History matters: the long-term impact of colonial public investments in French West Africa

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Abstract

To what extent do colonial public investments continue to influence current regional inequalities in French-speaking West Africa? Using a new database and the spatial discontinuities of colonial investments policy, this paper gives evidence that early colonial investments had large and persistent effects on current outcomes. The nature of investments also matters: current *educational* outcomes have been more specifically determined by colonial investments in *education* rather than health and infrastructures, and vice-versa. I show that a major channel for this historical dependency is a strong persistence of investments: regions that got more at the early colonial times continued to get more.

Keywords: development, history, public investments

JEL classification: N37, O11, P16

Since West African countries acceded independence in 1960, their economic performances have been strikingly low in comparison with other developing countries. This is what makes many observers refer to an "African tragedy". Obviously, the need for understanding this tragedy is a crucial issue. The economic historian Paul Bairoch writes: "*There is no doubt that*

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a large number of negative structural features of the process of economic underdevelopment have historical roots going back to European colonization" (Bairoch (1993, p.88)). Since 2000, a growing literature focuses on the interaction between colonialism and development. Several empirical papers have tested the impact of colonial history on development paths and for the best clarity I classify them in three groups according to their colonial dimension of interest. A first group of papers focuses on differences induced by colonisers' identities: La Porta et al. (1998) and Acemoglu and Johnson (2003) find that colonizing countries had an impact on the development path of ex-colonies through the nature of legal systems they imported in colonies. Both give evidence that former English colonies benefit from better institutions than former French colonies thanks to a more efficient legal system inherited from colonial times. A second group of papers focuses on the impact of European settlement: Acemoglu, Johnson and Robinson (2001) show that former settlement colonies perform better than former extractive colonies because they inherited institutions that protect better private property rights. Finally, a third group of papers focuses on the impact of institutions induced by particular administrative rules: Banerjee and Iyer (2005) study the impact of colonial land tenure system on Indian districts development. They provide evidence that districts in which property rights in land were given to cultivators now perform better than districts in which these rights were given to landlords. Iyer (2004) compare economic outcomes in India across areas under the direct colonial rule of British administrators with areas under indirect colonial rule. She finds that districts under direct colonial rule have significantly lower availability of public goods than districts under indirect colonial rule.

These two last papers differ from the others in the sense that they do not compare all former colonies but focus on one particular country, India. The authors argue that it allows them to locate the source of difference more easily, relative to the case where ex-colonies have radically different historical, geographical, cultural backgrounds as well as different colonial

histories. My paper follows the same idea: it focuses on one particular source of difference - colonial public investments- in one particular area –French West Africa. This region exhibits a noticeable homogeneity regarding to its geographical, anthropological, cultural and historical characteristics. Moreover, it was colonised by France only (which allows us to control for the coloniser's identity), at the same period (from the last quarter of the nineteenth century to 1960[3]). The sources of difference between districts of former French West Africa are therefore easier to identify than between all former colonies. I compare the current performances of French West African districts that received different levels of public investments during colonial times. This paper thus proposes an empirical framework to estimate the long term impact of public investments on spatial inequalities. This is motivated by two underlying questions: first, what is the importance of colonial history relative to pre-colonial history and geography? Second, what are the long term returns of public investments?

With respect to the existing literature, this paper innovates in underlying the role of public investments rather than the more general role of institutions. Institutions are commonly viewed as providing a general favorable environment for development. But it is not clear in what precise way they encourage economic development. Acemoglu, Johnson and Robinson (2003) privilege the interpretation of institutional overhang, but it is generally impossible to distinguish between the various potential channels of institutions' influence. Banerjee and Iyer (2005) and Iyer (2004) give evidence that the effect of land tenure system and colonial rule on productivity in India is indirect, partially lying on their effect on current investments: they argue that the differences in current economic outcomes are largely due to differences in current investments. Focusing on public investments therefore contributes to precise why

[3] Guinea acceded independence in 1958, whereas the other colonies of French West Africa acceded independence in 1960.

long term history matters. The results are robust when controlling for country fixed effects - which captures the effect of institutions, so I am investing a very distinct channel for persistence of differences in the colonial period. Another advantage of this paper is the use of a first-hand dataset that matches direct and precise historical data with current data on districts. Colonial and pre-colonial data come from historical archives found in Paris and Dakar, whereas recent data come from national household surveys performed in the middle of the 1990's. I matched both using the geographical coordinates of the surveyed households' locality and very precise colonial maps of each district.

Colonial times introduced important differences between districts of former French West Africa. Colonial investments in education, health and infrastructures were indeed very unequal among districts. Graphs 1 and 2 plot colonial investments and 1995 performances. They show a strong relationship between colonial investment and outcomes today. But the relationship between colonial investments and current development cannot be taken as conclusive evidence since pre-colonial characteristics could have influenced both colonial investments and development paths, resulting in bias estimates of the causal effect of public investments on current development. French colonial power could actually have invested more in the most prosperous districts, which would have reached a higher level of development than the poor ones anyway. To overcome this potential selection bias, this paper uses a number of strategies. First, it exploits proxies of the potential determinants of colonial investments, which can be classified in three groups: geographical factors, pre-colonial factors, and characteristics of colonial conquest. Access to a detailed history explains how variations came about. OLS regressions including these proxies give a first estimate of the impact of colonial investments on current development controlling for main pre-colonial characteristics. Second, I use historic data on pre-colonial population densities and political development to examine whether it was the most developed parts of West Africa that selected

into colonial investments. Evidence shows that it was actually not the case. Third, I use the geographical discontinuities of colonial policy in order to circumvent the problem of omitted variable. The autonomy of the French districts' Administrators and the arbitrariness of colonial borders actually lead to accidental variations between neighbor districts. Some unobservable characteristics that may not be captured by our OLS controls should be in fact similar for neighbor districts, so differences in outcomes between neighbor districts are more likely to be due to differences in colonial public investments.

Results show that colonial public investments have been a strong determinant of current districts' development. Colonial investments in a certain type of public goods (education, health or infrastructures) between 1910 and 1928 explain about 30% of the corresponding current performances. Moreover, the nature of investments matters: current educational performances are more specifically determined by colonial investments in education, as current health performances by colonial investments in health and current infrastructures' development by colonial public works. I also find lower but significant cross-effects of health investments on connection to electricity and access to a private water tap. According to my estimates, the long term impact of colonial investments is thus very high. The path of public investments from 1910 to 1939 show that districts which received much in early times kept on receiving more than the others later, which explains that differences did not narrow over time. I find that the fact that later investments continued to be located in areas that had many of them already is more likely to be due to the lasting nature of physical facilities and positive externalities on local demand for public goods rather than externalities across investments, political externalities or appropriation of public investments by political power.

The paper is structured as follows: Section I describes historical background and investments policy under French rule in West Africa. Section II describes data and gives some summary

statistics on current development, colonial investments and districts' characteristics. Section III describes the empirical approach used to estimate the impact of colonial investments on development paths. The main empirical results are reported and discussed in section IV. Section V discusses the mechanisms that might explain the persistence of the effect of colonial investments. Section VI concludes.

I. Historical background: French colonisation

A. French political control on West Africa

French West Africa lasted officially 65 years, from 1895 to 1960. Empirically, military expansion lasted from 1854 to 1903, pacification from 1854 to 1929 and effective occupation from 1904 to 1960.

The French first arrived in 1854 on the Senegalese coasts, driven by the famous General Louis Faidherbe. Colonial expansion in the 1850's began from the west of the region: a first military column went from the Senegalese coasts eastbound and arrived in the late 1850's at the west side of current Mali (Kayes, Satadougou). A second military expansion was engaged during the 1850's northbound to current Mauritania. A third military expansion took place along the Guinean coasts (Conakry, Boffa, Boke, Forecariah). South Dahomey was then the only new expansion of the 1860's. No new expansion occurred during the 1870's. Main colonial expansion occurred in the 1880's from South to North and from West to East. In the 1890's, a last military column progressed from the south-east side of current Mali towards East as far as Lake Tchad, joined by a column progressing from Benin's coasts towards North.

French West Africa was officially created in 1895 as a federation of colonies of West Africa. But the conquest was not yet achieved. The Federal Government became effective in 1904. Despite a military control on the major part of the territory before 1900, there were no sensitive all-day life modifications for local people before 1900-1910 except in few coastal localities. Local chiefs' prerogatives in particular were in general still intact, their military obedience being materialised by friendship treaties. Hostile chiefs only suffered from French military repression. Civil administration took place progressively in the whole territory from 1900 to 1920. We can thus consider that an administrative occupation has been effective in the major part of the territory from approximately 1910 to 1960.

B. Financial and administrative organisation of French West Africa

French colonial administration was structured as a pyramid: at the top stood the General Governor of the federation. "Lieutenant-Governors" were below at the head of the colonies: Senegal, Guinea, Dahomey, Soudan, Upper-Volta, Ivory Coast, Niger and Mauritania. Administrators were below at the head of the districts, about 15 per colony. In 1925, French West Africa counted 120 districts (see Map 1). The largest districts were divided in subdivisions that were also managed by French administrators (in 1925, the number of subdivisions -or districts when the districts had no subdivision- amounted to 164). African chiefs were at the bottom of the pyramid. The colonial administration designed local chiefs as "village's chiefs" and limited their influence to small areas.

In this pyramidal organisation, the effective power was concentrated at the third stage: the districts' administrators were "*the real chiefs of the French empire*" (Delavignette (1939)). Their tasks were very important: overseeing tax collection, representing the Lieutenant-Governor in all official events, counting people living in the district, drawing up the district's map, steering elementary schools, watching Koranic schools, planning and supervising the building of roads, bridges, wells and tracks, arresting criminals and judging them according to the "native population code"[4]. The official tasks of African chiefs were to collect taxes, recruit workforce for hard labour and recruit military reservists. The number of reservists to recruit and the amount of taxes to collect was defined by French district's administrators. African chiefs were therefore quartered to auxiliaries of French colonial administrators. The administrative organisation was thus officially centralized but effectively decentralized. French districts' administrators could manage their local policy in an almost independent way thanks to physical distances and lack of means of communication. Neighbour districts could therefore experiment different colonial policies.

[4] Called in French the « code de l'indigénat ». This code was exclusively devoted to African people.

French colonial financial system in West Africa was organised with 3 levels of budgets: the budget of the French Ministry of Colonies, French West Africa's federal budget and colonies' local budgets. The budget of the French Ministry of Colonies was credited with metropolitan taxes and entirely devoted to military expenses. French West Africa's federal budget was credited with custom duties generated by trade between the federation and the rest of the world. This budget had to cover three expenses: the running expenses of the General Government and its central services, large-scale public works covering several colonies (mostly railway works), and subsidies to poor colonies (only Mauritania). Finally, colonies' local budgets were credited with local taxes. Each colony had to use its own resources so as to finance French colonisation costs (except Mauritania which benefited from federal subsidies). According to the statistics I computed[5], 60% of colonies' budgets came from the capitation tax. Direct taxes (capitation tax, trading tax and property tax) represented altogether 89% of total colonies' resources. Local budgets had to cover all expenses except for military expenses and some of the biggest large-scale public works. Colonisation's costs were thus endured by local populations themselves rather than French taxpayers, and more precisely mostly by households rather than firms. Colony's government and central services absorbed 30% of colony's resources. Districts received the other 70%, on average distributed as follows: 40% for administration expenses, 10% for public works, 15% for education and health expenses (personal and material), and the 5% left for miscellaneous expenses. Investments in infrastructures, health and education in districts amounted together to 25% of colonies' budgets. All expenses in colonies and *a fortiori* in districts were therefore carried out by local budgets, except for some very large-scale public works, almost exclusively railway works, financed by federal resources.

[5] These statistics were calculated from 71 budgets covering the 8 colonies between 1907 and 1930.

C. Public goods investment policy

Colonial administration invested in three public goods: education, health and infrastructures. Every year French administrators had to define precisely how many teachers, schools, doctors, hospitals they needed and how much money they wanted for public works so as to elaborate the annual local budget. In education field, administrators had thus to decide how many European teachers, African teachers and teaching assistants as well as how much teaching material they needed. In medical field as well, they decided how many European doctors and nurses, African doctors and nurses, medical assistants and how much medical material they needed. Finally, they decided how much financial resources they needed to cover their infrastructures expenses: roads, wells, tracks, buildings, bridges' reparations and constructions. A very precise "plan de campagne" was established annually to describe all the works to be performed in each locality.

Colonial investments in education, health and infrastructures were not proportional to districts' taxes. Taxes were actually brought together at the colony level, most of them were absorbed by central services and administration expenses, and the part of public expenses devoted to colonial investments was reallocated among districts with little concern about the initial contributions of each districts. Some districts contributed a lot in local budgets but received back low investments, others contributed a lot in local budgets and received back high investments, and conversely. As a consequence, the correlation between tax revenue and public investment was positive but small (about 0.2). No explicit investments strategy can actually be found in local budgets. Motivations reported at the beginning of each local budget explain the general level of annual resources and modifications in resources employment but do not motivate the spatial distribution of public goods provision. However, all historical documents on French colonial administrative system mention the relative autonomy of French districts'

administrators and their power in terms of policy making (Cohen (1974), Ki-Zerbo (1978), Bouche (1991)). Biographies of former French colonial administrators also give evidence on their initiating role in investments decision processes (Delavignette (1939), Duchamps (1975)). The influence of administrators on investments policy was thus certainly very high. Thus, their personality or educational background could be an exogenous source of differences in colonial public investments. But some intrinsic districts' characteristics also certainly influenced administrators' investments policy and constituted therefore an issue for identifying the causal impact of colonial investments on current development. My empirical strategy tries to circumvent this potential problem.

II. Data and summary statistics

To estimate the impact of colonial investments in public goods on current districts' development, I use data on current development, colonial investment policy and other pre-colonial characteristics as control variables. All data are at the district level, a district in French West Africa being an administrative unit within a colony. Map 1 shows the districts configuration the paper refers to, which is the configuration in 1925. At this time, French West Africa counted 120 districts in 8 colonies. On average districts have an area of 48 000 km^2 and a population of 120 000.

I choose to use district-level rather than state-level data for two major reasons: first, using district-level data gives a larger sample size. Second, French colonial system was in fact decentralised and variations therefore arose at the district level rather than at the state level. District was thus the pertinent unit in respect to historical effects the paper focuses on. The drawback is that no district-level data is available so I had to compute current and historical data on my own.

