expanded in 1994 to other languages and counted a bit more than 100 schools in 1997 (Traoré, 2001). Contrary to the first experimental schools, the 6 years of primary education were entirely taught in the local language, with a progressive introduction to French once students fully mastered the mother tongue.

Qualitative and quantitative evaluations conducted during the experiment provided mixed evidence about its results (Skattum, 2010; Traoré, 2001). Maurer (2007) also reported implementation issues that hindered the program's scale-up.

[33]Centre International Audiovisuel d'Études et de Recherches

A.2 Additional inputs

Figure A.1: Examples of a textbook in Bamanankan for grade 1 students



Notes: This figure presents the different language trees for the 12 languages that can be used as a language of instruction as stated in the 1999 bilingual education reform in Mali. Ethnologue is the source used to create the trees (Eberheard, Simons, and Fennig, 2025). Yellow cells indicate languages while green cells indicate language families. Family connections are indicated with black lines. The four language families on the left hand side of the figure are the higher level of language families as listed in Ethnologue.

Figure A.2: Language trees for the languages of instruction in Mali

A.3 Tables

Primary education	**Local language**	**French**
Grade 1	100%	0%
Grade 2	75%	25%
Grade 3	50%	50%
Grade 4	50%	50%
Grade 5	25%	75%
Grade 6	25%	75%

Table A.1: Time spent teaching in French and the local language at each grade of the primary cycle

Notes: This table comes from the work of Diarra (2020).

Region	Language(s)
Kayes	Soninke, Bamanankan, Fulfulde, Khassonke
Koulikoro	Bamanankan, Syenara, Mamara
Sikasso	Bamanankan, Syenara, Mamara
Segou	Bamanankan, Bomu, Mamara
Mopti	Fulfulde, Dogon, Bamanankan, Songhay, Bozo
Tombouctou	Songhay, Tamasheq, Fulfulde
Gao	Songhay, Tamasheq
Kidal	Tamasheq
Bamako	Bamanankan

Table A.2: Language choice per region

Notes: This table comes from the work of Diarra (2020) and indicates the local language(s) chosen to be languages of instruction for at least one school in each region.

Year	Geographical level	Information	Source
1994-1997	District	Number of BS per language	Diarra (2020)
2002	District	Number of BS	MEN (2003)
2005	Region	Number of BS per language	??
	District	Number of BS	??
2011	Commune	List of BS with info. on their status	Diarra (2013b)

Table A.3: Year, geographical level, and information available for bilingual education

Notes: "BS" stands for bilingual schools. "1994-1997" stands for "from 1994 to 1997". This table gives information about data retrieved about bilingual education supply in Mali. To document the expansion of bilingual education, I use original data from several reports published by the Bilingual Education Department within the Ministry of Education between 2002 and 2011 (Diarra, 2013b; MEN, 2003). I also use data on the first experiments from a PhD thesis in linguistics (Diarra, 2020). From the different sources detailed previously, I can document four periods: the first experiment from 1994 to 1997, then 2002, 2005, and 2011. Diarra (2020), Diarra (2013b), and MEN (2003).

Characteristics	Mean	SD	N
A. Individual characteristics			
Female (0/1)	0.55	0.5	8636
Age	23.7	6.12	8636
Muslim (0/1)	0.95	0.22	8636
Urban (0/1)	0.49	0.48	8636
Attended school (0/1)	0.51	0.5	8635
Number of schooling years	4.01	6.25	8636
Literate in French (0/1)	0.52	0.5	8633
Literate in the local language (0/1)	0.13	0.33	8623
B. Commune characteristics			
Number of students in school age	616.65	893.63	167
Number of primary schools	24.74	35.01	167
Share of bilingual schools	0.45	0.32	167
Linguistic HHI	0.46	0.15	165

Notes: (0/1) indicates a dummy variable. SD stands for standard deviation. N stands for the number of non-missing observations for each variable. All descriptive statistics are computed using weights provided in the LSMS survey.

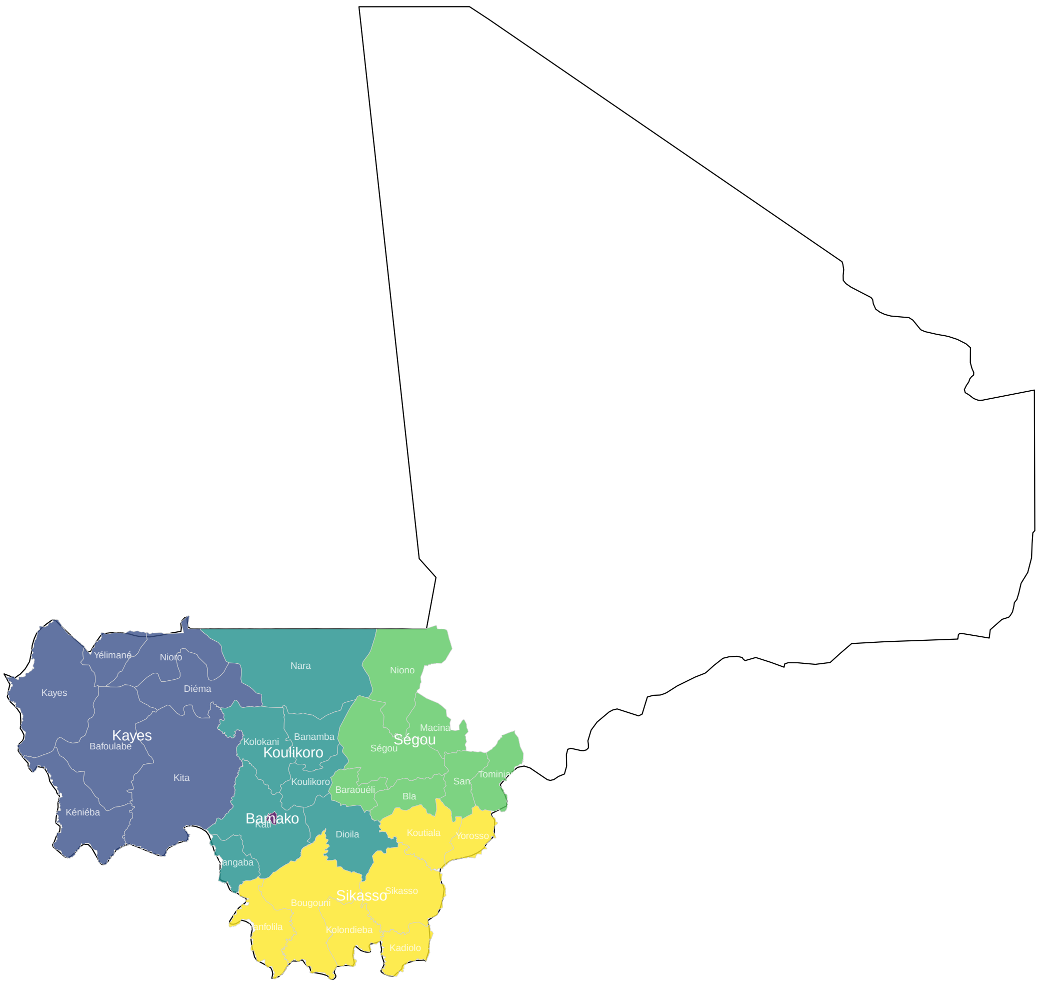
Table A.4: Description of the sample

	High exposure		Low exposure		Diff. in Means	
	Mean (1)	Std	Mean (2)	Std	(2) - (1)	p-value
Female (0/1)	0.57	0.50	0.59	0.49	0.02	0.28
Age	29.29	3.41	29.17	3.40	-0.12	0.34
Muslim (0/1)	0.95	0.23	0.96	0.20	0.01	0.12
Urban (0/1)	0.30	0.46	0.36	0.48	0.05***	0.00
Attended school (0/1)	0.36	0.48	0.44	0.50	0.07***	0.00
Number of schooling years	4.38	6.78	5.51	7.58	1.13***	0.00
Literate in French (0/1)	0.36	0.48	0.45	0.50	0.09***	0.00
Literate in the local language (0/1)	0.12	0.33	0.11	0.31	-0.01	0.20
N	**1.599**		**1.692**			

Notes: This table uses the sample of individuals born before 1994, i.e. before the official introduction of local languages in education. The first and second columns present the average and the standard deviation of every outcome detailed on the left column for the high-exposed to bilingual education individuals, the third and the fourth the same statistics for the low-exposed to bilingual education individuals. The fifth communes present the differences in means between the first and the third column, and the results of the t-test are given in the sixth column. I use the weights provided in the LSMS to perform the analysis. Signif. Codes: ***: 0.01, **: 0.05, *: 0.1

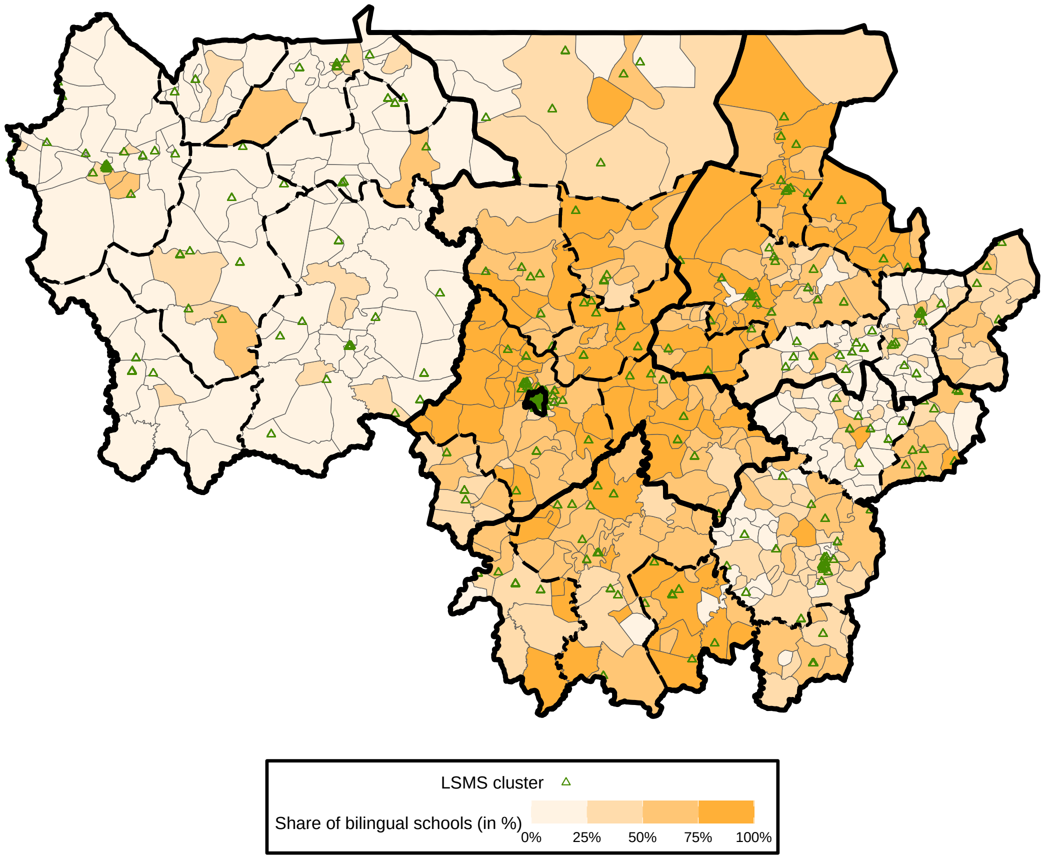
Table A.5: Balance table at the individual level between communes with high and low exposure to bilingual education