A. Current districts development

Although West Africa counts among the poorest regions of the world, there is an important heterogeneity between countries of this region. In 2000, Ivory Coast's GNP per capita (690$) was four times higher than Niger's (190$)[6]. In 1995, primary net enrolment rate varied from 25% in Niger to 75% in Benin[7]. Literacy rate amounted to only 13.5% in Niger, around 20% in Mali and Burkina Faso, 32% in Senegal and Benin, 38% in Mauritania, and reached 44% in Ivory Coast[8]. The inequalities between countries are thus consequent. But the greatest inequalities in former French West Africa do not arise at the state level but at the district

[6] Sources: World Bank statistics.
[7] Sources: World Bank statistics.

level. District level data on current development used in this paper come from national household surveys implemented in the 1990's[9]. Unfortunately, I could not use any survey for Benin which is therefore out of the sample. The number of available districts is therefore 101. Development indicators which can be computed from each national household surveys are: (i) the proportion of 7-12-year old children attending school, (ii) the proportion of 0-5-year old children suffering from stunting and (iii) the proportions of households connected to electricity, having access to a private water tap and using a modern fuel[10]. The Mauritanian survey does not contain information about the weight and the height of the children, so (ii) excludes Mauritanian districts.

The top part of table 1 presents summary statistics on those 5 development indicators. On average per district in 1995, 34% of the 7/12-year old children attended school, 37% of 0-5-year old children suffered from stunting, 12% of households were connected to electricity, 10% had access to a private water tap (as opposed to public sources of water like fountains or natural sources like streams), and 14% used a modern fuel for cooking. Data thus give evidence of the very low development level of French-speaking West Africa. But the distributions of all these indicators are exceptionally unequal, particularly for infrastructures development indicators, as shown by the high values of standards errors and gaps between means and medians or between 25th and 75th percentiles.

Map 2 represents the geographical distribution of districts by terciles of the proportion of 7-12-year old children attending school. The districts of the first tercile are light coloured, those of the third tercile are dark coloured. We can observe some regional tendencies ("light" areas versus "dark" areas): North-West of West Africa and South of Ivory Coast are

[8] Sources: World Bank statistics.
[9] See Appendix 1 for further details on data.

obviously more educated than the rest of the region. Spatial inequalities are therefore partly a matter of country and geographical location. Nevertheless, these maps also give evidence of an important heterogeneity between neighbouring districts. To measure the importance of being in a particular country, I decomposed the total variance of each indicator in two parts, the variance within countries and the variance between countries. I calculated the share of total variance due to variance within countries and it shows clearly the predominance of within countries variance which represents around 80% of total variance. Country or geographical position is thus a small part of the story. What we have to explain are therefore inequalities at the district level rather than at the state level.

B. Colonial public investments

Data on colonial investments come from annual local budgets from 1910 to 1928. Local budgets are presented at the colony level but often detail tax revenue and public investments at the district level. Regarding education, I collected the number of teachers per district for each available year between 1910 and 1928 and use the average number of teachers per 100,000 inhabitants as a proxy of colonial investments in education. I use exactly the same variable for colonial investments in health substituting medical staff to teachers. Finally, I collected annual public works material expenses per district between 1910 and 1928 and use the average amount of public works expenses over 1910-1928 per capita as a proxy of colonial investments in infrastructures[11]. Public works consisted in roads, wells, tracks, buildings and bridges repair and construction.

[10] Surveys count on average 450 households, 620 7-12 year old children and 370 less than 5 year-old children per district.

[11] Another possible proxy of colonial investments in infrastructures could be the annual public works material expenses per district between 1910 and 1928 divided by land area. My results are robust whatever proxy is used. But dividing the amount of public works expenses by land area is more problematic in presence of desert-edge districts because land area is huge and effective land occupation is very low, resulting in a confusing proxy.

Data on large-scale public works financed on federal resources are not included for two reasons: first, it would have required the collection of federal budgets data in addition to local ones, which represents an important additional effort; second, federal budgets do not decompose investments neither at the district level nor at the state level, which would make any repartition between districts very hypothetical. This exclusion produces actually an understatement of colonial investments inequalities: large-scale public works financed on federal resources were mostly devoted to main towns or main axes of each colony, those which were already advantaged by local budgets. Actual colonial inequalities in infrastructures were thus probably larger than measured here.

It is well known that Christian missionaries were quite important in the development of education and health systems in English African colonies as well as in French Equatorial Africa, but they were mainly absent from French West Africa (Ki-Zerbo (1978), Bouche (1991)). In 1903, the French parliament actually voted the secularization of social services in the colonies and stopped the subsidies accorded by French authorities to Christian missionaries. Archives thus do not mention the role of missions except in Dahomey[12], which is not included in my study. The omission of Christian missionaries in this paper should therefore not affect my results. Beside Christian missionaries, there were also in some areas some Koranic schools, but I will not take them into account because these schools dispensed a very specific education which focuses on religious achievement.

As shown in the medium part of table 1, colonial investments per district were very low: 4 teachers and 8.5 medical workers per 100,000 inhabitants and 0.44 FF[13] per inhabitant for public works on average per year over 1910-1928. Standard deviations are very high compared

[12] Bouche (1991) explains that this colony had a significant part of missionary schools because the demand for education was far more important than the supply from public services in this colony.
[13] Monetary data are calculated in constant 1910 FF.

to means and gaps between terciles' means are huge, especially between the two top terciles. This gives evidence that colonial investments were very unequal. Maps 3 and 4 show the geographical distribution of colonial investment in education and health. It is clear that colonial investments policy were unbalanced: Upper-Volta and South-East of Niger have been disadvantaged in terms of human capital investments; investments in infrastructures were more concentrated in coastal areas of Senegal, Guinea and Ivory Coast and that reflects the structure of French colonial economic system based on trade with European countries. In addition to regional discriminations, it is also noticeable that many neighbour districts received very different colonial treatments. The average gap between two neighbour districts is equal to 5 teachers and 10 doctors, which is big compared to the average numbers of teachers and doctors per district.

Totalizing average investments per district over 1910-1928 shows that there were on average only 700 teachers and 1 230 medical workers in whole French West Africa (among who a large majority of Africans). Colonial investment effort was thus not massive. But these investments were very unequally distributed. Colonial public investments' policy was therefore an important source of inequality between districts.

C. Other districts characteristics

At the end of nineteenth century, French West Africa was a vast territory of 4 800 000 km^2 habited by a scarce population of around 12 000 000 people[14]. Population density was therefore very low (2.5 people per km^2). As said in introduction, a great advantage of limiting the study to a geographically restricted area is that sources of variation can be much more easily identified than in case of very different historical, anthropological, geographical and institutional backgrounds. This section identifies districts' characteristics which potentially

determined both colonial investments and development performances. I collected an important number of districts' observable characteristics. All data are original ones.

Geographical characteristics

Districts' geographical characteristics are potentially important determinants of their development path: they condition soil fertility, climate severity or mildness, accessibility to water, etc (Bloom and Sachs (1998)). Climate, proximity to the coast or access to practicable rivers could also have influenced colonial investments through their impact on districts accessibility and attractiveness. I thus use geographical characteristics reflecting districts' accessibility and attractiveness as control variables. These characteristics are altitude, annual precipitations, latitude, longitude, presence of a coastal border and presence of an important river.

Pre-colonial history

We could expect Europeans to prefer pre-colonial prosperous areas. The colonial strategy was actually extraction. Profitability of extraction was likely to be higher in prosperous areas because dense population provided a supply of labour that could be forced to work in plantations and public works and also because there are more resources to be extracted (Acemoglu, Johnson and Robinson (2002)). Curtin (1995, p. 447) writes that "European capital was invested where exploitable resources promised the most extractive returns". District-level information on pre-colonial times is difficult to collect but I constructed four proxies of pre-colonial districts characteristics. First, I capture the pre-colonial economic prosperity with the initial population density. As documented by Malthus (1798) and Bairoch (1988), only prosperous areas could support high population densities because more natural resources and agrarian prosperity is necessary to nourish a large population. This measure is therefore more

[14] This corresponds to French West Africa's population around 1910. See Appendix 1 for further details on data sources.

appropriate in the case of rural societies. At the end of the nineteenth century, West Africa was mostly a rural area: towns were scarce and very small[15]. Pre-colonial population density was concentrated in 5 places: on the right side of the Niger Loop (Mossi States), on Senegalese coastal areas (Djolof kingdoms), in central Guinea (Fuuta-Jalon), in south-central Ivory Coast (Baoule people), and in Guinean forest area (Toma and Guerze people). Second, I use the amount of trading tax collected in 1914 in each district to control for commercial development. Trading tax was introduced few years before 1914 and regarded all secondary and tertiary activities. Tariffs depended on firms' activity and number of employees. Third, besides these local trade activities, there were some very important overseas trade areas: European trading counters. These trading counters had created big discontinuities in West African economic development. That is why I simply constructed a dummy variable indicating the location of these European trade counters. Fourth, I roughly capture the differences in pre-colonial political development with a dummy for pre-colonial centralized political power ("state societies") as opposed to stateless societies. The existence of a centralized political power could have encouraged colonial investments according to the fact that investments could be more profitable in state rather than stateless districts, as shown by Geneaioli and Rainer (2003).

French conquest characteristics

Colonial conquest could reveal some districts intrinsic characteristics which make them more or less attractive for French power and more or less inclined to develop. I therefore use three variables on colonial conquest as control variables: first, the year of French colonial conquest's beginning, defined as the year of arrival of the first military troops. Fifty years passed between the beginning and the end of French colonial expansion in West Africa, which makes a big difference in comparison to the length of colonial era itself. Colonialism timing might be

[15] In 1910, the five biggest towns were Saint-Louis (around 24 000 habitants), Dakar (18 400), Rufisque (12 500), Conakry (8 200) and Cotonou (4 400). These towns were actually much smaller at the end of the pre-colonial era.

correlated with both colonial investments (early conquered districts could have been advantaged in comparison to lately conquered districts or may be disadvantaged since colonization was extractive) and development potentialities (more affluent areas could have been colonized sooner). Second, I use African people resistance against French colonial power as control variable because it might be correlated with colonial investments (rewards or punishments in response to local people's attitude) and development potentialities because resistance might reflect some cultural, anthropological or political characteristics. Third, I use local chiefs' indemnities as control variable because these indemnities rewarded chiefs for their obedience to colonial power. Chiefs' indemnities are thus a proxy for African chiefs' reaction: some refused to cooperate and were often killed or exiled, whereas others cooperated with French colonial power and received some indemnities. As African people resistance, collaboration between traditional and colonial power might reflect be correlated with both colonial investments and development potentialities.

Early European settlement

According to existing literature, European settlement encouraged good colonial treatment (Acemoglu, Johnson and Robinson (2001), Cogneau and Guénard (2003)). In West Africa, very few Europeans settled in comparison to other colonies like Australia, Canada etc. However, early French settlement can reflect districts initial attractiveness. Since it was probably a strong determinant of colonial investments, the impact of colonial investments on current performances could be driven by the fact that Europeans settlers tended to select into more prosperous areas. Moreover, European settlement *per se* could influence positively development paths through institutional channels, as documented in Acemoglu, Johnson and Robinson (2001). Faced with the statistical challenge of isolating the causal impact of public investments, controlling for European settlement is thus of crucial concern. But the flip side of this strategy is that European settlement could also be endogenous to colonial public

investments: the supply of public goods might be attractive for new settlers as well. To solve this problem, I add only early European settlement (1910) as a control variable, since early European settlers were more likely to be influenced by districts' characteristics compared to colonial supply of public goods simply because the supply of public goods was almost non-existent at the beginning of colonial times. 1910 is early enough to argue that European settlement was unlikely to be the result of any colonial policy.

III. Basic correlations: OLS Estimates

A. Empirical Strategy

I compare districts development performances according to colonial investments they received between 1910 and 1928 by running ordinary least squares regressions of the form:

$$(1) \qquad Y_i = \alpha + \beta CI_i + OCI_i\gamma + X_i\lambda + u_i$$

where Y_i is an outcome variable in district i, CI_i the colonial investment of interest in district i, OCI_i other colonial investments in district i and X_i control variables.

Outcomes in equation (1) are those presented in section II: the proportion of 7/12-year old children attending school, the proportion of 0-5-year old children suffering from stunting and the proportions of households connected to electricity, having access to a private water tap and using a modern fuel.

Regarding colonial investments, what interests me more specifically is the impact of colonial investments in education on educational performances, the impact of colonial investments in health on health performances and the impact of colonial investments in infrastructures on infrastructures' development. As colonial investments in education, health and infrastructures are highly correlated, I want to disentangle each investment's own effect. I thus measure the specific impact of a given colonial investment (CI_i in equation (1)) on the related current performance (Y_i in equation (1)) by controlling for the other colonial investments (vector OCI_i in equation (1)). When Y_i is districts' proportion of 7/12-year old children attending school, CI_i is therefore districts' average annual number of teachers per 100,000 capita, and vector OCI_i is districts' average annual medical staff per 100,000 capita and average annual amount of public works per capita. When Y_i is districts' proportion of 0-5-year old children suffering from

stunting, CI_i is districts' average annual medical staff per 100,000 capita, and when Y_i is one of the three infrastructures development indicator, CI_i is districts' average annual amount of public works per capita, vector OCI_i being the two other colonial investments. Since districts which received many teachers received also many doctors and much infrastructure (correlations between these three variables are between 0.60 and 0.80), colonial investments impact is likely to be driven by the general amount of investments rather than by a specific investment. Controlling for the two other colonial investments in equation (1) is therefore interesting to isolate the specific impact of each kind of investment and brings an additional control for the potentially unobserved characteristics which influenced all investments in the same way. It helps to identify the causal impact of a specific investment on the corresponding current outcome.

X_i is the set of control variables described in section 3: geographical variables (precipitations, altitude, latitude, longitude, coastal border dummy and practicable river dummy), pre-colonial prosperity (centralised political power dummy, 1910 population density, 1914 collected trade taxes per capita and European trade counter dummy), conquest variables (year of colonial conquest's beginning, length of local resistance and local chiefs indemnities) and early European settlement (1910 European settlers per 100,000 inhabitants). I argue that these controls are more precise and demanding than usual and that they purge a big part of the endogenous factors.

Dakar and Saint-Louis had a very specific status during the whole colonial period. They were both founded by the Europeans; Saint-Louis was the first city founded by the Europeans in West Africa in 1659, it was the capital of French West Africa until 1902 and then the capital of two colonies, Mauritania and Senegal. Dakar was the capital of the whole French West Africa since 1902. These two cities were not exactly some "districts" because were not attached to a

broader region. As a consequence, Dakar and Saint-Louis did not appear in colonial budgets as districts but as "direct administrated territories". As far as public investments are concerned, Dakar and Saint-Louis received much more annual colonial investments than the classical districts: 63 (respectively 202) teachers per 100,000 inhabitants, 133 (respectively 241) medical workers per 100,000 inhabitants and 12.1 (respectively 21.6) FF per capita in public works for Dakar (respectively Saint-Louis) on average over 1910-1928. They are also much more developed today than the rest of the region. The colonial investments gap between those two cities and the others therefore would produce an important overstatement of the impact of colonial investments on current performances and would probably reflect the very specific colonial treatment they received. I therefore prefer to drop out Dakar and Saint-Louis from the sample.