A.4 Maps & Graphs



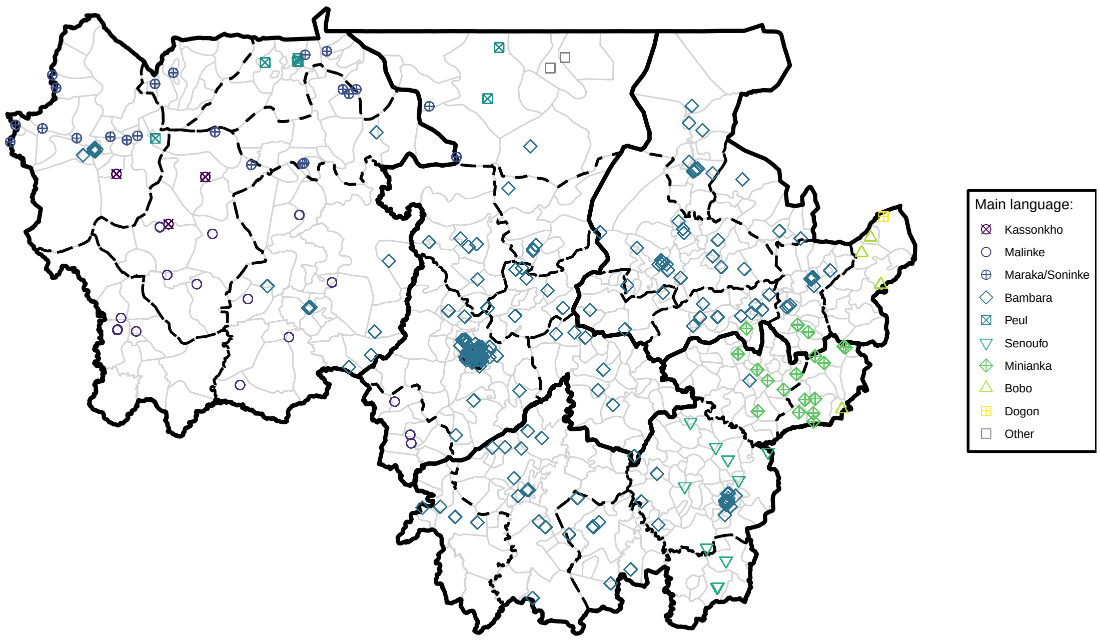
Notes: This figure maps the regions and districts covered by the 2011 census on the bilingual schools. It also maps the border of the Malian territory as a whole. Regions are indicated in bigger size, while districts are indicated by smaller size letters.

Figure A.3: Map of Mali with regions covered by the 2011 bilingual education census



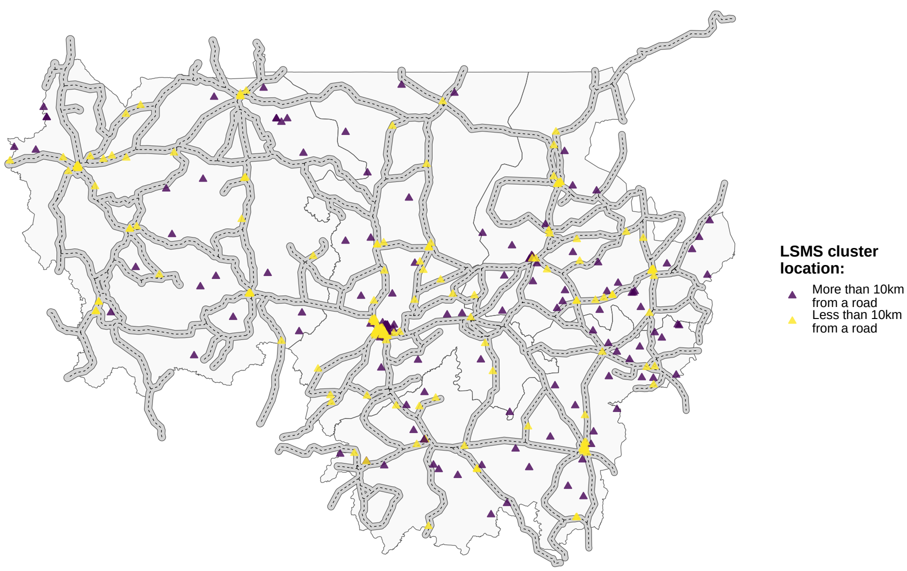
Notes: Solid black lines represent the regional borders, dashed black lines represent the district borders, and gray lines represent the communal borders. The color represents the intensity in the fraction of bilingual schools in each commune: the whiter the commune, the less the provision of bilingual education in the commune. The green triangles represent the location of LSMS clusters used in the analysis. This figure maps only the following regions considered in the empirical analysis: Bamako, Kayes, Koulikoro, Segou, and Sikasso.

Figure A.4: Bilingual education supply in 2011 and LSMS clusters by commune



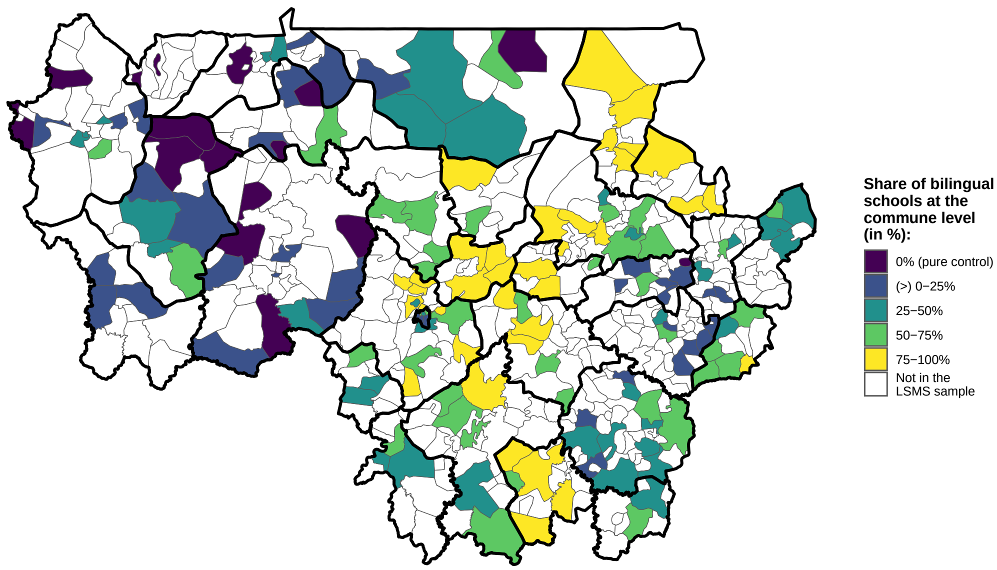
Notes: Solid black lines represent the regional borders, dashed black lines represent the district borders, and gray lines represent the communal borders. The dots are the LSMS cluster locations. Colors and shapes indicate the dominant language of the commune in which these clusters are located, as given in the 2009 census.

Figure A.5: Map of LSMS clusters with the main language spoken



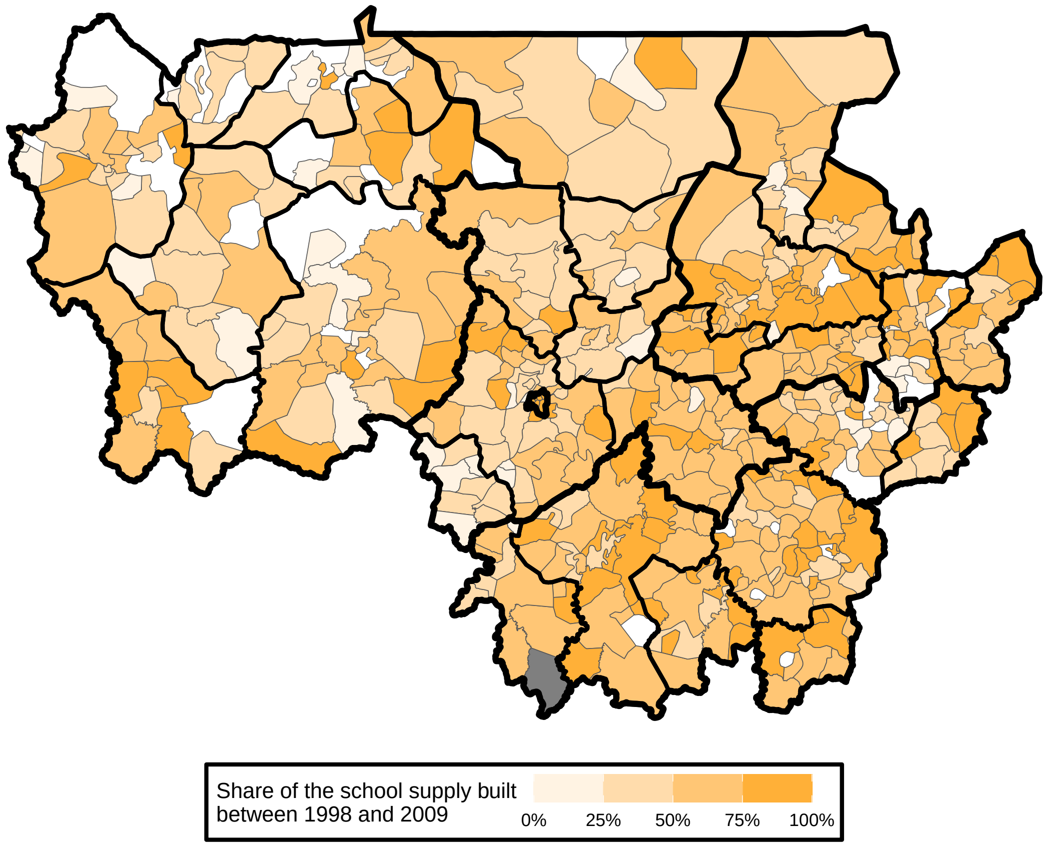
Notes: Solid black lines represent the regional borders. Roads represented on the map are taken from the Michelin map from 2000 (Müller-Crepon, 2023; Müller-Crepon, Hunziker, and Cederman, 2021). The dots are the LSMS cluster locations, and their colors vary according to whether they are located within 10 kilometers (distance as the crow flies) from the closest road.

Figure A.6: Map of road access to LSMS clusters



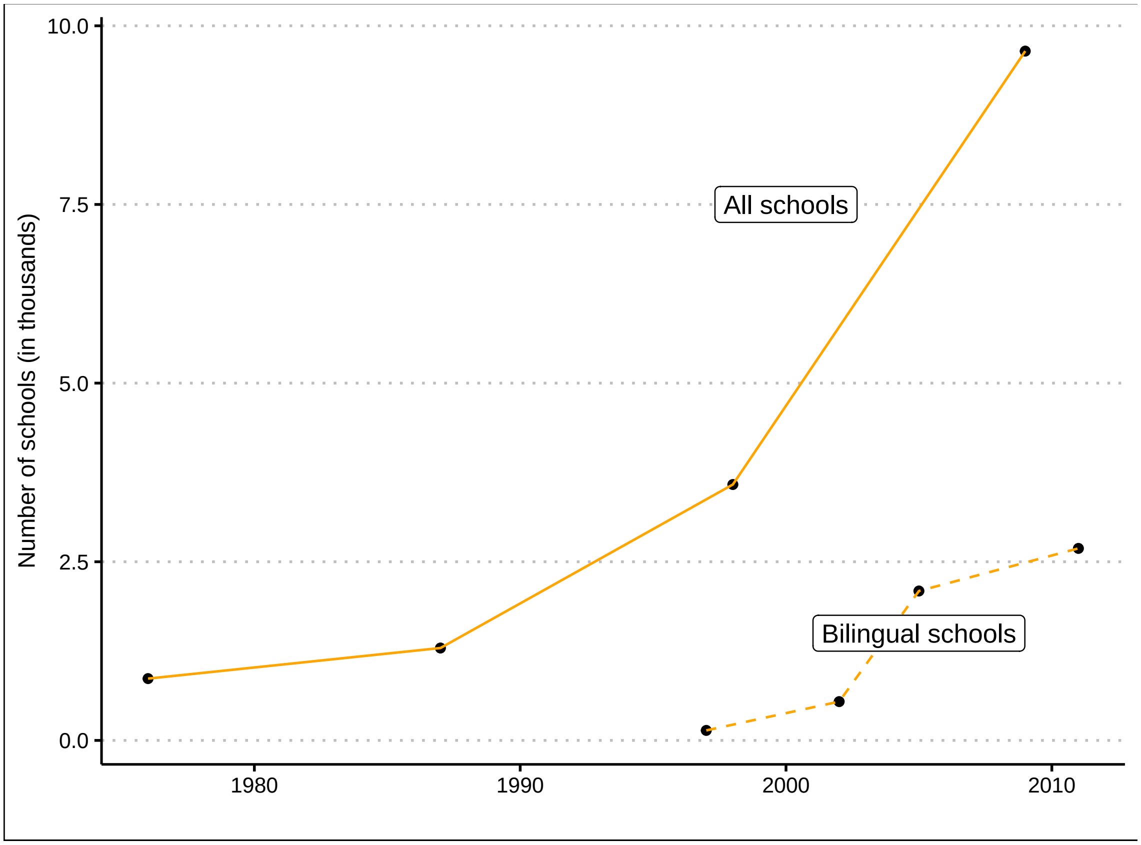
Notes: Solid black lines represent the district borders, and grey lines the communal ones. Colors indicate the fraction of the bilingual education supply for communes in the LSMS sample.

Figure A.7: Map of discretized bilingual education supply



Notes: Solid black lines represent the regional borders, dashed black lines represent the district borders, and gray lines represent the communal borders. The color represents the growth rate of the education supply at the commune level: the whiter the commune, the less schools were built between 1998 and 2009, in comparison to existing school supply in 1998.

Figure A.8: Map of the education growth rate between 1998 and 2009 at the commune level

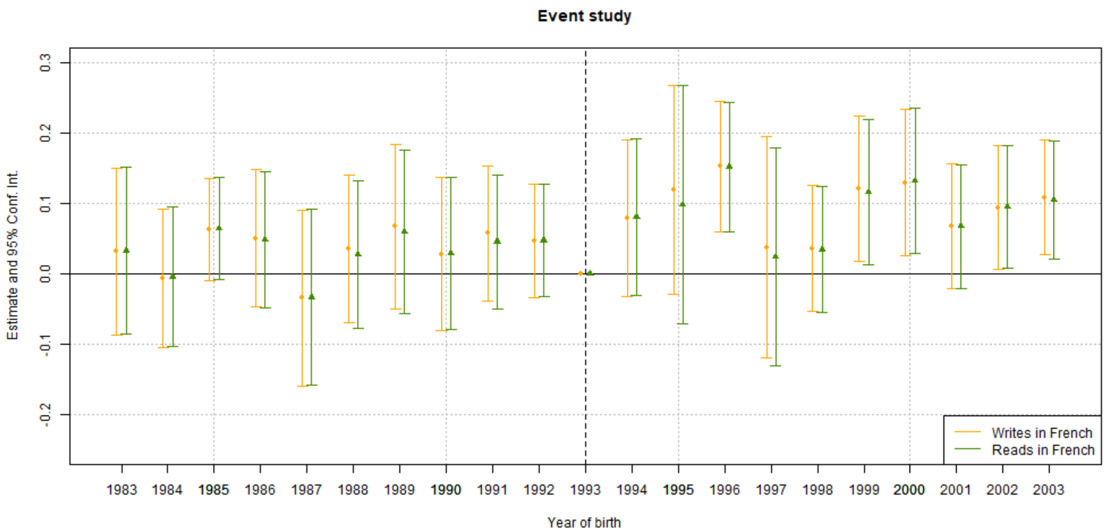


Notes: The orange line represents the school supply, regardless of the languages of instruction used in the school. The school supply was inferred from the national census data. The orange dotted line represents the number of bilingual schools. The number of bilingual schools was retrieved from archival sources from the Bilingual education monitoring section. The four points in time are the only years for which I have accurate data (see Table A.3).

Figure A.9: Time evolution of the number of schools

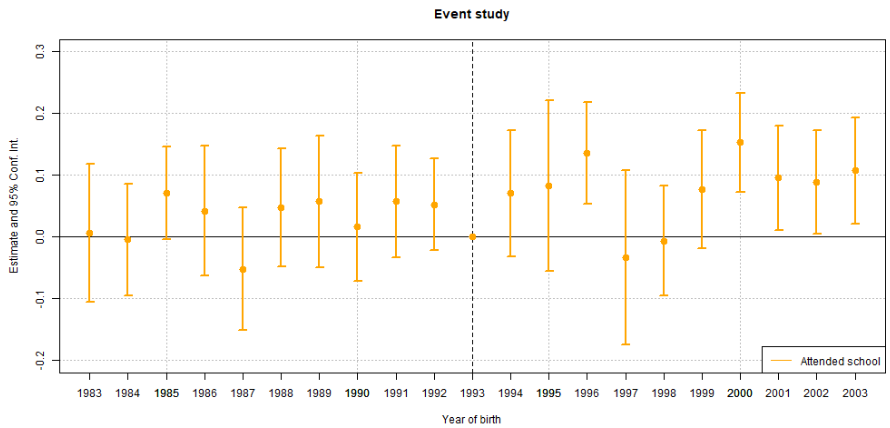
B Additional results

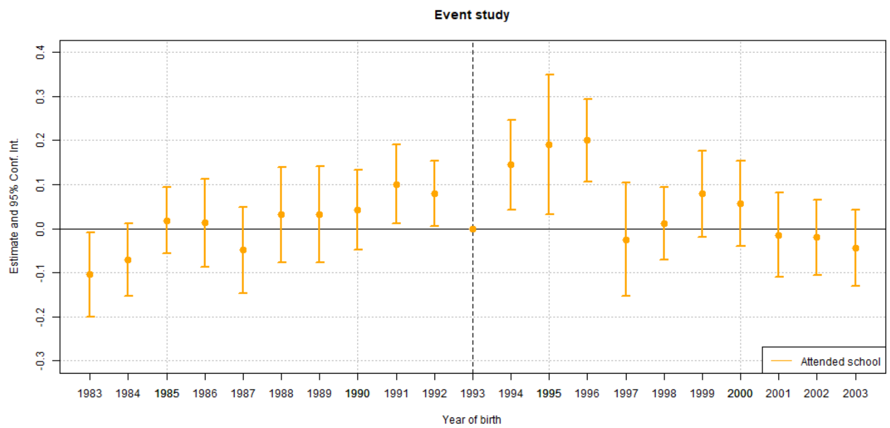
B.1 General results

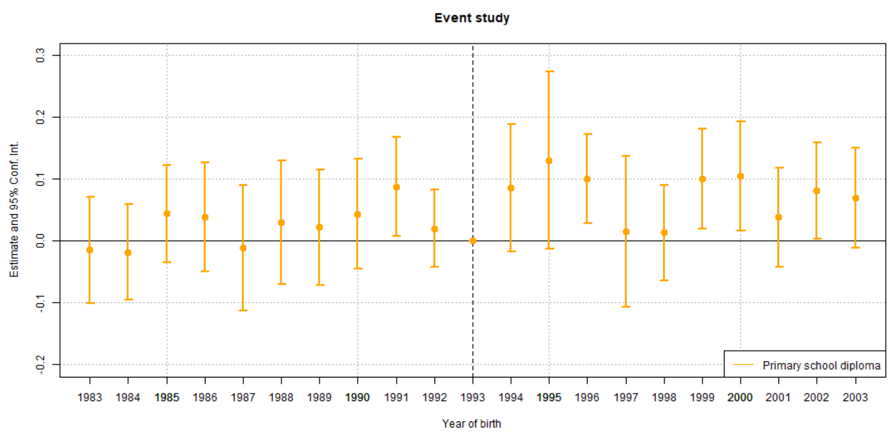


Notes: Point estimates and 95% confidence intervals are derived from an event study regression over the 1985-2003 birth cohorts. In addition to time and commune fixed effects, I use district fixed effects to capture that the median of bilingual education share varies across districts. To obtain these estimates, I perform two distinct regressions: one with whether the individual knows how to write in French as the dependent variable and one with whether the individual knows how to read in French as the dependent variable. I cluster at the LSMS cluster level, which corresponds roughly to the village level. Individuals born in 1993 are the last birth cohort to be taught entirely in French, i.e., not treated, represented by a black dashed vertical line.

Figure A.10: Event study results for literacy in French

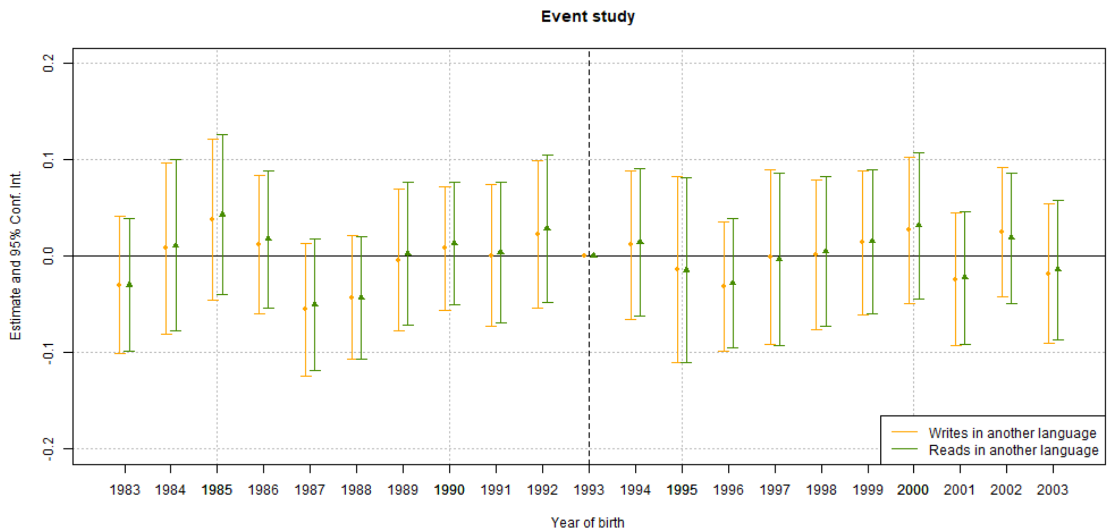






Notes: See Figure A.10 for additional notes.