Our coefficient of interest is thus β, and to a lesser extent γ, because it is also interesting to know whether there are "cross effects", for example effects of colonial investments in education on current health and infrastructures performances.

B. Results

Table 2 and table 3 report OLS estimates of the impact of 1910-1928 colonial investments on 1995 performances. Column (2) includes geographical controls, column (3) adds pre-colonial characteristics, column (4) adds conquest characteristics and column (5) adds European settlement in 1910 as control variable. In column (6) I add dummy variables that indicate the country districts located after independence. These are included for the reason that the dependent variables are taken from country surveys that may be constructed using different methodologies. Finally, column (7) reports the regression coefficients controlling for the other colonial investments to isolate the specific impact of each type of investments.

The general picture that emerges from these tables is that districts which received more investments over 1910-1928 have significantly better performances today. The size of the impact of colonial investments is important: adding one teacher per 100,000 inhabitants over 1910-1928 would lead the percentage of 7-12-year old children attending school in 1995 growing up to about 1 point. Adding one doctor per 100,000 inhabitants over 1910-1928 would lead the percentage of 0-5-year old children suffering from stunting in 1995 falling down to about 0.5 points. Finally, adding one franc per capita devoted to public works over 1910-1928 would lead the percentages of households having access to a private water tap and using a modern fuel growing up to about 3 points. But the specific impact of the investments in infrastructures appears statistically unconvincing since the coefficient is not significant in column (7), except in panel *B*. However, table 2 clearly shows that colonial investments in health and in infrastructures did not have *per se* an impact on current school attendance and that colonial investments in education and in infrastructures did not have *per se* an impact on current health performances. These findings therefore highlight the specific impact of colonial investments in education on educational performances and the specific impact of colonial investments in health on health performances, which gives strong evidence that the nature of public investments matters even in the long run. This is also an important point as regard to identification of the causal impact of public investments: the fact that "cross-investment" effects are very small compared to "direct-investment" effects is very interesting because it confirms that I identify correctly the causal impact of a specific investment rather than other correlated factors.

We can finally notice that the explanatory variables in this paper account for about 40% of the variation in 1995 health performances, 50% of the variation in 1995 school attendance and 70% of the variation in 1995 access to infrastructures. More importantly, each specific colonial

investment alone accounts for about 30% of the variation of the corresponding 1995 performance.

IV. Econometric issues: selection and causality

Although the OLS estimates show that differences in colonial investments probably *caused* differences in current performances thanks to precise and demanding controls, it remains plausible that control variables included in previous specifications do not capture all factors correlated with both colonial investments and current outcomes. In this section, I pursue two strategies to evaluate whether the relationship between colonial investments and current performances might reflect omitted variables. First, using historic data and qualitative evidence from African historians, I evaluate the importance and characteristics of selection into colonial investments. As I will show, evidence suggests that selection was not important. If any, it was usually the regions that were the least prosperous that selected into colonial investments. Given this evidence, it is unlikely that the strong relationship between colonial investments and current performances is driven by selection. Second, I use a 'natural experiment' approach that consists in comparing neighbour districts only. Results from this matching strategy confirm the OLS estimates.

A. Historical Evidence on Selection during colonial times

Using data on initial population densities (1910), I check whether it was the more prosperous or less prosperous areas that selected into colonial investments. Acemoglu, Johnson and Robinson (2002) have shown that population density is a reasonable indicator of economic prosperity, following Thomas Malthus and Paul Bairoch's arguments. Table 4 shows the relationship between population density in 1910 and colonial investments in education (respectively health, infrastructures). The data give evidence that the colonial supply of public goods was equal in most and least prosperous areas. In the cases of education and health, the advantage even turned slightly in favour of least prosperous areas, probably due to the fact that

public goods are lumpy fixed investments. In this case, the selection, if any, tends to bias the OLS estimates towards zero.

A second potential source of selection may be that societies politically well-structured have selected into colonial investments. Pre-colonial kingdoms were politically unified and therefore benefited to a greater social cohesion. As a consequence, they were likely to claim a larger share of the new public goods than decentralized and heterogeneous societies (Banerjee, Iyer and Somanathan (2006)). But data give evidence that districts located in pre-colonial kingdoms were less impacted by colonial investments than the others: the average annual number of teachers per 100,000 inhabitants over 1910-1928 was 3.5 as opposed to 5.2, the average annual number of doctors per 100,000 inhabitants over 1910-1928 was 6.3 as opposed to 10.6, and the average annual expenses in public works was 0.24 as opposed to 0.64 (all these differences are significant at the 5% level). The general picture that emerges from the data is that the selection bias is again rather downward.

One could think that colonial investments were actually determined by some characteristics related to European suitability rather than pre-colonial development. Acemoglu, Johnson and Robinson (2001) document the fact that European settlement was for instance influenced by the disease environment, which is somehow disconnected from local prosperity. Such an exogenous source of variation in colonial investments within French West Africa could be the distance from the coast. The distance from the coast was actually a physical determinant of European settlement since Europeans arrived by boats and were more likely to settle in nearer areas than in farer ones. If colonial supply of public goods followed European settlement (because European demand for schools, hospitals and infrastructures was high) we would expect colonial investments to be negatively correlated to the distance from the coast. Table 4 shows the correlation between colonial investments in education, health and infrastructures and distance from the coast. The correlation is actually significantly negative (or nil in the case of

investments in health), which confirms that something accidental influenced overall colonial investments patterns. But the correlation does not explain much of the variation in colonial investments (8%, 2% and 9% respectively). In particular, it is too weak to use distance from the coast as a valuable instrument for colonial investments.

To conclude, the variation in districts characteristics leave much of the observed variation in colonial investments unexplained (the share of variation attributable to population density and pre-colonial political status together is only 4% and the share attributable to distance from the coast does not exceed 9%). If local characteristics were only weak determinants of colonial investments, then the decisive factor is to be found elsewhere. On this point, Banerjee, Iyer and Somanathan (2006) highlight the role of "top-down interventions" in bringing about changes in public goods access. Based on historian literature on colonial French West Africa, "top-down interventions" seem to be an appropriate explanation of the observed variations in colonial investments for several reasons. First, districts administrators were largely autonomous as explained in section 1. All testimonies from former administrators attest that they controlled every aspects of districts management and drawn their own policy (Cohen (1974), Delavignette (1939), Association des anciens élèves de l'école coloniale (1998), Colombani (1991)). Second, there was a large heterogeneity among administrators: Cohen (1974) report 5 types of administrators: (i) former soldiers (apparently the most brutal and violent with local populations), (ii) former metropolitan civil servants (inappropriate for colonial service), (iii) former Governor secretaries (good for administrative work but not for management), (iv) former administrators' assistants (not much educated but well-informed on administrator's work) and finally (v) former pupils of French "Ecole Coloniale" (well-educated, part of the French elite). Third, Cohen (1974) (among others) emphasizes the relationship between the administrators' educational and familial backgrounds and their vision of colonization (more or less humanist). The specific personality of the administrators was therefore a strong

determinant of the policy they implemented, in particular at the beginning of colonial times (in the 1900s and 1910s) because administrators stayed long enough in specific districts to implement long-term projects (after the World War I, they had relatively shorter tenures, typically 3 years). According to historian sources, the intervention of the administrators accounts for a significant part of the design of public goods policy. Since the affectation of an administrator in a specific district was a matter of vacancy and not a matter a selection (Cohen (1974, p.76)), the variation in the "quality" of the administrators constitutes an exogenous source of variation in public goods policy[16].

B. Matching estimates

The strategy that I pursue is to use a matching approach that consists in comparing neighbour districts only. This strategy exploits the spatial discontinuities of investments policy. The underlying idea is that geographical neighbours had similar unobservable characteristics before being separated by a border under colonial rule. Differences in neighbours' outcomes are then unlikely to be due to differences in omitted variables. This approach is thus very close to a matching approach. In the case of French West Africa, there are good reasons to think that neighbour districts were very similar before colonial times. Districts borders did actually not exist in pre-colonial era and were created at the beginning of French colonial rule. Most of them are natural borders (rivers), some are simply straight lines between two points. The aim of colonial power was to build districts that represented approximately a similar charge for French administrators, either in terms of population or in terms of area: colonial annual political reports give evidence that the definition of districts' borders was often a matter of administrative charges rather than a matter of intrinsic characteristics. Colonial power also divided some communities to have a greater control on it. Districts administrators'

[16] I do not use the identity of the administrators as instrument because of the lack of data. Such data probably exists but I do not know exactly where (probably in Dakar) and what can be found on administrators'

annual reports relate many cases of unrest at the borders due to the fact that people continued to ignore it and went here and there without worrying about colonial administrative rules. Pre-colonial and colonial maps show that pre-colonial kingdoms' borders have been ignored as well as ethnic differences. This fact is clearly obvious on colonial districts maps: these maps indicate precisely the ethnic groups present in each district, and we can see that an ethnic group was often present on both sides of a border. Districts' borders are thus somewhat arbitrary.

This leads me to assume that neighbour districts shared similar unobservable characteristics. This assumption can be interpreted as the fact that unobservable characteristics are geographically distributed and that districts borders were sufficiently exogenous to make differences between neighbour districts' unobservable characteristics not salient. I thus suppose that current outcomes of district *i* belonging to neighbourhood *j* can be written as a linear function of its colonial investments CI_i and OCI_i, its intrinsic characteristics X_i, and a neighbourhood fixed effect θ_j:

$$(2) \qquad Y_i = \alpha + \beta CI_i + OCI_i\gamma + X_i\lambda + \theta_j + u_i$$

The only difference between equations (1) and (2) is the presence of a neighbourhood fixed effect in equation (2) representing the fact that districts of a same neighbourhood share common unobservable characteristics.

The outcome differential between two districts *i* and *i'* belonging to a same neighbourhood *j* can be written:

$$(3) \qquad Y_i - Y_{i'} = \beta(CI_i - CI_{i'}) + (OCI_i - OCI_{i'})\gamma + (X_i - X_{i'})\lambda + u_i - u_{i'}$$

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characteristics. It is not certain that those characteristics that influenced the supply of public goods were

Parameter β can be estimated by running an OLS regression of districts of the same neighbourhood' outcomes differential on the corresponding colonial investments differential. These regressions allow me to check that my first results from equation (1) were not driven by omitted variables. Since district *i* can appear several times in the differentials within a neighbourhood, standard errors within neighbourhoods are not independent. Standard errors are thus adjusted for clustering at the neighbourhood level.

An intuitive definition of neighbour districts would be "districts that share a common border" (Banerjee and Iyer (2005) use this definition with a similar empirical context as mine). But the problem with this naïve definition is that neighbourhoods overlap (see more explanations in Appendix 2). In order to circumvent this problem, I need a definition of neighbour districts which create disjointed neighbourhoods. I define a neighbourhood as a cluster of three districts that share a common border and assume that neighbourhood fixed effect is similar within but not between clusters. This leads to divide districts map in disjointed neighbourhoods which are sets of three districts sharing a common border. Appendix 2 gives further details on matching procedure[17].

Table 5 shows the matching estimates of the impact of colonial investments on current performances. They are close to OLS estimates, slightly smaller but not significantly different, which indicates that naïve estimates were possibly a little upwardly biased but not driven by unobservable characteristics shared by neighbour districts. The fact that matching estimates are

observed by the French administration.

[17] Banerjee and Iyer (2005) also use the fact that neighbour districts share similar unobservable characteristics. But they derive a different empirical strategy using a sub-sample of neighbour districts to check if OLS results are driven by omitted variables. They argue that restricting the sample to those districts which happen to be geographical neighbours with a different colonial treatment adds controls for possible omitted variables. But in the case of a continuous treatment (like colonial investments), using a sub-sample of neighbour districts is not sufficient to control for omitted variables: in presence of a "low-middle peer" (one district receiving a "low" treatment and its neighbour a "middle" treatment) and a "middle-high peer" (one district receiving a "middle" treatment and its neighbour a "high" treatment), results might be driven by the difference between the low-treated and the high-treated districts which might not be neighbours. Bias due to omitted variables is thus not corrected. That is why I chose to follow a matching approach rather than Banerjee and Iyer (2005) sub-sample approach.

a little smaller than OLS estimates can also reflect externalities between neighbour districts: the treatment could affect the control group because neighbour districts might benefit from investments in neighbouring areas. In this case, matching estimates are downwardly biased. These regressions also indicate that observed geographical, pre-colonial and colonial characteristics explain between 50% and 80% of the differences in current performances between neighbour districts.

In the end, we may think that the long term impact of early colonial investment is too large to be due uniquely to the early colonial investments themselves. Since these results do not take into account what happened later, they may reflect the relationship between early colonial investments and something caused by them. We therefore need to explore what happened in the interval.

V. Why do early colonial public investments still matter?

Previous results establish large and robust differences in current performances due to differences in colonial public investments. Why are long term returns to investments so large? In this section, I want to give some potential answers to this question.

One reason why early investments had large long term returns is that more schools, dispensaries and infrastructures continued to be built in places that had many of them already at the beginning of colonial period. I consider the average annual numbers of teachers over two periods: 1910-1928 (period 1) and 1930-1939 (period 2). Graph 3a shows that districts which received more teachers during the first period continued to receive more new teachers during the second period. The correlation between the number of teachers in period 1 and in period 2 is 0.87, even if the number of teachers jumped from 3 per district on average in period 1 to 9 per district on average in period 2. To take into account the variations in population size, I also plot on graph 3b the number of new teachers per 100,000 inhabitants over 1930-1939 along the distribution of the number of teachers per 100,000 inhabitants over 1910-1928. The correlation is a little lower (0.72) because few, if any, new teachers were posted in sparsely populated districts (desert-edge areas), which had many teachers per population unit over 1910-1928 due to the fact that teachers are lumpy-fixed investments. One district, Tabou, lost 2 teachers between period 1 and period 2, what was not so much in absolute terms but produced a big loss compared to its sparse population (this district appears as an outlier on graph 3b). Nevertheless, the number of teachers per population unit over 1910-1928 is a positive and significant determinant of the number of new teachers per population unit over 1930-1939, as shown in table 6 columns (1), (2). This result is robust to the inclusion of my usual control variables as shown in column (3). Early investments thus attracted later investments at least during the colonial period.