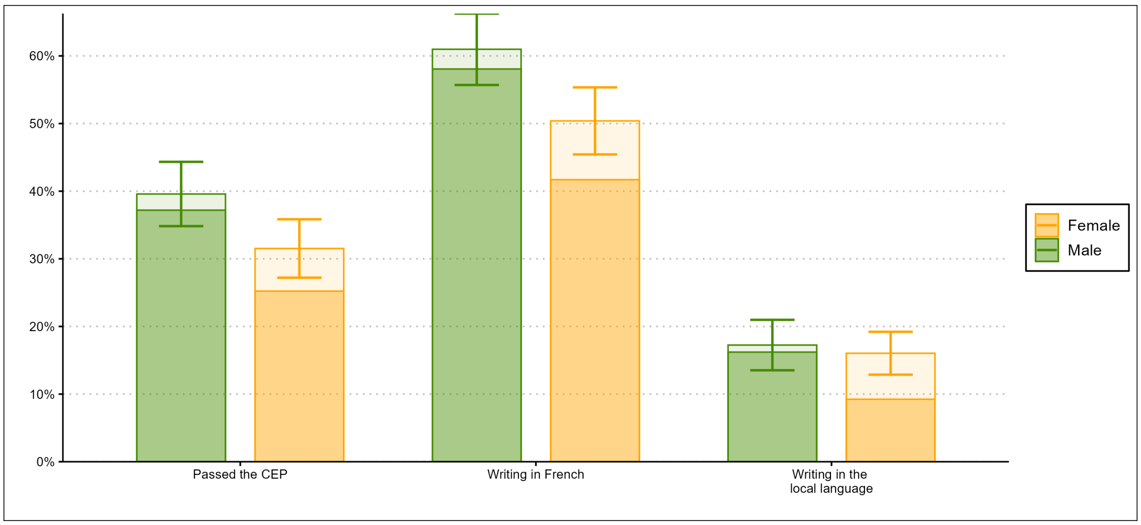
Figure A.11: Event study results for schooling outcomes



Notes: Point estimates and 95% confidence intervals are derived from an event study regression over the 1985-2003 birth cohorts. In addition to time and commune-fixed effects, I use district-fixed effects to capture variation in the median bilingual education share across districts. To obtain these estimates, I perform two distinct regressions: one with whether the individual knows how to write in another language as the dependent variable (in orange), and one with whether the individual knows how to read in another language as the dependent variable (in green). I cluster the standard errors at the LSMS cluster level, which corresponds roughly to the village level. Individuals born in 1993 are the last birth cohort to be taught entirely in French (i.e., not treated), represented by a black vertical dashed line.

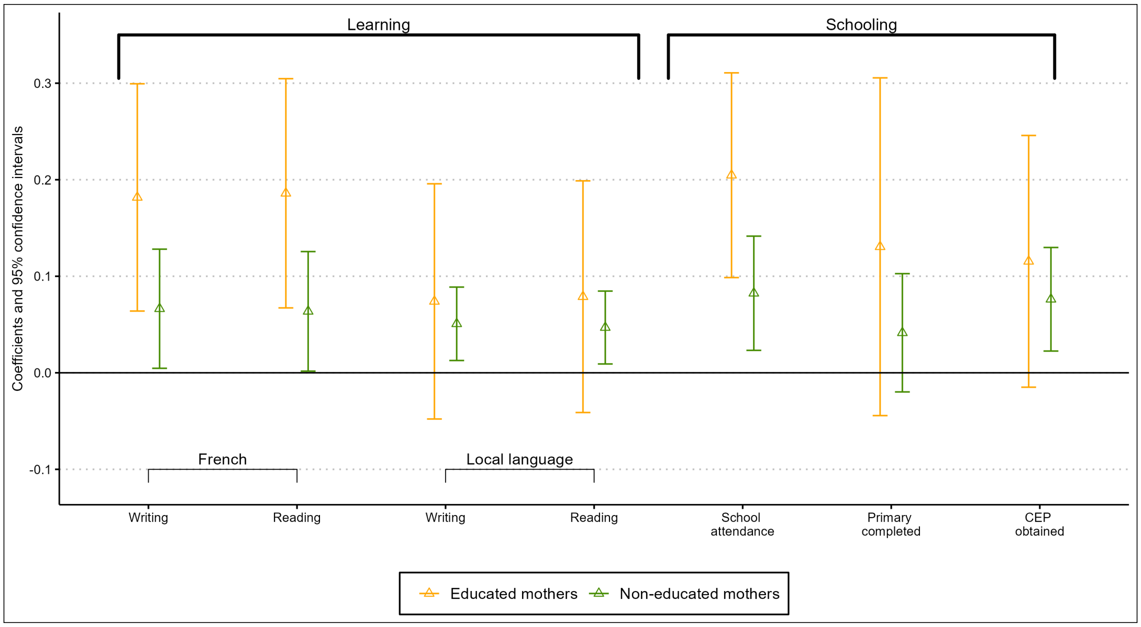
Figure A.12: Event study results for literacy in another language

B.2 Heterogeneity results



Notes: The solid bars represent the outcome mean at baseline, for the three outcomes described on the x-axis. The shadowed areas on top on the solid bars illustrate the effect of bilingual education on each of these outcomes, with the corresponding 95% confidence intervals. Each of these results are depicted at the gender level. Point estimates and 95% confidence intervals are derived from a TWFE linear regression, described in Table A.7.

Figure A.13: TWFE coefficient estimates of bilingual education effects relative to the outcome means, by gender



Notes: Point estimates and 95% confidence intervals are derived from a TWFE linear regression on several outcomes: (1) and (2) are writing and reading literacy in French, (3) and (4) in the local language, and (5) (6) and (7) are school achievements indicators. I use district fixed effects to capture the fact that the median of bilingual education share varies across districts. I cluster at the LSMS cluster level, which corresponds roughly to the commune level. To obtain heterogeneous effects, I interact the DiD coefficient in Equation 1 with a dummy equal to one if the mother went to school, and add this dummy as well to the set of fixed-effects.

Figure A.14: TWFE coefficient estimates of bilingual education effects, by mother education

Dependent Variables:	Attended school	Completed primary education	Primary school diploma
Model:	(1)	(2)	(3)
Variables			
Born after 1994	0.156***	-0.020	0.073***
	(0.019)	(0.022)	(0.016)
High exposed commune	0.023	0.019	0.028
	(0.032)	(0.033)	(0.032)
Born after 1994 × High exposed commune	0.059**	0.042	0.041*
	(0.026)	(0.031)	(0.025)
Fixed-effects			
District FE	Yes	Yes	Yes
Fit statistics			
Mean of Y	0.495	0.282	0.305
Observations	8,635	6,001	8,635
R^2	0.12179	0.10339	0.12921

Clustered (LSMS cluster) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Notes: All dependent variables are binary outcomes. The model estimated is a linear regression. The level of analysis is at the individual level, i.e. one observation is one person. The differences in the number of observations is related to missingness of the outcome of interest in the raw LSMS data. I use the weights given in the LSMS data, and cluster the standard errors at the enumeration area. Clustering at the treatment level, i.e. the commune, produces the same results.

Table A.6: TWFE results on schooling outcomes

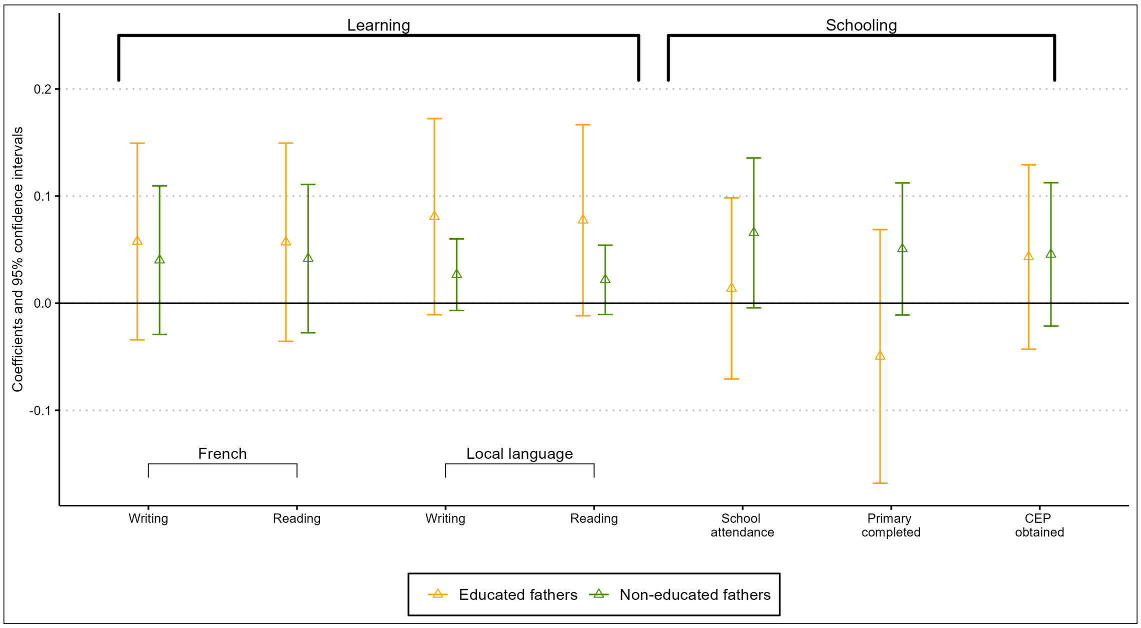
	Local language		French		Attended	Completed	Primary school
Dependent Variables:	Writing	Reading	Writing	Reading	school	primary educ.	diploma
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables							
Boy dummy	0.177***	0.179***	0.083***	0.083***	0.161***	0.151***	0.131***
	(0.014)	(0.015)	(0.010)	(0.010)	(0.014)	(0.016)	(0.013)
Interaction coefficient for boys	0.029	0.025	0.010	0.013	0.041	0.013	0.024
	(0.032)	(0.032)	(0.023)	(0.022)	(0.030)	(0.036)	(0.029)
Interaction coefficient for girls	0.087***	0.088***	0.068***	0.065***	0.083***	0.061*	0.063**
	(0.030)	(0.031)	(0.019)	(0.018)	(0.029)	(0.033)	(0.026)
Fit statistics							
Mean of Y	0.123	0.118	0.489	0.484	0.495	0.282	0.305
Observations	8,636	8,633	8,636	8,623	8,635	6,001	8,635
R^2	0.17880	0.17603	0.05446	0.05389	0.14440	0.12757	0.14643

Clustered (LSMS cluster) standard-errors in parentheses

*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

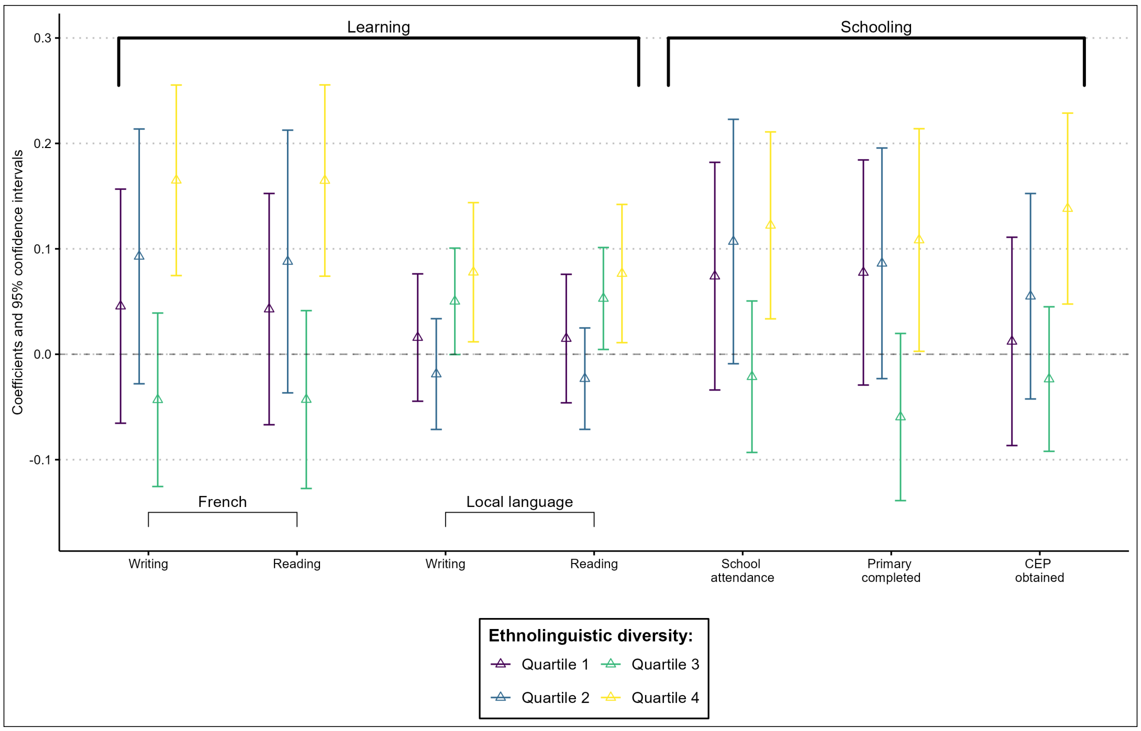
Notes: All dependent variables are binary outcomes. The model estimated is a linear regression. The level of analysis is at the individual level, i.e. one observation is one person. The differences in the number of observations is related to missingness of the outcome of interest in the raw LSMS data. I use district fixed-effects. I use the weights given in the LSMS data, and cluster the standard errors at the enumeration area. Clustering at the treatment level, i.e. the commune, produces the same results. I report here only interaction terms estimates and the coefficient associated with being a boy.

Table A.7: TWFE results, by gender



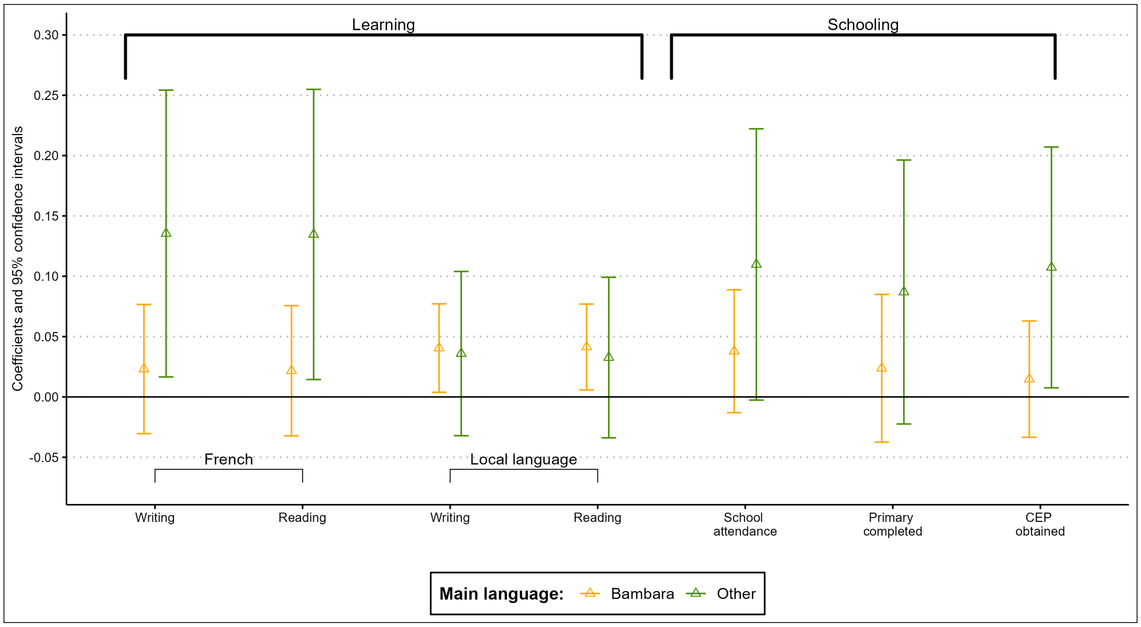
Notes: Point estimates and 95% confidence intervals are derived from a TWFE linear regression on several outcomes: (1) and (2) are writing and reading literacy in French, (3) and (4) in the local language, and (5) (6) and (7) are school achievements indicators. I use district fixed effects to capture the fact that the median of bilingual education share varies across districts. I cluster at the LSMS cluster level, which corresponds roughly to the commune level. To obtain heterogeneous effects, I interact the DiD coefficient in Equation 1 with a dummy equal to one if the father went to school, and add this dummy as well to the set of fixed-effects.

Figure A.15: TWFE coefficient estimates of bilingual education effects, by father education



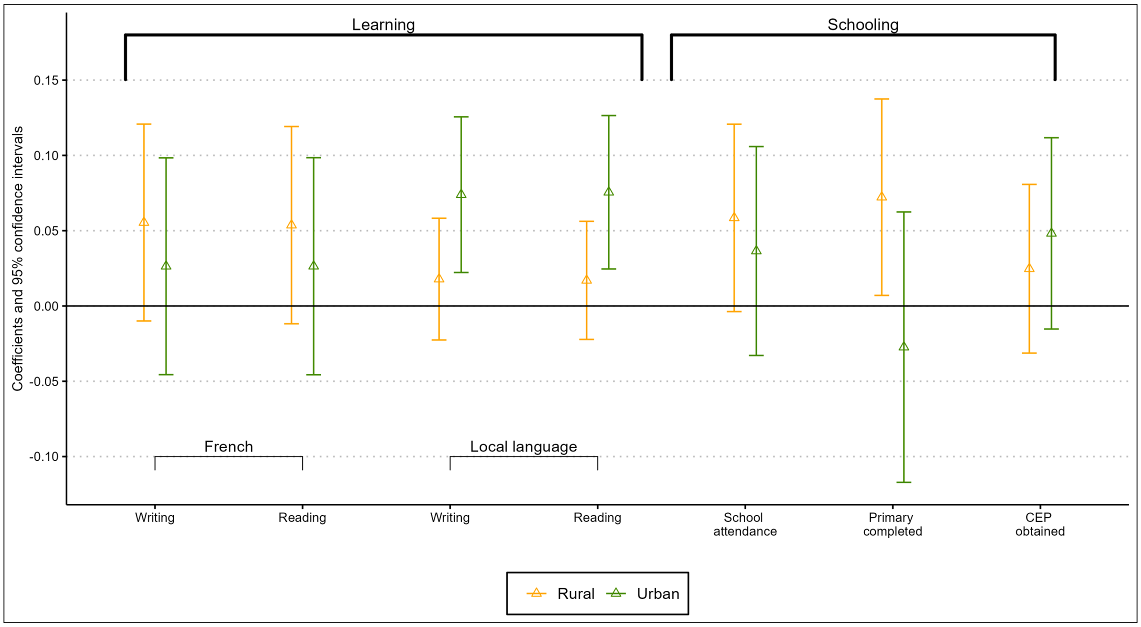
Notes: Point estimates and 95% confidence intervals are derived from a TWFE linear regression on several outcomes: (1) and (2) are writing and reading literacy in French, (3) and (4) in the local language, and (5) (6) and (7) are school achievements indicators. I use district fixed effects to capture the fact that the median of bilingual education share varies across districts. I cluster at the LSMS cluster level, which corresponds roughly to the commune level. To obtain heterogeneous effects, I interact the DiD coefficient in Equation 1 with a dummy equal to one if the commune has a linguistic Hirschman Herfindhal Index higher than the median, and add this dummy as well to the set of fixed-effects.

Figure A.16: TWFE coefficient estimates of bilingual education effects, by linguistic diversity



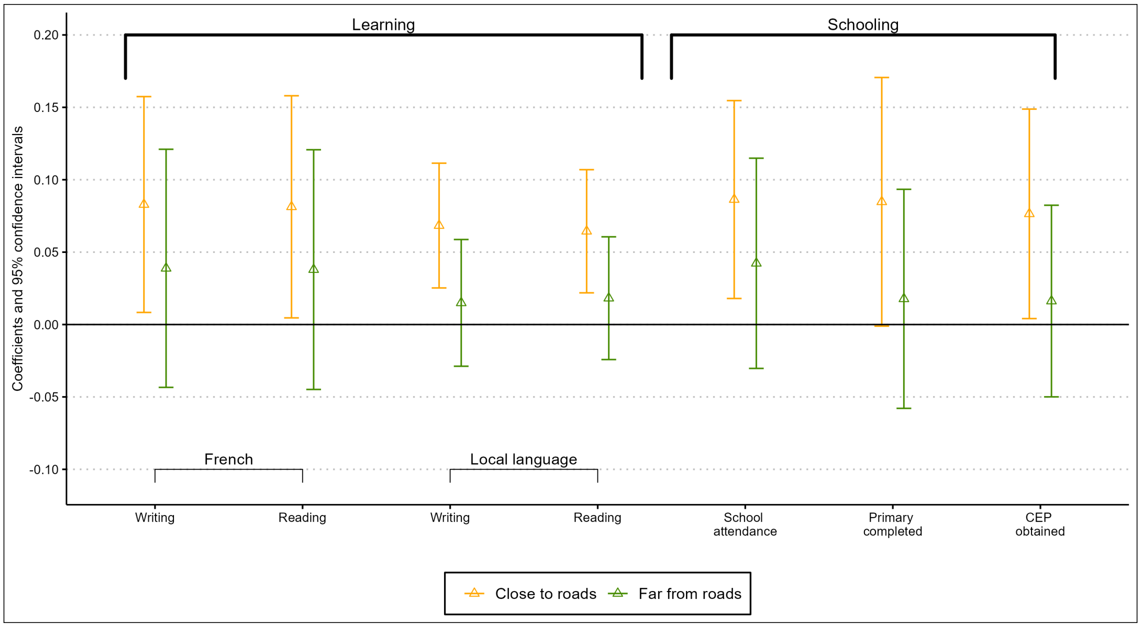
Notes: Point estimates and 95% confidence intervals are derived from a TWFE linear regression on several outcomes: (1) and (2) are writing and reading literacy in French, (3) and (4) in the local language, and (5) (6) and (7) are school achievements indicators. I use district fixed effects to capture the fact that the median of bilingual education share varies across districts. I cluster at the LSMS cluster level, which corresponds roughly to the commune level. To obtain heterogeneous effects, I interact the DiD coefficient in Equation 1 with a dummy equal to one if the main language spoken by individuals at the commune level is Bamanankan (obtained by aggregating the number of speakers for every language at the commune level), and add this dummy as well to the set of fixed-effects.

Figure A.17: TWFE coefficient estimates of bilingual education effects, by the main language of the community



Notes: Point estimates and 95% confidence intervals are derived from a TWFE linear regression on several outcomes: (1) and (2) are writing and reading literacy in French, (3) and (4) in the local language, and (5) (6) and (7) are school achievements indicators. I use district fixed effects to capture the fact that the median of bilingual education share varies across districts. I cluster at the LSMS cluster level, which corresponds roughly to the commune level. To obtain heterogeneous effects, I interact the DiD coefficient in Equation 1 with a dummy equal to one if the village (LSMS cluster) is urban, and add this dummy as well to the set of fixed-effects.