I do not have the evidence on investments between 1940 and 1995 (or only on small samples) so I do not know how things evolved in the interval. But some of the 1995 national household surveys give evidence on distance to public goods. For 52 districts[18], I can calculate the proportion of households living within 30mn from a primary school, a medical centre and drinkable water. Graphs 4a, 4b and 4c shows that the current distance to public goods is still correlated to early colonial public investments. The repetition of investment location between 1910 and 1995 was thus sufficiently large to make early differences still sensitive, which makes reasonably think that repetition was not just limited to the next period (1930-1939).

I propose to explore what could explain that more teachers were posted in areas that had many of them already and to test some of the potential mechanisms. A first explanation could be that the same practice appears as more valuable for new adopters thanks to increasing returns to the adoption of this practice or because of costs in changing from an established practice to a different one. Increasing returns may be due to externalities across investments: if there are more roads in a district, it is easier to have teachers or/and students to come here. Alternatively, if there are more doctors, people are healthier and children are more likely to attend school. But the data does not confirm this story: in column (4) and (5), I include the other investments over 1910-1928 as additional regressors to the number of teachers per 100,000 inhabitants over 1910-1928. This specification also allows to assessing whether the other investments explain the observed correlation between early and later investments in education. They rather had a negative impact on the number of new teachers over 1930-1939, which could reflect substitutability rather than complementariness.

Increasing returns could also arise because of the lasting nature of physical facilities: it is cheaper to post a new teacher in an existing school than to build a new school from scratch for

her. If this story is true, we expect the number of teachers per school to increase over time. Graph 5 represents the evolution of the number of teachers per school between 1910 and 1953, using data on both the number of teachers and the number of schools per district. It is clear that this is a part of the story: the number of teachers per school jumped from 1 to 4 between 1910 and 1953. In columns (6) and (7), I include the number of new schools per 100,000 inhabitants over 1930-1939 as an additional regressor. This does not alter the coefficient on the number of teachers per 100,000 inhabitants over 1910-1928, which shows not only that more new teachers were posted in *districts* that had many of them already, but also that more new teachers were posted in *schools* that had many of them already. This observation is also consistent with other explanations than the lower cost of using existing physical facilities. Some positive social interactions as peer-effects or intergenerational externalities can explain that a more educated population produces a higher demand for education (see Goux and Maurin (2007) for a empirical analysis on peer effects and Cunha and Heckman (2007) for a theoretical argument of intergenerational externalities). The increase in the number of teachers per school might also reflect an increase in local demand for education due to endogenous accumulation of human capital: a higher supply of human capital in period 1 encouraged investment in human capital-related activities which in turn encouraged an increase in demand for schooling in period 2 (Acemoglu (2002)). More generally, the fact that the new teachers were more likely to be posted in existing schools may reflect any very local increase in demand due to positive externalities. But these externalities have to be very limited in terms of spatial spreading to be consistent with the fact that many new teachers were posted in existing schools rather than in new schools that could potentially be built in the close area.

I also test whether some positive political externalities explain the fact that more teachers were posted in districts that had many of them already. Early investments could have created some

[18] These are the Senegalese, Malian, Nigerien and Burkinabè districts.

positive effects on political voice, as discussed in Banerjee et al. (2006). They relate that the political voice of particular groups may affect public good provision. The idea is that the political leverage of one group to the others allows them to appropriate a large share of the newly provided public goods. In the colonial context, it could be plausible that some districts with more public goods in period 1 acquired a stronger political voice and therefore appropriated a larger share of the new teachers on period 2, explaining why new teachers on period 2 were posted in areas that had many of them in period 1. It is well-known that French administrators set up a direct rule over the colonies regardless of the pre-colonial political structures. But after the first period of conquest and administrative settling, the colonial power changed its mind about the optimal 'indigenous policy' since they realized that the control of large territories and large populations demanded more administrative forces than French people solely offered. Some local chiefs have been progressively associated in the colonial administration since 1920 as intermediaries between local populations and French administrators. It is possible that local chiefs were easier to recruit in places that got more of public goods at the early colonial times (due to higher human capital). As African local chiefs increased the political voice of their groups - they could defend their interests in the opinion of the French administrator, districts with a larger association of local chiefs might appropriate a larger share of newly provided public goods. To test this potential mechanism, I use the amount of local chiefs' wages reported in colonial budgets as a proxy of local chiefs association: the larger the local chiefs' wages, the more associated. Table 6 column (8) reports the coefficients of the regression of the number of new teachers per 100,000 inhabitants over 1930-1939 on the amount of local chiefs wages per 100,000 inhabitants over 1930-1939. In column (9) I add geographical, pre-colonial, conquest and initial attractiveness variables as control variables. In both columns, results show that the amount of local chiefs wages is positively correlated with the number of new teachers over 1930-1939, but the coefficient is not significant (t-

statistic=1.28). Moreover, we can see that the coefficient on the number of teachers per 100,000 inhabitants over 1910-1928 remains exactly the same so this story does not explain why more teachers were posted in districts that had many of them already.

Finally, public investments in an area might lead to a more stable political environment which makes it easier to provide facilities in the future as well. Since I collected data on the political climate at the district level[19], I include an index of political instability as additional regressor in column (10) and (11). This index is the average annual number of severe events expressing hostility towards colonial power over 1920-1940. If there are political positive externalities, we expect political instability over 1920-1940 to have a negative impact on the number of new teachers per 100,000 inhabitants over 1930-1939. Data says the opposite: the more hostile, the more new teachers (perhaps to satisfy population expectations and calm the political situation). Moreover, given the level of hostility over 1906-1920, more teachers over 1910-1928 had a negative impact on hostility over 1920-1940 (*results not shown*). These findings tell us that colonial power possibly invested more in hostile areas for political purposes, which effectively had a positive impact on political climate. Once again, the inclusion of the index of political instability does not alter the impact of the number of teachers per 100,000 inhabitants over 1910-1928 on the number of new teachers per 100,000 inhabitants over 1930-1939. Political externalities therefore are not a good candidate to explain why more teachers were posted in districts that had many of them already.

The scarcity of data makes it not possible to pin down the precise channels underlying the relationship with any reasonable degree of certainty. I can just eliminate some stories as positive externalities across investments and positive effects on the political stability. A political economy story telling that investment is associated to political power remains

[19] I collected data on political climate at the district level from the annual political reports written by the districts administrators to the Governor. For further detail on data collection and method, I refer to Huillery (2008).

plausible but does not capture much of the mechanism. My important finding is that many new teachers joined existing facilities, which is consistent with both the lasting nature of physical facilities and (very local) positive externalities on the demand for education.

I do not have a clear story for the reason of the persistence of public investments but I have strong evidence that teachers continued to go where teachers used to be affected. Large long term effects of early colonial investments are thus explained by the repetition of colonial (and apparently post-colonial) investments location. Early small events or historical accidents might thus have large effects on later outcomes. There may not have been any particular reason to prefer one place to another before public investments took place (as discussed in section IV.A.), but as they have become concentrated in one place, any new entrant elsewhere could have been at a disadvantage, and therefore tended to move into the hub if possible, further increasing its relative efficiency. The mechanism at work is thus be a "virtuous cycle" effect which can explain why small but early public investments in some districts became larger and larger over time and lead to very large returns today.

VI. Conclusion

The purpose of this paper was to assess the long term effects of history on development and the influence of colonial experience in West Africa. While the political economy literature is insisting rightly on "institutional overhang" and the persistence of bad institutions, this paper shows that the persistence of colonial experience may be more local since public investments continued to beget more investments and better current outcomes at the district level. Adding one teacher (respectively doctor) per 100,000 inhabitants in the early colonial period would lead to 1 (respectively 0.5) additional point in the percentage of school enrolment (respectively stunting children). Adding one franc per capita in public works in the early colonial period would lead to about 3 additional points in the percentage of access to private water tap and modern fuel. The paper also shows that the nature of public investments matters: current educational performances are specifically determined by colonial investments in education, as current health performances by colonial investments in health and current infrastructures' development by colonial investments in infrastructures and health. According to our estimates, the enduring influence of early colonial investments can be explained by the fact that later investments continued to be located in areas that had many of them already: the more investments over 1910-1928, the more new investments over 1930-1939, and the more public goods today. This paper thus contributes to explicit the mechanisms through which spatial inequalities arise and persist, and gives evidence that even in the long run inequalities do not vanish because there are increasing returns to the adoption of a practice and because both starting point and accidental events can have significant effects on the ultimate outcome.

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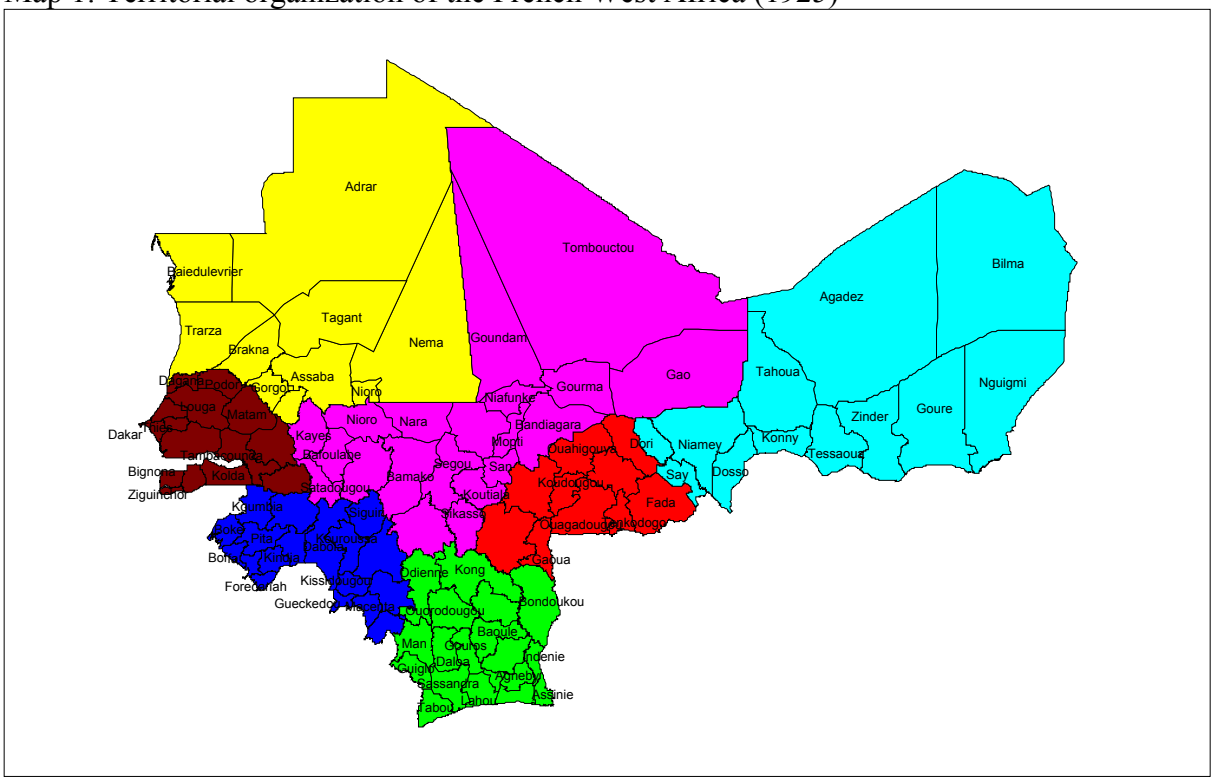
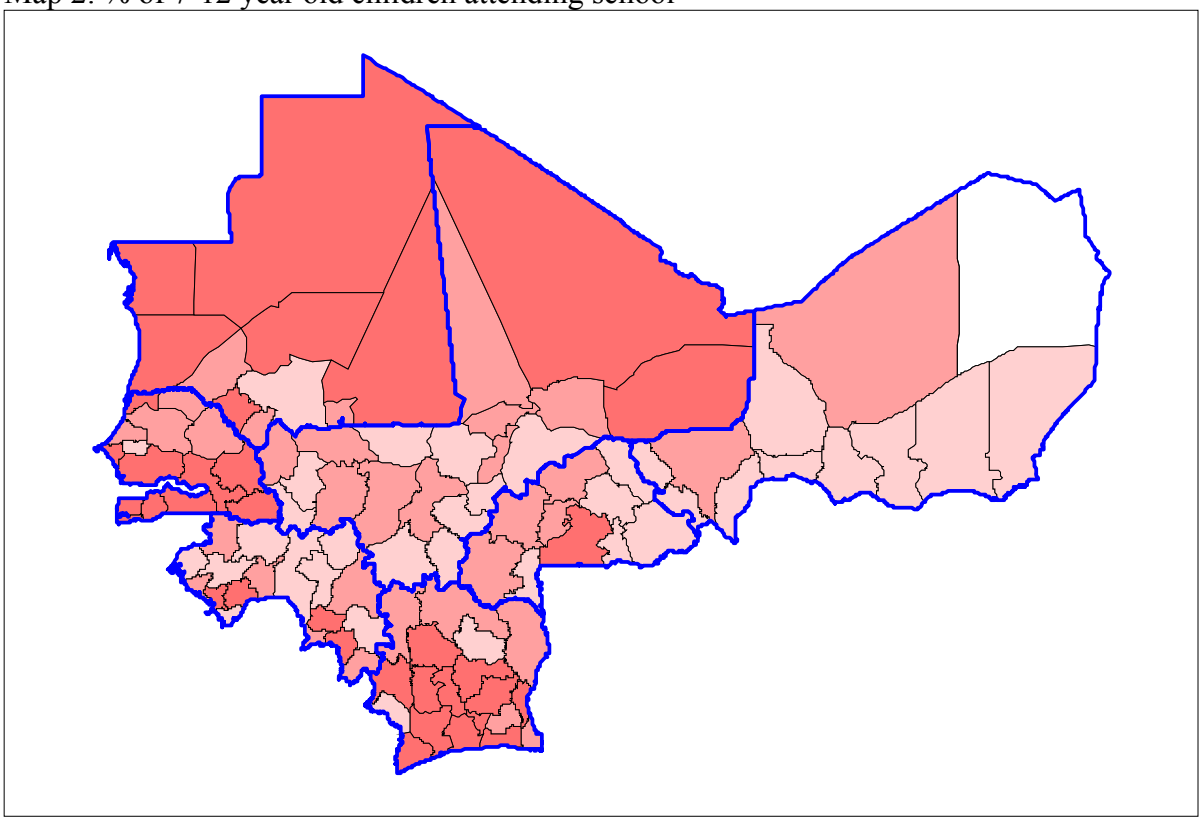
Maps

Map 1: Territorial organization of the French West Africa (1925)

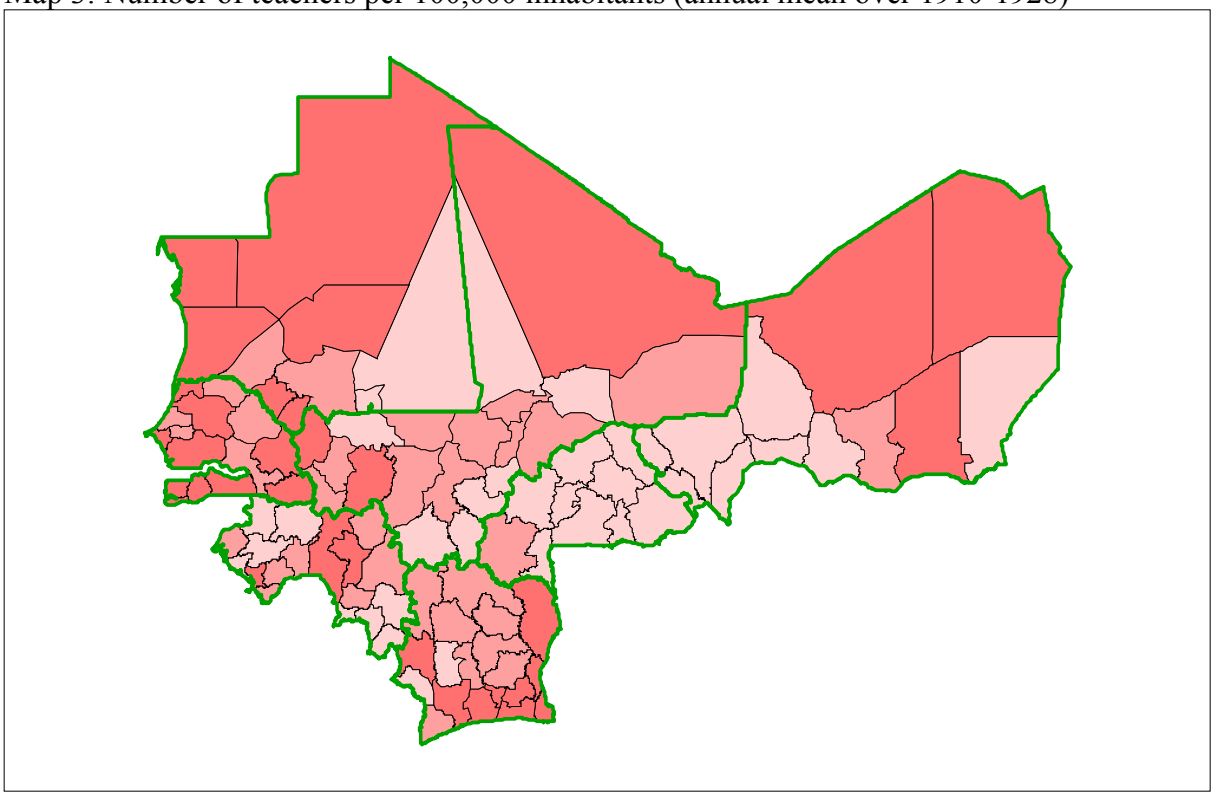


Map 2: % of 7-12 year old children attending school



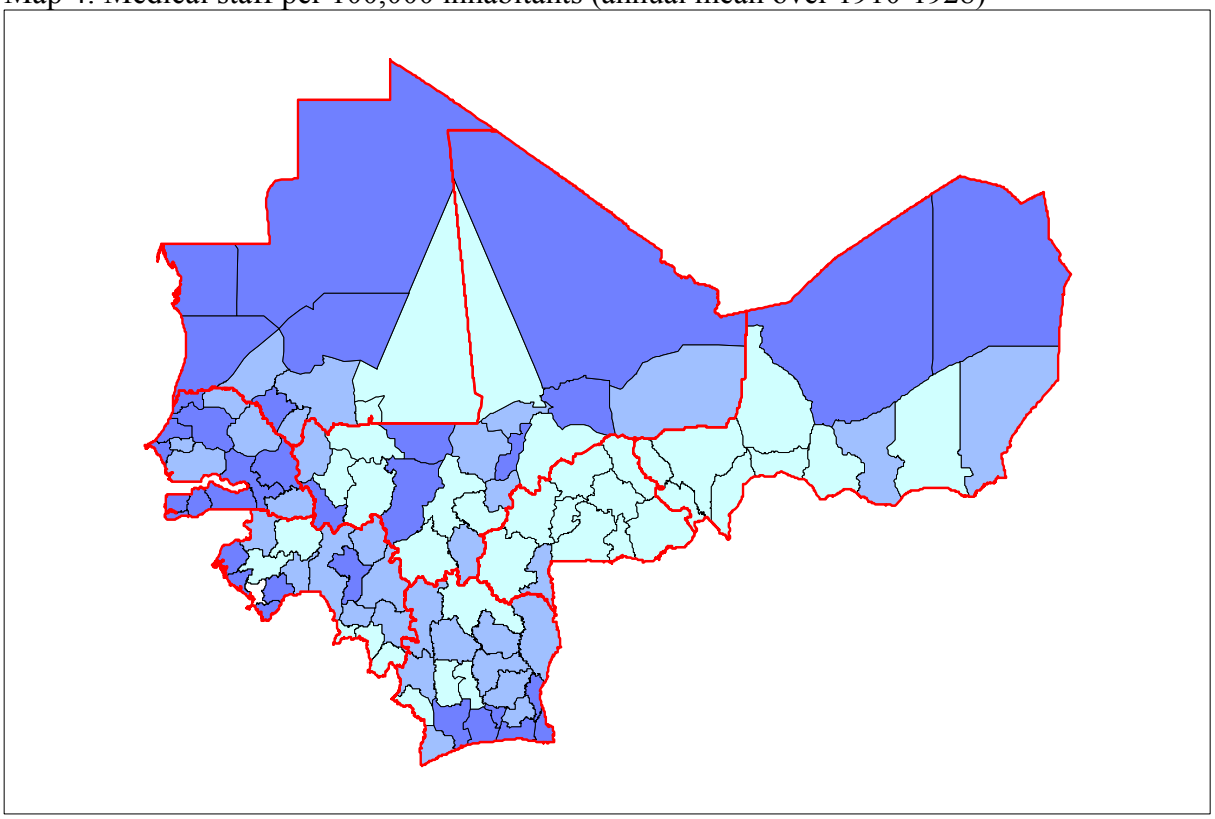
Lecture: Lowest tercile in light colour, Highest tercile in dark colour

Map 3: Number of teachers per 100,000 inhabitants (annual mean over 1910-1928)



Lecture: bottom tercile in light colour, top tercile in dark colour.

Map 4: Medical staff per 100,000 inhabitants (annual mean over 1910-1928)



Lecture: bottom tercile in light colour, top tercile in dark colour.

Table 1: Summary statistics on districts

	Mean	S.D.	25th percentile	Median	75th percentile	Min	Max	Nb Obs
1995 districts development								
% of 7-12-year old children attended school	34	16	22	33	43	1	75	98
% of 0-5-year old children suffering from stunting	37	12	28	37	44	7	85	89
% of households connected to electricity	12	17	2	4	17	0	87	98
% of households having access to private water	10	13	1	5	14	0	72	98
% of households using a modern combustible	14	19	1	6	21	0	94	98
% of households living within 30mn from a primary school	67	15	57	69	78	32	92	52
% of households living within 30mn from a medical centre	41	16	29	40	51	13	76	52
% of households living within 30mn from drinkable water	82	14	74	84	94	41	99	52
Colonial period								
Number of teachers per 100,000 hbt over 1910-1928	4	5	1	3	4	0.2	28	99
Medical staff per 100,000 hbt over 1910-1928	8.5	15	1	4.4	9	0	111	98
Public works expenses per capita over 1910-1928 (in 1910 FF)	0.44	1.2	0.05	0.13	0.31	0.003	9.7	99
New teachers per 100,000 hbt over 1930-1939	4.6	6.7	1.2	2.7	5.2	-12.3	41.5	99
New schools per 100,000 hbt over 1930-1939	1.7	2.4	0.3	1.4	2.5	-11	9.5	99
Local chiefs wages per 100,000 hbt over 1930-1939	92,319	113,797	28,827	46,931	97,021	0	582,889	99
Index of hostility towards colonial power over 1920-1940	0.42	0.41	0	0.33	0.66	0	2	99
Control variables								
Number of European Settlers per 100,000 hbt in 1910	100	254	7.8	21	68	0	2125	99
Colonial conquest								
Year of colonial conquest's beginning	1880	13.9	1879	1887	1890	1854	1903	99
Local resistance length	22.7	15.2	11	20	31	0	74	99
Local chiefs indemnities	657	1516	0	0	420	0	7726	99
Precolonial characteristics								
Centralized political power dummy	0.49	0.5	0	0	1	0	1	99
1910 population density	6.22	7.15	1.72	3.8	7.9	0.008	38	99
Trade taxes per capita collected in 1914	0.23	0.38	0.004	0.04	0.31	0	1.81	99
European trade counter dummy	0.04	0.2	0	0	0	0	1	99
Geographical characteristics								
Altitude (feets)	816	594	242	859	1161	0	3044	99
Annual rainfalls average over 1915-1975 (mm)	1050	718	500	890	1546	17	3248	99
Latitude	12.3	3.6	9.6	12.8	14.8	4.8	21	99
Longitude	-6.7	6.8	-12.1	-7.3	-3.35	-17.1	12.9	99
Coastal dummy	0.17	0.38	0	0	0	0	1	99
Presence of an important river dummy	0.65	0.48	0	1	1	0	1	99

See Apendix 1 for data description and sources.

Statistics are all calculated at the district level. Saint-Louis and Dakar are excluded from the sample. Data on 1995 current development is missing for Bilma.

Data on % 0-5-year old children suffering from stunting is missiong for Mauritanian districts. Data on medical staff per 100,000 hbt is missing for Conakry.

S.D.: Standard Deviation

Table 2: The impact of colonial investments on 1995 education and health: OLS estimates

Coefficient on colonial investments (annual mean over 1910-1928)	no controls (1)	geographical controls (2)	pre-colonial controls (3)	conquest controls (4)	attractiveness controls (5)	country fixed effects (6)	other investments controls (7)
Panel A: % 7-12-year old children attending school as dependent variable							
Number of teachers per 100,000 hbt	**1.66****	**1.28****	**1.16****	**0.93****	**1.14***	**0.79+**	**0.95+**
	(0.26)	(0.31)	(0.36)	(0.35)	(0.48)	(0.45)	(0.52)
Medical staff per 100,000 hbt							0.07
							(0.22)
Public works expenses per 1 hbt							3.18
							(3.23)
R2	0.30	0.41	0.42	0.50	0.50	0.56	0.50
Nb Obs	98	98	98	98	98	98	97
Panel B: % 0-5-year old children suffering from stunting as dependent variable							
Number of teachers per 100,000 hbt							0.47
							(0.46)
Medical staff per 100,000 hbt	**-0.43****	**-0.60****	**-0.59****	**-0.60****	**-0.56****	**-0.49***	**-0.56****
	(0.13)	(0.16)	(0.17)	(0.17)	(0.20)	(0.20)	(0.21)
Public works expenses per 1 hbt							-3.55
							(5.85)
R2	0.27	0.30	0.32	0.34	0.34	0.41	0.37
Nb Obs	88	88	88	88	88	88	88
Control variables							
Geographical characteristics	NO	YES	YES	YES	YES	YES	YES
Precolonial characteristics	NO	NO	YES	YES	YES	YES	YES
Colonial conquest	NO	NO	NO	YES	YES	YES	YES
Initial attractiveness	NO	NO	NO	NO	YES	YES	YES
Country fixed effects	NO	NO	NO	NO	NO	YES	NO

Standard errors in parentheses. ** significant at the 1% level, * significant at the 5% level, + significant at the 10% level.
Each cell represents the coefficient from an OLS regression of the dependent variable on the independent variable.
In panel *A* column (8), the number of observations falls to 97 because data on medical staff per 100,000 hbt is missing for Conakry district.
In panel B, the number of observations falls to 88 because data on medical staff per 100,000 hbt is missing for Conakry district and data on % 0-5-year old children suffering from stunting is missing for Mauritanian districts.
Initial attractiveness control variables are: Number of European Settlers per 100,000 population in 1910, Trade taxes per capita collected in 1914
Colonial conquest control variables are: Year of colonial conquest's beginning, Local resistance length, Local resistance length2, Local chiefs indemnities
Precolonial characteristics control variables are: Centralized political power dummy, European trade counter dummy, 1910 population density
Geographical characteristics control variables are: Annual rainfalls average over 1915-1975, Altitude, Longitude, Latitude, Coastal dummy, River dummy

Table 3: The impact of colonial investments on 1995 access to infrastructures: OLS estimates

Coefficient on colonial investments (annual mean over 1910-1928)	no controls (1)	geographical controls (2)	pre-colonial controls (3)	conquest controls (4)	attractiveness controls (5)	country fixed effects (6)	other investments controls (7)
Panel A: % households connected to electricity as dependent variable							
Number of teachers per 100,000 hbt							0.01
							(0.40)
Medical staff per 100,000 hbt							0.12
							(0.18)
Public works expenses per 1 hbt	**8.71****	**6.96****	**9.05****	**8.69****	**5.29****	**5.72****	**1.16**
	(1.1)	(1.11)	(1.36)	(1.29)	(1.43)	(1.39)	(2.50)
R2	0.38	0.58	0.61	0.67	0.73	0.78	0.70
Nb Obs	98	98	98	98	98	98	97
Panel B: % households having access to private water as dependent variable							
Number of teachers per 100,000 hbt							0.05
							(0.43)
Medical staff per 100,000 hbt							-0.03
							(0.19)
Public works expenses per 1 hbt	**6.11****	**5.62****	**6.92****	**6.80****	**5.74****	**5.82****	**3.11+**
	(0.92)	(1.00)	(1.25)	(1.27)	(1.52)	(1.54)	(1.85)
R2	0.31	0.41	0.44	0.47	0.49	0.54	0.50
Nb Obs	98	98	98	98	98	98	97
Panel C: % households using a modern fuel as dependent variable							
Number of teachers per 100,000 hbt							0.50
							(0.45)
Medical staff per 100,000 hbt							-0.005
							(0.20)
Public works expenses per 1 hbt	**8.81****	**6.75****	**9.88****	**9.58****	**7.49****	**7.70****	**3.14**
	(1.37)	(1.35)	(1.63)	(1.36)	(1.60)	(1.55)	(2.81)
R2	0.30	0.51	0.56	0.72	0.74	0.79	0.72
Nb Obs	98	98	98	98	98	98	97
Control variables							
Geographical characteristics	NO	YES	YES	YES	YES	YES	YES
Precolonial characteristics	NO	NO	YES	YES	YES	YES	YES
Colonial conquest	NO	NO	NO	YES	YES	YES	YES
Initial attractiveness	NO	NO	NO	NO	YES	YES	YES
Country fixed effects	NO	NO	NO	NO	NO	YES	NO

Standard errors in parentheses. ** significant at the 1% level, * significant at the 5% level, + significant at the 10% level.
Each cell represents the coefficient from an OLS regression of the dependent variable on the independent variable
In column (8), the number of observations falls to 97 because data on medical staff per 100,000 hbt is missing for Conakry district.
Initial attractiveness control variables are: Number of European Settlers per 100,000 population in 1910, Trade taxes per capita collected in 1914
Colonial conquest control variables are: Year of colonial conquest's beginning, Local resistance length, Local resistance length2, Local chiefs indemnities
Precolonial characteristics control variables are: Centralized political power dummy, European trade counter dummy, 1910 population density
Geographical characteristics control variables are: Annual rainfalls average over 1915-1975, Altitude, Longitude, Latitude, Coastal dummy, River dummy

Table 4: Historical evidence on selection during colonial times

	Dependent variable: colonial investments (annual mean over 1910-1928)					
	Number of teachers per 100,000 hbt	Medical staff per 100,000 hbt	Public works expenses per 1 hbt	Number of teachers per 100,000 hbt	Medical staff per 100,000 hbt	Public works expenses per 1 hbt
	(1)	(2)	(3)	(4)	(5)	(6)
Coefficient on						
Population density 1910	**-0.13***	**-0.27**	**-0.006**			
	(0.07)	(0.20)	(0.017)			
Distance from the coast (km)				**-0.004****	**-0.005**	**-0.0009****
				(0.0001)	(0.004)	(0.0003)
R2	0.03	0.02	0.001	0.08	0.02	0.09
Nb Obs	99	99	99	99	99	99

Standard errors in parentheses. ** significant at the 1% level, * significant at the 5% level, + significant at the 10% level.
Each cell represents the coefficient from an OLS regression of the dependent variable on the independent variable.