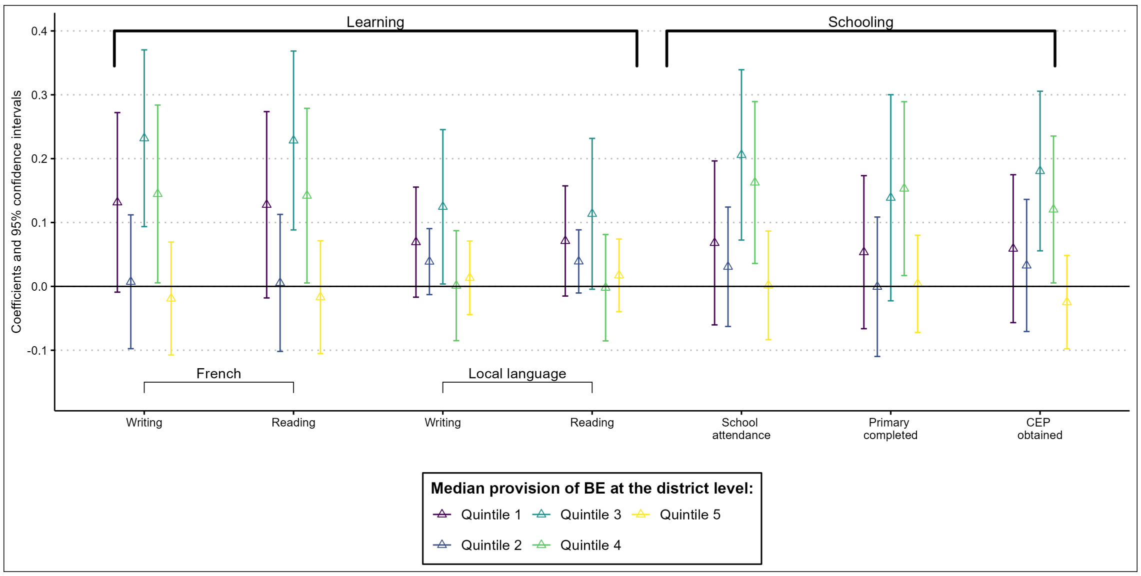
Figure A.18: TWFE coefficient estimates of bilingual education effects, by urban/rural status



Notes: Point estimates and 95% confidence intervals are derived from a TWFE linear regression on several outcomes: (1) and (2) are writing and reading literacy in French, (3) and (4) in the local language, and (5) (6) and (7) are school achievements indicators. I use district fixed effects to capture the fact that the median of bilingual education share varies across districts. I cluster at the LSMS cluster level, which corresponds roughly to the commune level. To obtain heterogeneous effects, I interact the DiD coefficient in Equation 1 with a dummy equal to one if the village (LSMS cluster) is less than 10 kilometers (distance as the crow flies) from a road (see Map A.6). Road data are taken from Müller-Crepon (2023) and Müller-Crepon, Hunziker, and Cederman (2021).

Figure A.19: TWFE coefficient estimates of bilingual education effects, by road access status

B.3 Relaxing the homogeneity treatment effect



Notes: Point estimates and 95% confidence intervals are derived from a TWFE linear regression on several outcomes: (1) and (2) are writing and reading literacy in French, (3) and (4) in the local language, and (5) (6) and (7) are school achievements indicators. I use district fixed effects to capture the fact that the median of bilingual education share varies across districts. I cluster at the LSMS cluster level, which corresponds roughly to the commune level. To obtain heterogeneous effects, I interact the DiD coefficient in Equation 1 with a dummy equal to one if the median share of bilingual education at the district level is higher than the national median, and add this dummy as well to the set of fixed-effects.

Figure A.20: TWFE coefficient estimates of bilingual education effects, by the median share of bilingual education provision

	Local language		French		Attended	Completed	Primary school
Dependent Variables:	Writing	Reading	Writing	Reading	school	primary education	diploma
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables							
Born after 1994	0.017	0.015	0.142***	0.140***	0.160***	-0.035	0.076***
	(0.013)	(0.012)	(0.020)	(0.020)	(0.019)	(0.023)	(0.017)
High exposed commune	-0.0004	-0.0007	-0.003	-0.004	-0.012	-0.016	-0.006
	(0.015)	(0.014)	(0.037)	(0.036)	(0.032)	(0.033)	(0.031)
Born after 1994 × High exposed commune	0.019	0.022	0.050*	0.051*	0.058**	0.064**	0.039
	(0.019)	(0.018)	(0.030)	(0.030)	(0.028)	(0.032)	(0.026)
Fit statistics							
Mean of Y	0.123	0.118	0.489	0.484	0.495	0.282	0.305
Observations	8,636	8,623	8,636	8,633	8,635	6,001	8,635
R^2	0.00695	0.00671	0.11743	0.11475	0.08517	0.07221	0.09628

Clustered (LSMS cluster) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Notes: All dependent variables are binary outcomes. The model estimated is a linear regression. The level of analysis is at the individual level, i.e. one observation is one person. The differences in the number of observations is related to missingness of the outcome of interest in the raw LSMS data. I use region fixed-effects, as the treatment uses the regional median as a reference point. I use the weights given in the LSMS data, and cluster the standard errors at the enumeration area. Clustering at the treatment level, i.e. the commune, produces the same results.

Table A.8: TWFE results with region fixed-effects

	Local language		French		Local language		French	
Dependent Variables:	Writing	Reading	Writing	Reading	Writing	Reading	Writing	Reading
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables								
Born after 1994	0.044*	0.046**	0.064*	0.062	0.025	0.021	0.016	0.016
x High exposed commune	(0.023)	(0.022)	(0.038)	(0.038)	(0.028)	(0.028)	(0.040)	(0.040)
Sub-sample	Far from median				Close to the median			
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fit statistics								
Observations	5,256	5,248	5,256	5,253	3,380	3,375	3,380	3,380

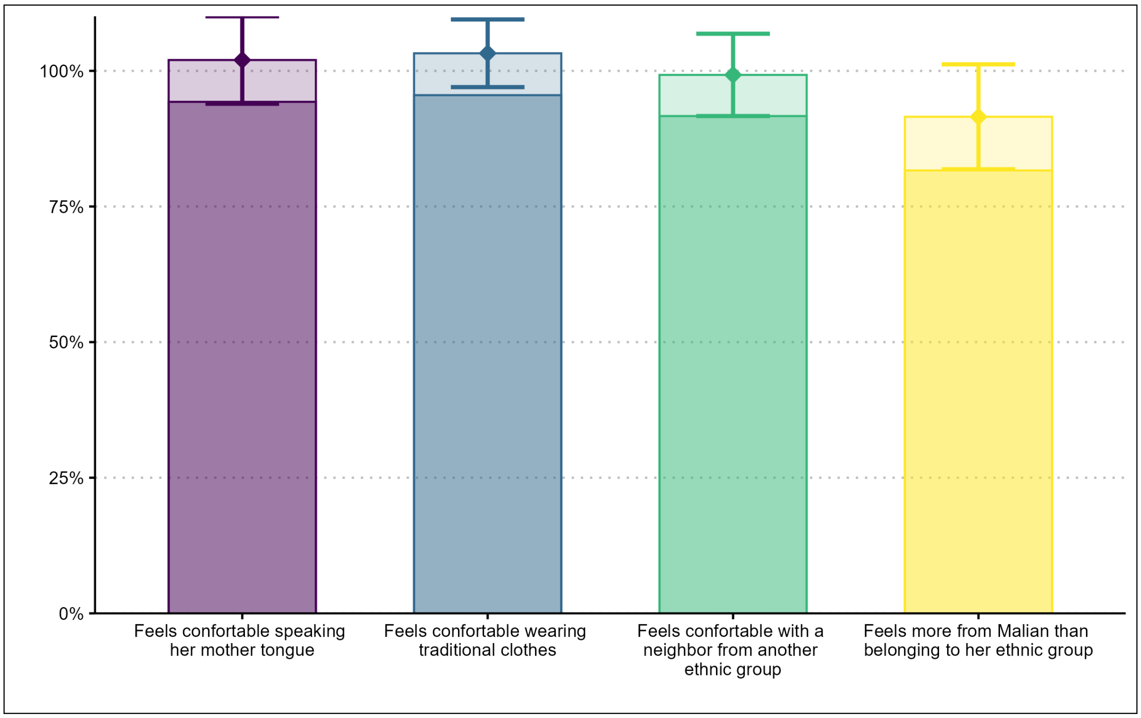
Clustered (LSMS cluster) standard-errors in parentheses

*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Notes: All dependent variables are binary outcomes. The model estimated is a linear regression. The level of analysis is at the individual level, i.e. one observation is one person. The differences in the number of observations is related to missingness of the outcome of interest in the raw LSMS data. I use the weights given in the LSMS data, and cluster the standard errors at the enumeration area. Clustering at the treatment level, i.e. the commune, produces the same results. I define the sub-sample of commune far (close) to the the median when it has a bilingual education supply at least (below) 10 percentage points higher or lower than the median. I use district fixed effects in all regressions.

Table A.9: TWFE results on learning outcomes by distance to the district median

B.4 Political cost



Notes: The solid bars represent the outcome mean at baseline, for the four outcomes described on the x-axis. The shadowed areas on top on the solid bars illustrate the effect of bilingual education on each of these outcomes, with the corresponding 95% confidence intervals. Point estimates and 95% confidence intervals are derived from a TWFE linear regression, described in Table A.10. The first outcome is derived from the question Q86B, and the second from the question Q82B, as coded in the codebook for the round 8 of Afrobarometer; I assigned a value of 0 for answers between 1 and 2, and 1 for answers between 3 and 5. The third outcome is derived from the question Q82D and the fourth from the question Q82C.

Figure A.21: TWFE coefficient estimates of bilingual education effects on ethnic outcomes

Dependent Variables:	Doesn't dislike having a neighbor from another ethnic group	Feels more Malian than from her ethnic group	Feels confortable... Wearing her traditional or cultural dress in public	Feels confortable... Speaking her mother tongue in public
Model:	(1)	(2)	(3)	(4)
Variables				
Born after 1994	-0.088**	-0.026	-0.036	-0.044
	(0.036)	(0.039)	(0.026)	(0.032)
High exposed commune	0.012	-0.022	-0.051*	-0.037
	(0.021)	(0.041)	(0.028)	(0.031)
Born after 1994 × High exposed commune	0.076	0.099*	0.077**	0.077
	(0.046)	(0.059)	(0.038)	(0.049)
Fit statistics				
Mean of Y	0.917	0.816	0.955	0.943
Observations	854	851	466	467
R^2	0.04905	0.04081	0.10228	0.07983

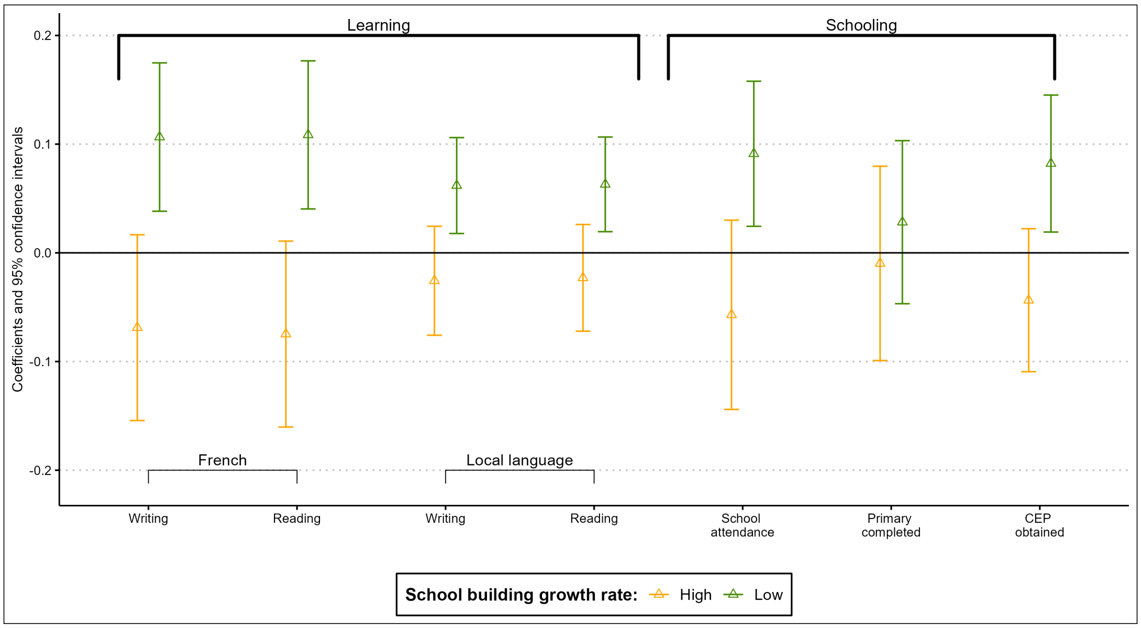
Clustered (Afrobarometer EA) standard-errors in parentheses

*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Notes: All dependent variables are binary outcomes. The first outcome is derived from the question Q86B, and the second from the question Q82B, as coded in the codebook for the round 8 of Afrobarometer; I assigned a value of 0 for answers between 1 and 2, and 1 for answers between 3 and 5. The third outcome is derived from the question Q82D and the fourth from the question Q82C. The model estimated is a linear regression. The level of analysis is at the individual level, i.e. one observation is one person. The differences in the number of observations is related to missingness of the outcome of interest in the raw Afrobarometer data. I use district and survey round fixed-effects. I use the weights given in the Afrobarometer data, and cluster the standard errors at the enumeration area for every round of survey data collection. Clustering at the treatment level, i.e. the commune, produces the same results.