Table 5: The impact of colonial investments on current performances: matching estimates

	Dependant variables				
	Difference in school attendance rate	Difference in stunting rate	Difference in % of households connected to electricity	Difference in % of households having access to water	Difference in % of households using a modern fuel
	(1)	(2)	(3)	(4)	(5)
Coefficient on					
Difference in colonial investments					
Number of teachers per 100,000 hbt over 1910-1928	**0.57+**	**0.78***	0.22	0.02	0.68
	(0.33)	(0.34)	(0.35)	(0.19)	(0.52)
Medical staff per 100,000 hbt over 1910-1928	-0.01	**-0.52****	**0.40****	**0.15***	0.17
	(0.17)	(0.17)	(0.09)	(0.07)	(0.12)
Public works expenses per capita over 1910-1928	0.88	-1.93	0.75	**2.5+**	**3.1***
	(2.4)	(1.79)	(1.44)	(1.3)	(1.6)
Control variables					
Difference in the number of European settlers per 100,000 hbt in 1910					
Difference in colonial conquest variables: year of colonial conquest's beginning, length of local resistance to colonial conquest, local chiefs' indemnities.					
Difference in precolonial characteristics: centralized political power dummy, 1910 population density, trade taxes collected in 1914 and former European trade counter dummy.					
Difference in geographical characteristics: altitude, latitude, longitude, annual rainfalls, coastal dummy, river dummy.					
Nb obs	71	62	71	71	71
Nb neighbourhoods	30	27	30	30	30
R2	0.49	0.64	0.65	0.81	0.66

** significant at 1%, * significant at 5%, + significant at 10%

Dependent and independent variables are the value differences between neighbour districts of the same neighbourhood.

Results come from 50 OLS regressions of the dependent variable on the independent variables using 50 random neighbourhood designs.

Reported coefficient is the mean of the 50 coefficients of the dependent variable on the independent variable.

Standard deviation in parentheses equals to (50/49)*the empirical standard deviation of the 50 coefficients of the dependent variable on the independent variable.

Number of observations is the mean of the 50 numbers of observations (neighbour districts differences) resulting from the 50 neighbourhood designs.

Number of neighbourhoods is the mean of the 50 numbers of neighbourhoods resulting from the 50 neighbourhood designs.

R^2 is the mean of the 50 R^2 from the 50 OLS regressions.

Data on stunting children is missing for the Mauritanian districts.

Data on medical staff per 100 000 hbt is missing for Conakry district.

Table 6: What explains that more teachers continued to be posted in areas that had many of them already?

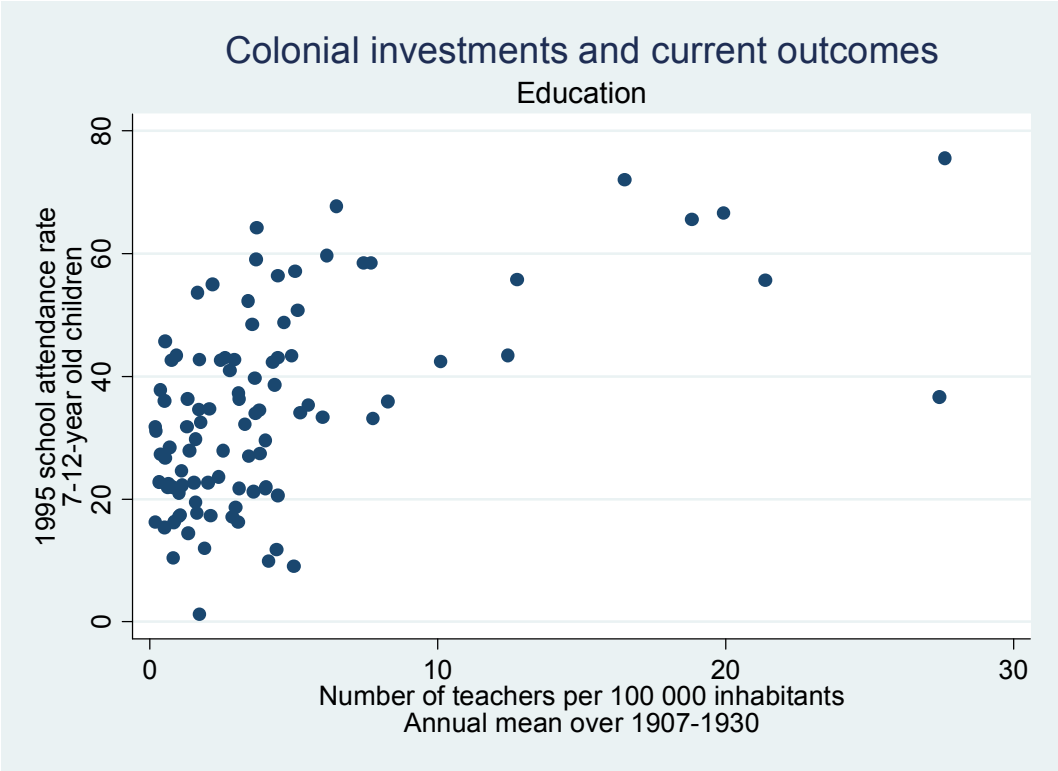
	Dependent variable: New teachers per 100,000 over 1930-1939						
Coefficient on	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Teachers per 100,000 hbt over 1910-1928	**0.47****	**0.63****	**0.47****	**0.92****	**0.87****	**0.55****	**0.67****
	(0.11)	(0.11)	(0.16)	(0.21)	(0.24)	(0.09)	(0.13)
Medical staff per 100,000 hbt over 1910-1928				**-0.15****	**-0.14+**		
				(0.05)	(0.074)		
Public works exp. per 1 hbt over 1910-1928				-0.07	-0.07		
				(1.12)	(1.26)		
New schools per 100,000 hbt over 1930-1939						**1.66****	**1.99****
						(0.22)	(0.27)
Local chiefs wages per 100,000 hbt over 1930-1939							
Hostility towards colonial power over 1920-1940							
R2	0,15	0,25	0,39	0,26	0,38	0,53	0,64
Nb Obs	99	98	98	97	97	98	98
Tabou in the sample	YES	NO	NO	NO	NO	NO	NO
Control variables							
Geographical characteristics	NO	NO	YES	NO	YES	NO	YES
Precolonial characteristics	NO	NO	YES	NO	YES	NO	YES
Colonial conquest	NO	NO	YES	NO	YES	NO	YES
Initial attractiveness	NO	NO	YES	NO	YES	NO	YES
Country fixed effects	NO	NO	YES	NO	YES	NO	YES

Standard errors in parentheses. ** significant at the 1% level, * significant at the 5% level, + significant at the 10% level.
Each cell represents the coefficient from an OLS regression of the dependent variable on the independent variable
In columns (6), (7) and (12), the number of observations falls to 97 because data on medical staff per 100,000 hbt is missing for Conakry district.
Initial attractiveness control variables are: Number of European Settlers per 100,000 population in 1910, Commercial taxes per capita collected in 1914
Colonial conquest control variables are: Year French troops arrived to begin the conquest, Length of African resistance to colonial conquest (simple and squared), Indemnities paid to pre-colonial African chiefs
Precolonial characteristics control variables are: Presence of a centralized political power, Presence of a European trade counter, Initial population density
Geographical characteristics control variables are: Annual rainfalls average over 1915-1975, Altitude, Longitude, Latitude, Presence of a coastal border, Presence of an important river
Teachers, medical staff, public works expenses and local chiefs' wages per population unit over period t are annual means over period t.
Hostility towards colonial power over 1920-1940 represents the annual mean of the numbers of events expressing hostility towards colonial power over 1920-1940.
New teachers (respectively schools) per 100,000 hbt over 1930-1939 represent the difference in the annual mean of the number of teachers (respectively schools) over 1930-1939 and 1910-1928.

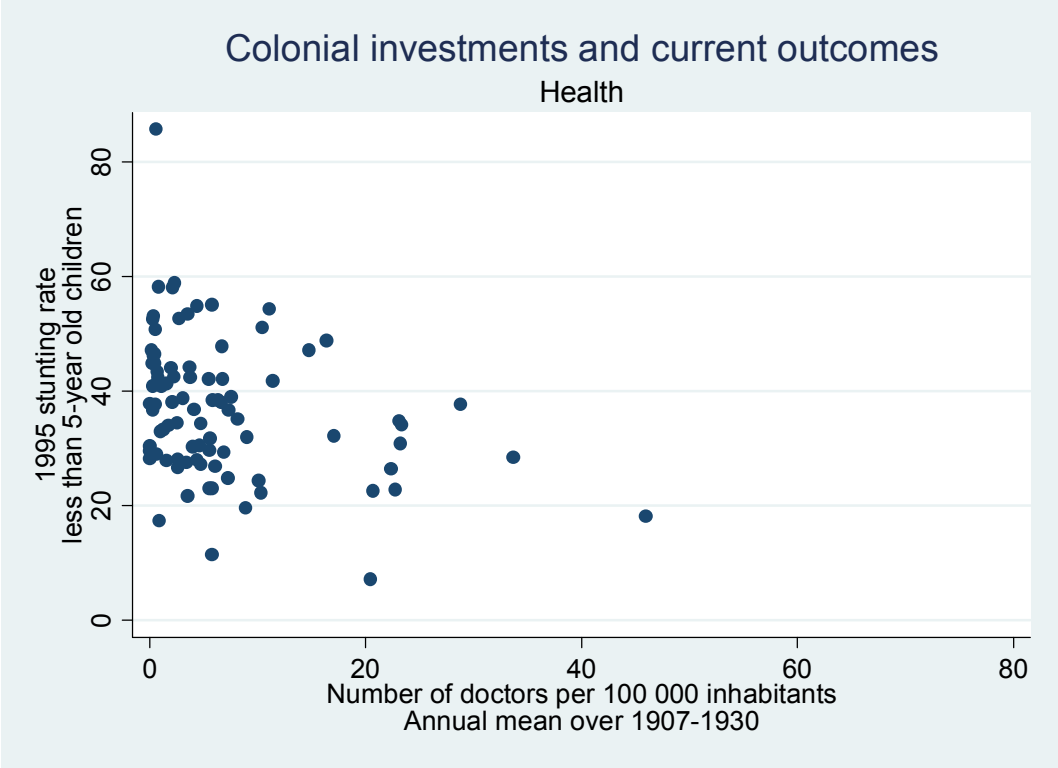
Table 6 −continued: What explains that more teachers continued to be posted in areas that had many of them already?