Table A.10: TWFE results on ethnic salience outcomes

C Robustness checks



Notes: Point estimates and 95% confidence intervals are derived from a TWFE linear regression on several outcomes: (1) and (2) are writing and reading literacy in French, (3) and (4) in the local language, and (5) (6) and (7) are school achievements indicators. I use district fixed effects to capture the fact that the median of bilingual education share varies across districts. I cluster at the LSMS cluster level, which corresponds roughly to the commune level. To obtain heterogeneous effects, I interact the DiD coefficient in Equation 1 with a dummy equal to one if the growth rate between 1998 and 2009 at the commune level (computed as one minus the share of schools in 2009 that were already existing in 1998) is higher than the national median, and add this dummy as well to the set of fixed-effects.

Figure A.22: TWFE coefficient estimates of bilingual education effects, by the exposure to school construction

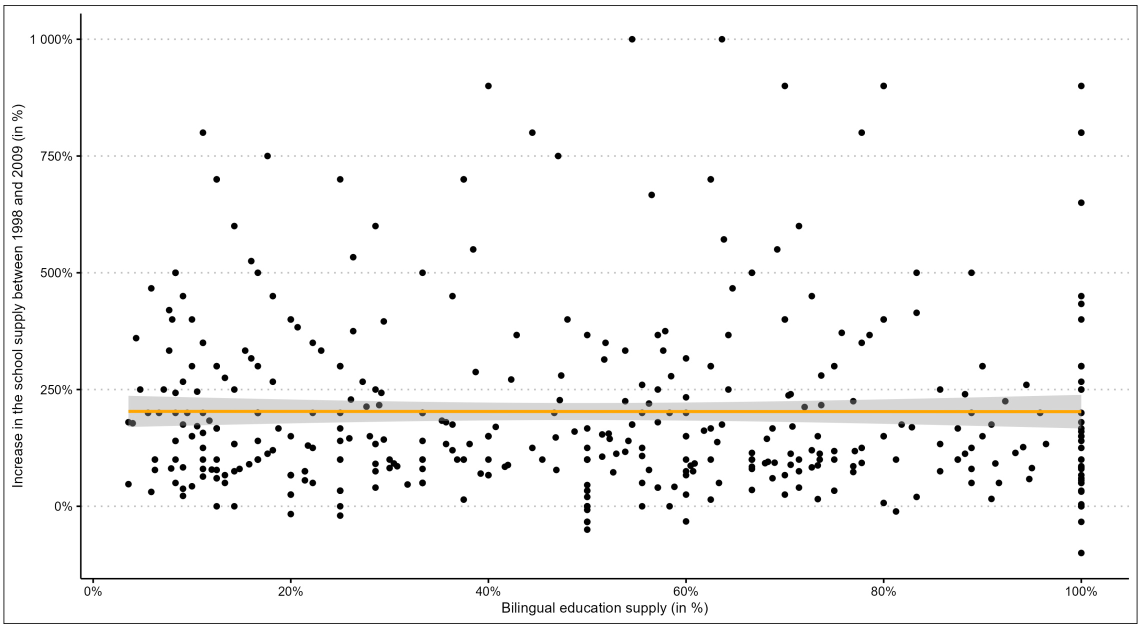
Dependent Variables:	Local language Writing	Local language Reading	French Writing	French Reading	Attended school	Completed primary educ.	Primary school diploma
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables							
Born after 1994	0.008	0.006	0.137***	0.136***	0.156***	-0.021	0.072***
	(0.012)	(0.011)	(0.020)	(0.020)	(0.019)	(0.021)	(0.016)
High exposed commune	0.014	0.014	0.021	0.019	0.012	0.010	0.016
	(0.015)	(0.015)	(0.041)	(0.041)	(0.034)	(0.035)	(0.034)
Average number of school-age	0.0009**	0.0009**	0.001	0.001	0.001	0.0010	0.001
children per school	(0.0004)	(0.0004)	(0.0009)	(0.0010)	(0.0009)	(0.0010)	(0.0008)
Born after 1994 ×	0.039**	0.039**	0.055*	0.054*	0.059**	0.043	0.041*
High exposed commune	(0.018)	(0.017)	(0.028)	(0.028)	(0.026)	(0.031)	(0.025)
Fit statistics							
Mean of Y	0.123	0.118	0.489	0.484	0.495	0.282	0.305
Observations	8,636	8,623	8,636	8,633	8,635	6,001	8,635
R^2	0.04339	0.04229	0.15351	0.15019	0.12250	0.10404	0.13013

Clustered (LSMS cluster) standard-errors in parentheses

*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

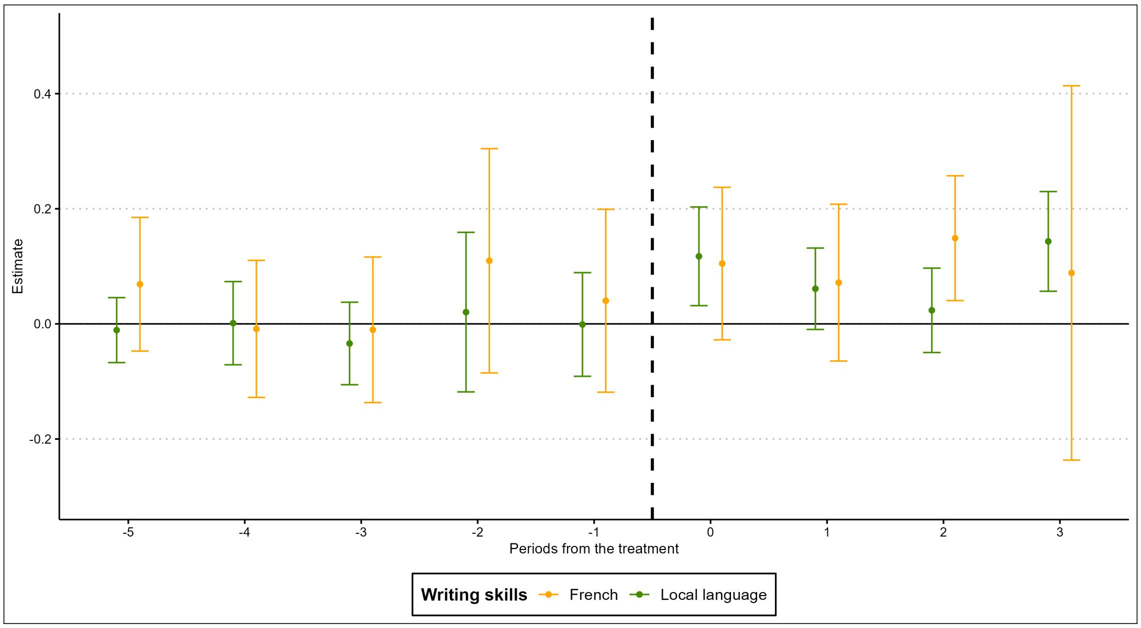
Notes: All dependent variables are binary outcomes. The model estimated is a linear regression. The level of analysis is at the individual level, i.e. one observation is one person. The differences in the number of observations is related to missingness of the outcome of interest in the raw LSMS data. I use district fixed-effects. I use the weights given in the LSMS data, and cluster the standard errors at the enumeration area. Clustering at the treatment level, i.e. the commune, produces the same results. The average number of school-age children per school is obtained by taking the ratio of the total number of children between 7 and 12 in 2009 (census) divided by the number of schools.

Table A.11: TWFE results on learning outcomes with additional controls



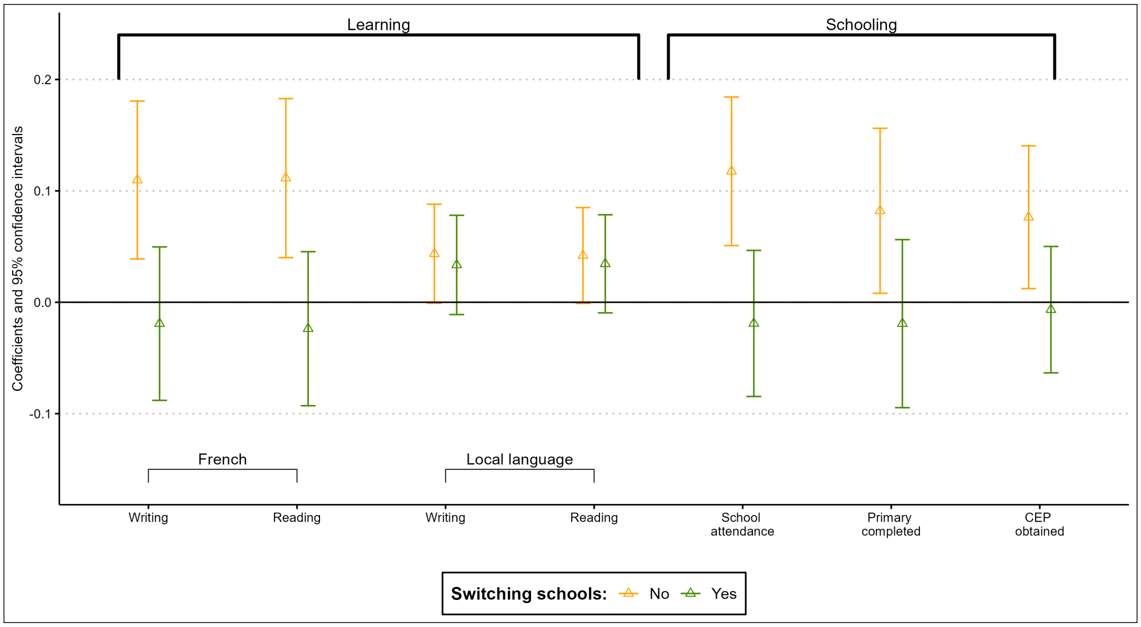
Notes: One black dot corresponds to one commune in the sample. The y-axis depicts the increase in the number of schools from 1998 to 2009 as given in the census, in percentage. The x-axis represents the share of bilingual schools among the total number of schools within the commune. The orange line is obtained from regressing the share of bilingual schools on the increase in schools. The shadowed area represents the 95% confidence interval of the estimated regression coefficient.

Figure A.23: Correlation between school building and bilingual education supply



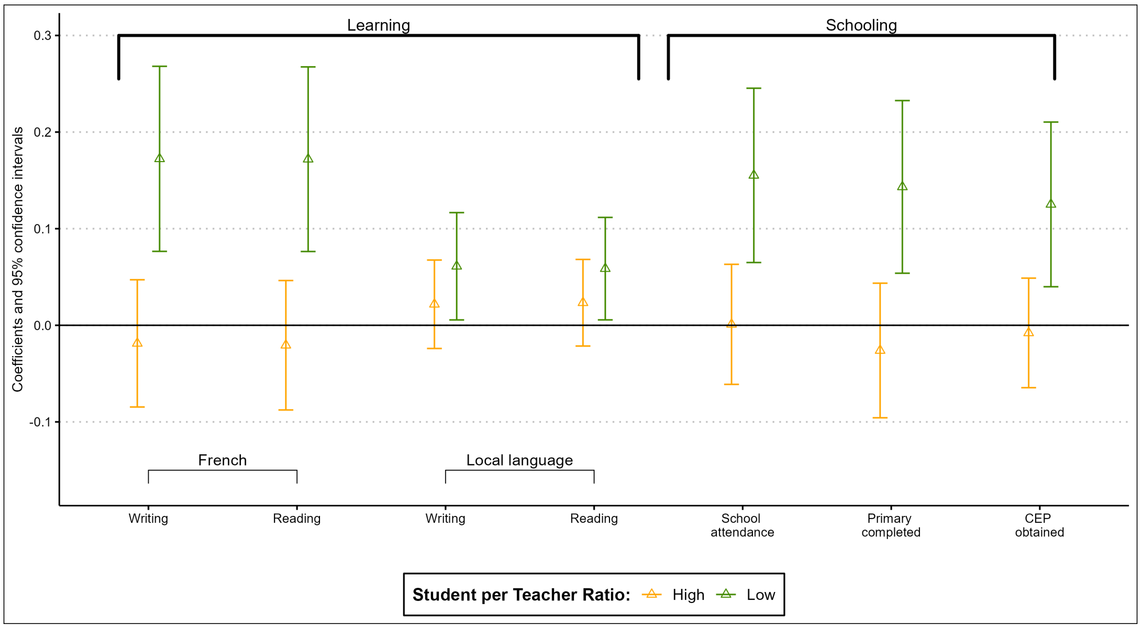
Notes: Point estimates and 95% confidence intervals are derived from a staggered analysis using Borusyak, Jaravel, and Spiess (2024). The dotted black vertical line indicates the last pre-treatment period. The two sets of points and coefficient estimates are obtained through two separate regressions. The treatment is estimated at the district level. I use region-fixed effects, and I cluster at the LSMS cluster level, which correspondents roughly to the village level.

Figure A.24: Staggered analysis on writing literacy



Notes: Point estimates and 95% confidence intervals are derived from a TWFE linear regression on several outcomes: (1) and (2) are writing and reading literacy in French, (3) and (4) in the local language, and (5) (6) and (7) are school achievements indicators. In addition to time and commune fixed effects, I use district fixed effects to capture that the median of bilingual education share varies across districts. I cluster at the LSMS cluster level, which corresponds roughly to the village level. To obtain heterogeneous effects, I interact the DiD coefficient with a dummy variable indicating whether the commune had some bilingual schools that switched to the French-only curriculum.

Figure A.25: TWFE coefficient estimates of bilingual education effects, by the continuity in bilingual education



Notes: Point estimates and 95% confidence intervals are derived from a TWFE linear regression on several outcomes: (1) and (2) are writing and reading literacy in French, (3) and (4) in the local language, and (5) (6) and (7) are school achievements indicators. In addition to time and commune fixed effects, I use district fixed effects to capture that the median of bilingual education share varies across districts. I cluster at the LSMS cluster level, which corresponds roughly to the village level. To obtain heterogeneous effects, I interact the DiD coefficient with a dummy variable indicating whether the student per teacher ratio at the district level is higher than the median.

Figure A.26: TWFE coefficient estimates of bilingual education effects, by the student-per-teacher ratio

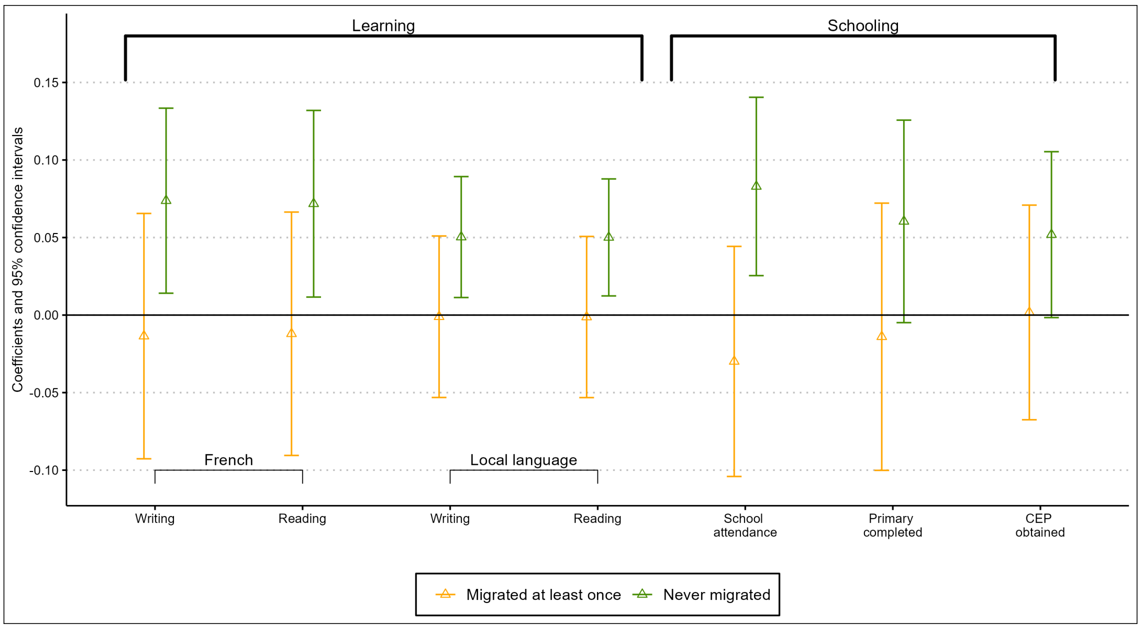
	Local language		French		Attended	Completed	Primary school
Dependent Variables:	Writing	Reading	Writing	Reading	school	primary educ.	diploma
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables							
Born after 1994	0.182***	0.011	0.175***	0.012	0.201***	0.028	0.089***
	(0.028)	(0.016)	(0.029)	(0.015)	(0.029)	(0.026)	(0.021)
High exposed commune	0.166***	0.044**	0.161***	0.045**	0.150***	0.135***	0.129***
	(0.037)	(0.021)	(0.037)	(0.020)	(0.037)	(0.032)	(0.027)
Born after 1994 × High exposed commune	0.056	0.037	0.063	0.033	0.045	0.041	0.036
	(0.040)	(0.025)	(0.040)	(0.025)	(0.040)	(0.043)	(0.036)
Fit statistics							
Mean of Y	0.117	0.112	0.437	0.433	0.459	0.241	0.259
Observations	4,162	4,162	4,161	4,159	4,162	2,889	4,162
R^2	0.17079	0.07503	0.16719	0.07337	0.15916	0.11066	0.13864

Clustered (LSMS cluster) standard-errors in parentheses

*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

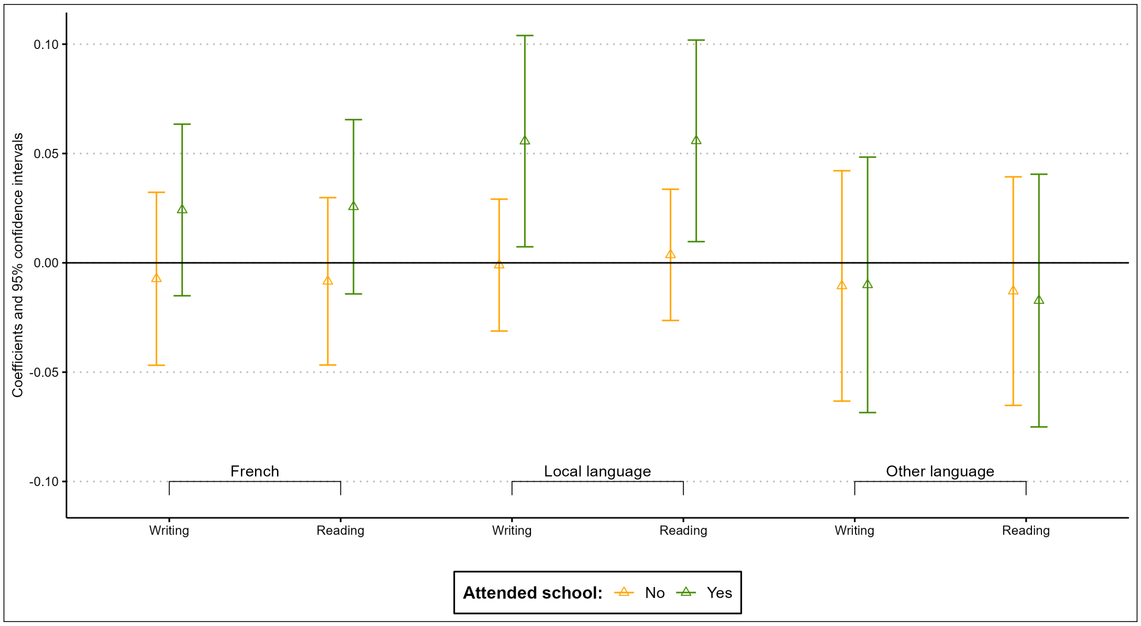
Notes: All dependent variables are binary outcomes. The model estimated is a linear regression. The level of analysis is at the individual level, i.e. one observation is one person. The differences in the number of observations is related to missingness of the outcome of interest in the raw LSMS data. I use district fixed-effects. I use the weights given in the LSMS data, and cluster the standard errors at the enumeration area. Clustering at the treatment level, i.e. the commune, produces the same results. The sample is restricted to clusters located at least 2km from the borders of the communes.

Table A.12: TWFE results restricting the sample to communes far from the communal borders



Notes: Point estimates and 95% confidence intervals are derived from a TWFE linear regression on several outcomes: (1) and (2) are writing and reading literacy in French, (3) and (4) in the local language, and (5) (6) and (7) are school achievements indicators. In addition to time and commune fixed effects, I use district fixed effects to capture that the median of bilingual education share varies across districts. I cluster at the LSMS cluster level, which corresponds roughly to the village level. To obtain heterogeneous effects, I interact the DiD coefficient with a dummy variable equal to one if the individual already experienced migration.

Figure A.27: TWFE coefficient estimates of bilingual education effects, by migration status



Notes: Point estimates and 95% confidence intervals are derived from a TWFE linear regression on several outcomes: (1) and (2) are writing and reading literacy in French, (3) and (4) in the local language, and (5) (6) in another language. In addition to time and commune fixed effects, I use district fixed effects to capture that the median of bilingual education share varies across districts. I cluster at the LSMS cluster level, which corresponds roughly to the village level. To obtain heterogeneous effects, I interact the DiD coefficient with a dummy variable equal to one if the individual went to school.

Figure A.28: TWFE coefficient estimates of bilingual education effects, by school attendance

Dependent Variables:	Born here (0/1)	Age at the school entry
Model:	(1)	(2)
Variables		
High exposed commune	0.004	-0.003
	(0.003)	(0.041)
Fixed-effects		
District FE	Yes	Yes
Fit statistics		
Mean of Y	0.989	6.60
Observations	7,727	4,121
R^2	0.00713	0.08627

Clustered (LSMS cluster) standard-errors in parentheses

*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Notes: I use a linear regression specification to obtain the coefficient estimates. I use district fixed effects, and I cluster at the LSMS cluster level, which corresponds roughly to the village level, and use household weights given in the LSMS survey. The mean of the outcomes is a weighted mean, using the same weights. The dependent variables are in Column (1) whether the individual was born in the surveyed village and in Column (2) the age when the individual started school for individuals who went to school (explaining the decrease in the number of observations).

Table A.13: Correlation between treatment and potential confounders