	Dependent variable: New teachers per 100,000 over 1930-1939				
Coefficient on	(8)	(9)	(10)	(11)	(12)
Teachers per 100,000 hbt over 1910-1928	**0.62****	**0.47****	**0.58****	**0.53****	**1.02****
	(0.11)	(0.16)	(0.11)	(0.16)	(0.16)
Medical staff per 100,000 hbt over 1910-1928					**-1.86***
					(0.9)
Public works exp. per 1 hbt over 1910-1928					-0.0001
					(0.0001)
New schools per 100,000 hbt over 1930-1939					**0,83**
					(1.17)
Local chiefs wages per 100,000 hbt over 1930-1939	0,0001	0,0001			**-0.13****
	(0.0001)	(0.0001)			(0.046)
Hostility towards colonial power over 1920-1940			**3.65****	**3.86****	**1.77****
			(1.40)	(1.69)	(0.24)
R2	0,27	0,41	0,29	0,43	0,66
Nb Obs	98	98	98	98	97
Tabou in the sample	NO	NO	NO	NO	NO
Control variables					
Geographical characteristics	NO	YES	NO	YES	YES
Precolonial characteristics	NO	YES	NO	YES	YES
Colonial conquest	NO	YES	NO	YES	YES
Initial attractiveness	NO	YES	NO	YES	YES
Country fixed effects	NO	YES	NO	YES	YES

Graph 1: The correlation between colonial investments in education and current educational outcomes

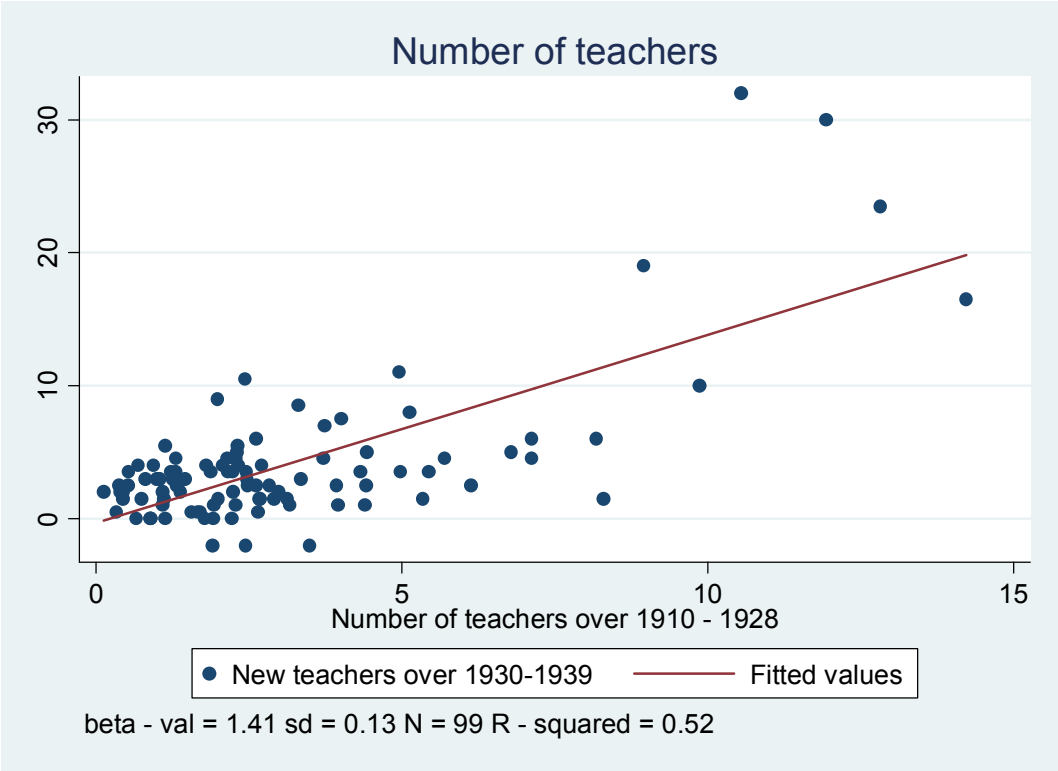


Graph 2: The correlation between colonial investments in health and current health outcomes

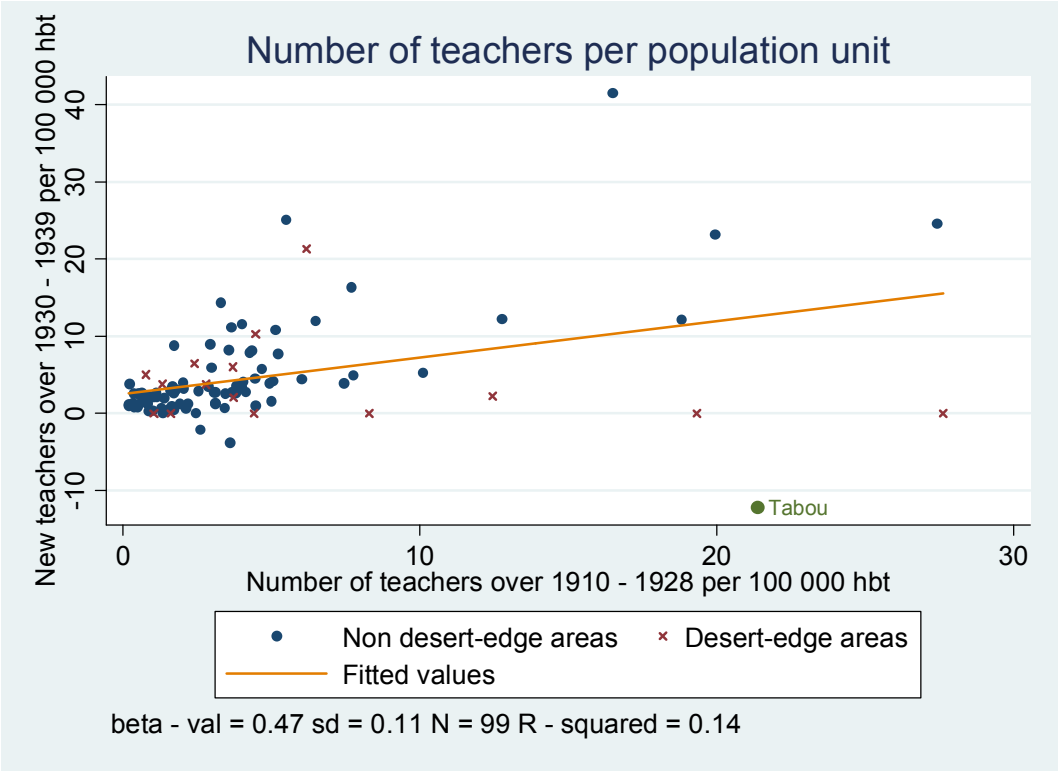


Graph 3: The relation between later and former investments

3.a

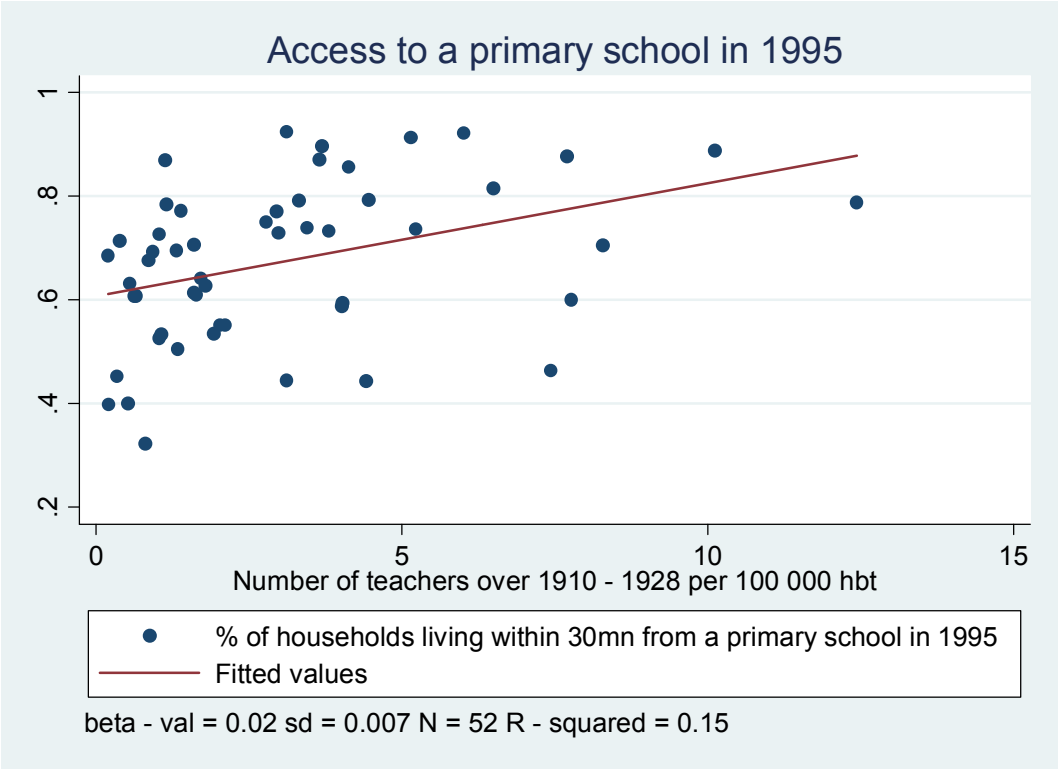


3.b

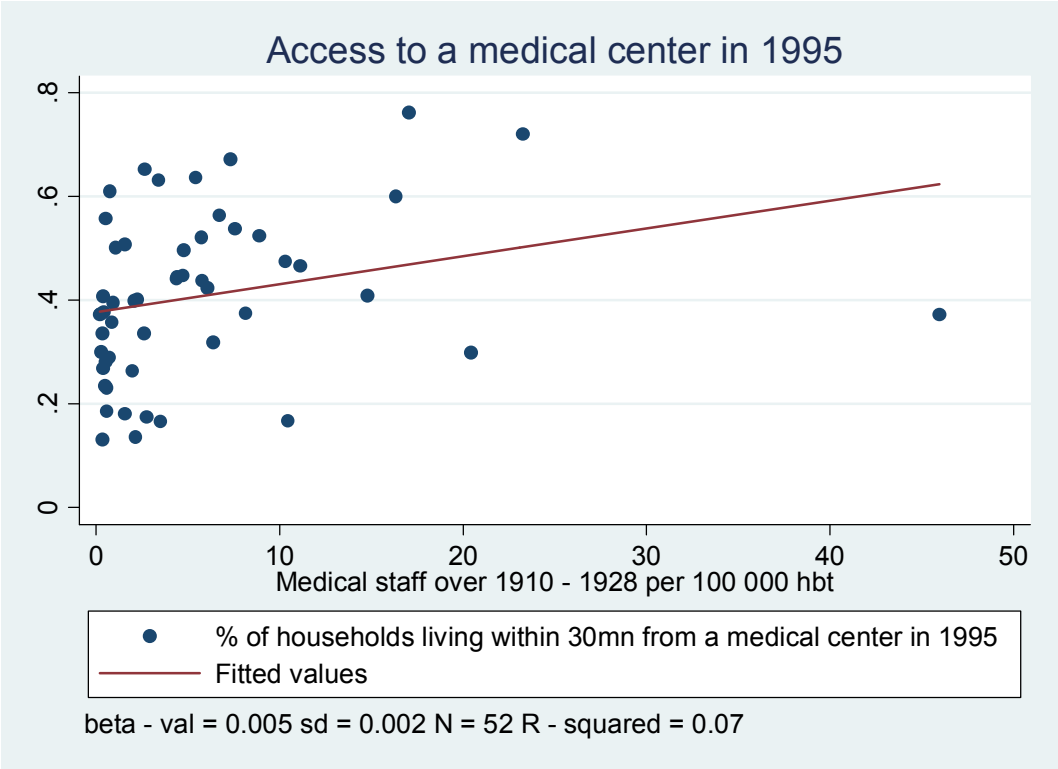


Graph 4: The relation between colonial investments and current access to public goods

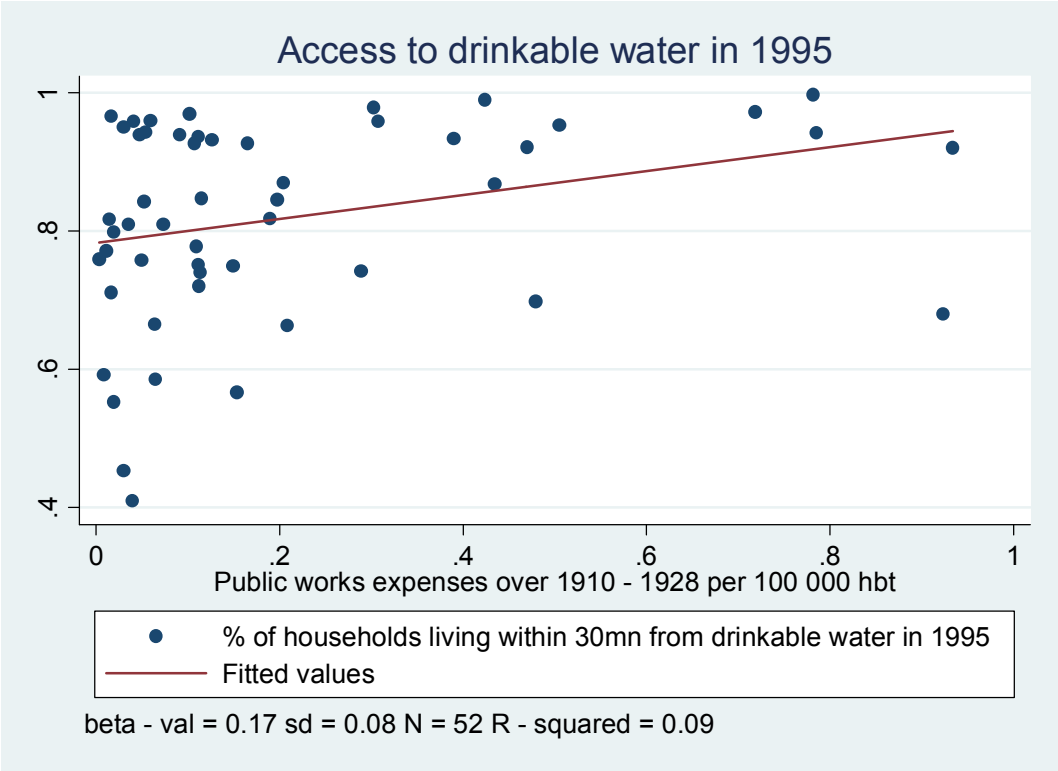
4.a



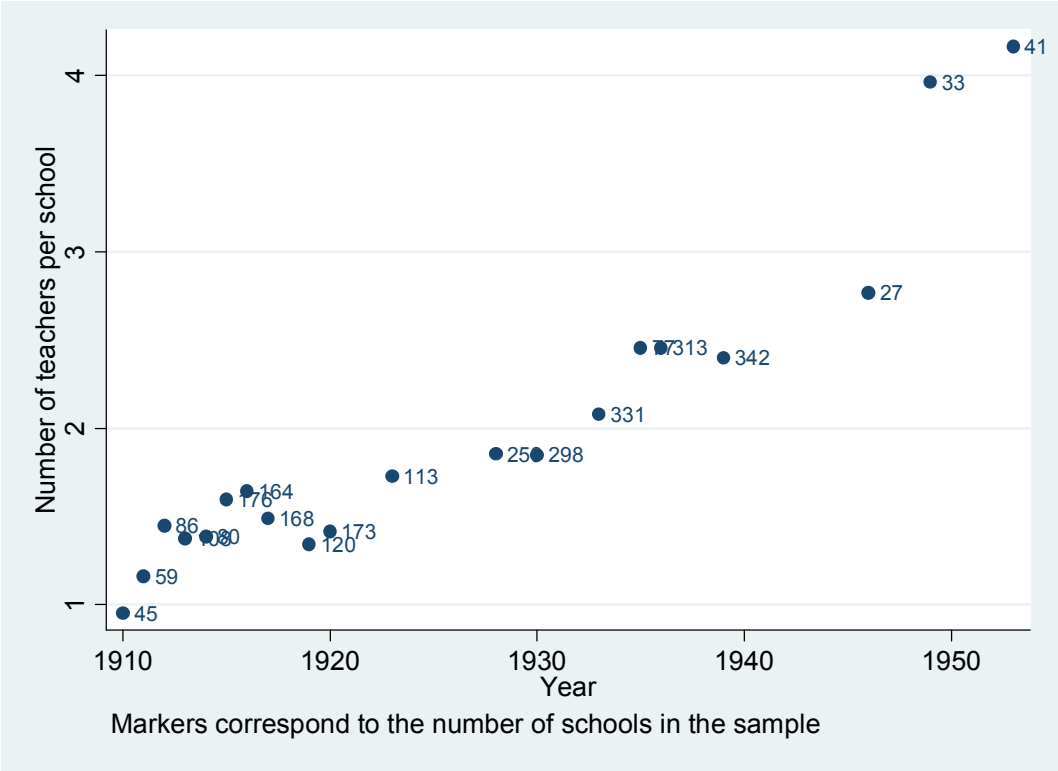
4.b



4.c


Access to drinkable water in 1995
1
.8
.6
.4
0
.2
.4
.6
.8
1
Public works expenses over 1910 - 1928 per 100 000 hbt
% of households living within 30mn from drinkable water in 1995
Fitted values
beta - val = 0.17 sd = 0.08 N = 52 R - squared = 0.09

Graph 5: The evolution of the number of teachers per school



Appendix 1: Data description and sources

1995 performances

Data on current performances comes from national household surveys: EPCV (1998) for Upper-Volta, ESAM II (2000) for Senegal, EIBC (1994) for Guinea, EPCES (1995) for Niger, EMCES (1994) for Mali, EPDS (1993) for Ivory Coast and EPCV (1995) for Mauritania.
These surveys report the localities where households live. I collected the geographical coordinates of households' localities on the website of Falling Rain Genomics. Then I matched localities' geographical coordinates with 1925 colonial districts maps that I found at the Documentation Française in Paris. This allowed me to compute statistics on current development at the colonial district level. I used statistical weights associated with the households in the survey, which is not ideal because these weights have been computed to make the sample representative at the national level and not at the district level.

(i) Proportion of 7-12-year old children attending school
This variable is the ratio of the number of 7-12-year children attending school on the total number of 7-12-year old children in the district.

(ii) Proportion of 0-5-year old children suffering from stunting
This variable is the ratio of the number of 0-5-year children suffering from stunting on the total number of 0-5-year old children in the district. Household surveys report the height and the weight of the 0-5-year old children. I used international standards associated to each age (measured in months) to calculate the proportion of stunting children in each district. A child is said to suffer from stunting if her height is less than two standard errors under the median height

(iii) Proportion of households connected to electricity
This variable is the proportion of households in the district which live in a house connected to electricity.

(iv) Proportion of households having access to a private a private water tap
This variable is the proportion of households in the district which live in a house with a private water tap, as opposed to public fountains or natural sources.

(v) Proportion of households using a modern fuel
This variable is the proportion of households in the district which use a modern fuel for cooking, namely gas, coal or electricity, as opposed to natural fuels.

(vi) Proportion of households living within 30mn from a primary school (respectively medical centre, drinkable water)
This variable is the proportion of households in the district for whom it takes less than 30mn to go to a primary school, or which are located at less than 3km from a primary school (respectively medical centre, drinkable water).

Colonial period

All data on colonial period except hostility towards colonial power come from the annual colonial budgets. In this paper, I use data from every year from 1910 to 1920, then 1923, 1925, 1928, 1930, 1933, 1936 and 1939. The volumes from 1910 to 1928 are located in Dakar (Archives Nationales du Sénégal), the later in Paris (Bibliothèque Nationale Française). Colonial budgets were presented at the colony level but often detailed the distribution of public goods, administrative staff and security expenses among districts, which allowed me to construct statistics at the district level. As districts borders evolved slightly during colonial times, I chose a map of reference, which is the 1925 districts

map. Original district-level data found in local budgets had to be adjusted to our constant statistical unit which is 1925 districts. I used information on territorial modifications from colonies' annual political reports[20] or localities' names mentioned in local budgets to know whether districts' borders were modified. Fortunately, the colonial budgets often detailed the distribution of public resources at the locality level. In this case, the location of localities on 1925 colonial maps allowed me to reorganize district level data according to 1925 districts configuration.

(i) Number of teachers per 100,000 inhabitants over 1910-1928
This variable is the average annual number of teachers over 1910-1928 divided by 1925 total population per 100,000 inhabitants units. The teachers reported in colonial budgets were those affected to public schools only.

(ii) Medical staff per 100,000 inhabitants over 1910-1928
This variable is the average annual number of doctors, nurses and medical auxiliaries over 1910-1928 divided by 1925 total population per 100,000 inhabitants units. The doctors, nurses and medical auxiliaries reported in colonial budgets were those affected to public medical centres only.

(iii) Public works expenses per capita over 1910-1928
This variable is the average annual amount of public expenses devoted to public works materials over 1910-1928 divided by 1925 total population per 100,000 inhabitants units. These expenses cover materials for the building and reparation of roads, bridges, housings, ports, airports, wells, sanitation and electrification. Since public works workforce was nourished by coerced labour, public works materials represented the major cost of colonial investments in infrastructures.

(iv) New teachers per 100,000 inhabitants over 1930-1939
This variable is the difference between the average annual number of teachers over 1930-1939 and the average annual number of teachers over 1910-1928, divided by 1925 total population per 100,000 inhabitants units. The teachers reported in colonial budgets were those affected to public schools only.

(v) New schools per 100,000 inhabitants over 1930-1939
This variable is the difference between the average annual number of schools over 1930-1939 and the average annual number of schools over 1910-1928, divided by 1925 total population per 100,000 inhabitants units. The schools reported in colonial budgets were public schools only.

(vi) Number of teachers per school at time t
This variable is the mean of the number of teachers divided by the number of schools in the districts.

(vii) Local chiefs wages per 100,000 inhabitants over 1930-1939
This variable is the average annual amount of wages paid to local chiefs enrolled in the colonial administration over 1910-1928. The local chiefs had to play the role of intermediary between the French administrator and the population, especially for tax collection and recruitment of military forces. Their wages varied according to the size of the population they had in charge but also according to their pre-colonial legitimacy and tribute: local chiefs descending from pre-colonial kingdoms received higher wages than those who were not from a royal family.

(viii) Hostility towards colonial power over 1920-1940
This variable is the average annual number of severe events expressing hostility from local population or local chiefs towards colonial power. Data on political events during colonial times comes from the annual political reports written by the French administrators to the colony governor. I coded events reported by the administrators in their reports and classified events expressing hostility in three classes:

[20] These reports can be found at the Archives Nationales in Paris. They were written by the Lieutenant-Governors to inform the General Governor on the colonies' political and administrative situation.

benign, moderate and severe events. Severe events are those which emerged from the major part of the population and necessitated an intervention from colonial power. Hostility towards colonial power expressed through refuse to pay taxes, refuse to enrol in military forces, refuse to do coerced labour, refuse to obey to colonial rules, riots or rebellions. It differs from resistance to colonial conquest which concerned African people reaction during conquest, whereas hostility refers to African people attitude

Early European settlement

(i) Number of European settlers per 100,000 inhabitants in 1910

This variable is the number of European settlers about 1910 divided by the total population per 100,000 units about 1910. District-level data on 1910 European settlers and on local population comes from colonial censuses, Archives Nationales, Fond Afrique Occidentale Française, série G, sous-série 22, Paris. In 1910, European people represented on average 0.1% of districts population (52 Europeans per district), which was overall extremely low, as in most of African colonies except North and South Africa.

Conquest characteristics

(i) Year of colonial conquest's beginning

I collected district-level data on French military expansion using French military archives: Pierre Deloncle (1934), Général Duboc (1939). These authors relate the timing of colonial conquest and allow me to compute the year colonial military forces arrived in each district. It varied from 1854 for some Senegalese districts to 1903 for the district of Agadez (Niger).

(ii) Local resistance to colonial conquest length

Data on African people resistance to colonial conquest come from Deloncle (1934), Duboc (1939), Suret-Canale (1964), Mickael Crowder & Obaro Ikime (1971), Ki-Zerbo (1978). I collected two dates to measure the length of African resistance: year of French military troops' arrival and year of the last military intervention for district pacification. I use the difference between these two dates as a measure of districts' length of African resistance. Data exhibit an average length of resistance of 23 years, which is much longer than what we are used to be told about colonial history. Differences in lengths of resistance are quite important: some districts opposed no resistance to the colonial power (district of Indénié in Ivory Coast, former Europeans trading counters), whereas others resisted more than 50 years (Casamance in Senegal, northern Mauritanian districts and middle-east of Benin).

(iii) Local chiefs' indemnities

This variable is the average amount of indemnities paid to pre-colonial chiefs in exchange of their acknowledgement of the superiority of the colonial power. The indemnities had nothing to do with the association of local chiefs in the colonial administration which was implemented far later. They just rewarded some of the pre-colonial local chiefs who accepted to resign. These indemnities are reported in the colonial budgets under the category "political expenses".

Pre-colonial characteristics

(i) Centralized political power dummy

Pre-colonial political context can be synthesized in two types of districts: those under a centralized political power (state societies) and those under no centralized political power (stateless societies). Data on pre-colonial kingdoms and empires comes from several historian sources: Jean Suret-Canale (1964), Marcel Chailley (1968), Adu A. Boahen (1989), Bouche (1991), Catherine Coquery-Vidrovitch & Henri Moniot (1993), Curtin & al. (1995). I constructed a dummy for the presence of a pre-colonial centralized political power which determines "state" and "stateless" districts. Districts sheltering a kingdom during the nineteenth century are classified as "state" districts.

(ii) 1910 population density
This variable is the 1910 local population divided by land area. District-level data on 1910 local population comes from colonial censuses, Archives Nationales, Fond Afrique Occidentale Française, série G, sous-série 22, Paris. It is more usual to divide total population by arable area but some districts are completely in the desert and therefore their arable land is zero.

(iii) Trade taxes collected in 1914
This variable is the amount of trade taxes collected in the district in 1914. Trade taxes were introduced during the 1900s and regarded all secondary and tertiary activities. Tariffs depended on firms' activity and number of employees. This variable thus allows me to measure the economic prosperity in addition to population density. Data on trade taxes collected in each district comes from the annual colonial budgets.

(iv) European trade counter dummy
This variable equals to 1 if the district sheltered a former European trade counter, else 0. Data on former trade counters comes from Curtin (1995).

Geographical characteristics

(i) Altitude
This variable is the altitude of the main town of each district. The main town of the district corresponds to the colonial "Chef-lieu", which is indicated on the 1925 colonial maps found in the Documentation Française, Paris. Data on altitude comes from the website of Falling Rain Genomics.

(ii) Latitude
This variable is the average latitude of the localities where households from the national surveys live. Data on the latitude of each locality comes from the website of Falling Rain Genomics.

(iii) Longitude
This variable is the average longitude of the localities where households from the national surveys live. Data on the longitude of each locality comes from the website of Falling Rain Genomics.

(iv) Annual rainfalls
This variable is the average annual precipitations in the main town of each district over 1915-1975. The main town of the district corresponds to the colonial "Chef-lieu", which is indicated on the 1925 colonial maps found in the Documentation Française, Paris. Data on annual precipitations in each "chef-lieu" comes from a database collected by ORSTOM which gives the annual precipitations on many towns of Africa from 1915 to 1975.

(v) Coastal dummy
This variable equals to 1 if the district has access to sea, else 0. Data on coastal borders come from the 1925 colonial maps found at the Documentation Française, Paris.

(vi) River dummy
This variable equals to 1 if the district has a navigable river, else 0. Data on important rivers come from the 1925 colonial maps found at the Documentation Française, Paris.

(vii) Distance from the coast
This variable is the distance from the coast of the main town of each district. The main town of the district corresponds to the colonial "Chef-lieu", which is indicated on the 1925 colonial maps found in the Documentation Française, Paris. I also used these maps to calculate the distance from the coast of each "Chef-lieu".

Appendix 2: Matching procedure

1) Definition of neighbourhoods

An intuitive definition of neighbour districts would be "districts that share a common border" (Banerjee & Iyer (2005) use this definition with a similar empirical context as mine). But the problem with this naïve definition is that neighbourhoods overlap. For instance, you can see on the right side of map 1 that both Nguigmi and Zinder are neighbours of Goure but are not neighbours themselves. Nguigmi's neighbourhood and Zinder's neighbourhood therefore overlap: they both contain Goure. In this case, assuming that neighbour districts share similar unobservable characteristics would simply imply that *all* districts share similar unobservable characteristics because every neighbourhoods share common districts with another neighbourhood. Therefore, the naïve assumption that districts sharing a common border share similar unobservable characteristics is not convenient in my context of overlapping neighbourhoods.

In order to circumvent this problem, I need a definition of neighbour districts which create disjointed neighbourhoods. I define a neighbourhood as a cluster of three districts that share a common border and assume that districts belonging to the same cluster share similar unobservable characteristics whereas districts belonging to different clusters do not necessarily share similar unobservable characteristics even if they share a common border[21]. Neighbourhood fixed effect is similar within but not between clusters. This leads to divide districts map in disjointed neighbourhoods which are sets of three districts sharing a common border.

2) Construction of neighbourhoods

Since there are several possible partitions of the districts into disjointed neighbourhoods, I compute neighbourhoods by randomly assigning to a district two districts that share a common border. This method potentially keeps some districts out of any neighbourhood: when all the districts that share a common border already belong to a neighbourhood, a district remains alone. In this case, I randomly choose to assign this district to one of the neighbourhoods around. As a result, most of neighbourhoods contain 3 districts but some contain 4 districts.

Since I do not want that estimates of equation (3) are driven by a particular neighbourhoods design, I run regressions with 50 random neighbourhood designs[22]. For each neighbourhoods design, I constitute a data set containing neighbour districts' differentials. In order to avoid redundant observations, I keep 2 differentials for 3-districts neighbourhoods and 3 differentials for 4-districts neighbourhoods. This produces samples of districts differentials counting between 65 and 80 observations, with a mean size of 71 observations. For each of the 50 neighbourhoods designs, equation (3)'s estimate provides estimates of β and γ.

3) Econometric estimates

I use the empirical mean of the 50 estimates of β (respectively γ) as an estimate of β (respectively γ) and the empirical standard deviation of the 50 estimates of β (respectively γ) as an estimate of the standard deviation of β (respectively γ). Since OLS estimators are normally distributed and unbiased, these estimators are unbiased and convergent.

[21] I admit that the number of three districts used to define neighbourhoods is arbitrary and could be changed. The fewer districts in a neighbourhood, the weaker the hypothesis on unobservable characteristics. But reducing the number of districts in a neighbourhood also reduces the number of observations in the sample to test equation (3). I therefore chose to cluster districts three by three rather than two by two to keep a reasonable number of observations in the sample.

[22] I also admit that the number of fifty is arbitrary and results do not change if I choose another number. Fifty is simply high enough to check that results are not driven by a particular neighbourhoods design.