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History Matters: The Long-Term Impact of Colonial Public Investments in French West Africa†

By Elise Huillery*

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 investment 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. (*JEL* H41, H54, N37, N47, 016)

Since West African countries acceded independence in 1960, the economic performance of these countries has been strikingly low in comparison with other developing countries. This is what makes many observers refer to this as an "African tragedy." Obviously, the need for understanding this tragedy is crucial. The economic historian Paul Bairoch writes: "There is no doubt that a large number of negative structural features of the process of economic underdevelopment have historical roots going back to European colonization" (Bairoch 1993, 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 into three groups according to their colonial dimension of interest. The first group of papers focuses on differences induced by colonizers' identities. Raphael La Porta et al. (1999) and Daron Acemoglu and Simon Johnson (2003) find that colonizing countries had an impact on the development path of former colonies through the nature of legal systems they imported to the colonies. Both give evidence that former English colonies benefit

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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 James A. Robinson (2001) show that former settlement colonies perform better than former extractive colonies because they inherited institutions that better protect private property rights. Finally, a third group of papers focuses on the impact of institutions induced by particular administrative rules. Abhijit Banerjee and Lakshmi Iyer (2005) study the impact of the colonial land tenure system on the development of Indian districts. They provide evidence that districts in which property rights for land were given to cultivators now perform better than districts in which these rights were given to landlords. Iyer (2005) compares 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 last two 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 former colonies have radically different historical, geographical, and 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 its geographical, anthropological, cultural, and historical characteristics. Moreover, it was colonized only by France (which allows us to control for the colonizer's identity), in the same period (from the last quarter of the nineteenth century to 1960).[1] 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 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 underlining 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 (2001) push ahead 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 (2005) give evidence that the effect of the land tenure system and colonial rule on productivity in India is indirect. Partially relying 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,

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

contributes to precisely why 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 1990s. 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 the districts of former French West Africa. Colonial investments in education, health, and infrastructure were indeed very unequal among districts. Figures 1 and 2 plot colonial investment and 1995 performances. They show a strong relationship between colonial investment and outcomes today. But the relationship between colonial investment and current development cannot be taken as conclusive evidence since pre-colonial characteristics could have influenced both colonial investment and development paths, resulting in bias estimates of the causal effect of public investment on current development. French colonial power could 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, I use a number of strategies in this paper. First, I exploit proxies of the potential determinants of colonial investment, which can be classified into 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 was not the case. Third, I use the geographical discontinuities of colonial policy in order to circumvent the problem of the omitted variables. 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 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 good (education, health, or infrastructures) between 1910 and 1928 explain about 30 percent of the corresponding current performance. Moreover, the nature of investments matters. Current educational performances are more specifically determined by colonial investments in education, current health performances by colonial investments in health, and current infrastructure's 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 very high. The path of public investments from 1910 to 1939 shows that districts that received greater investment in

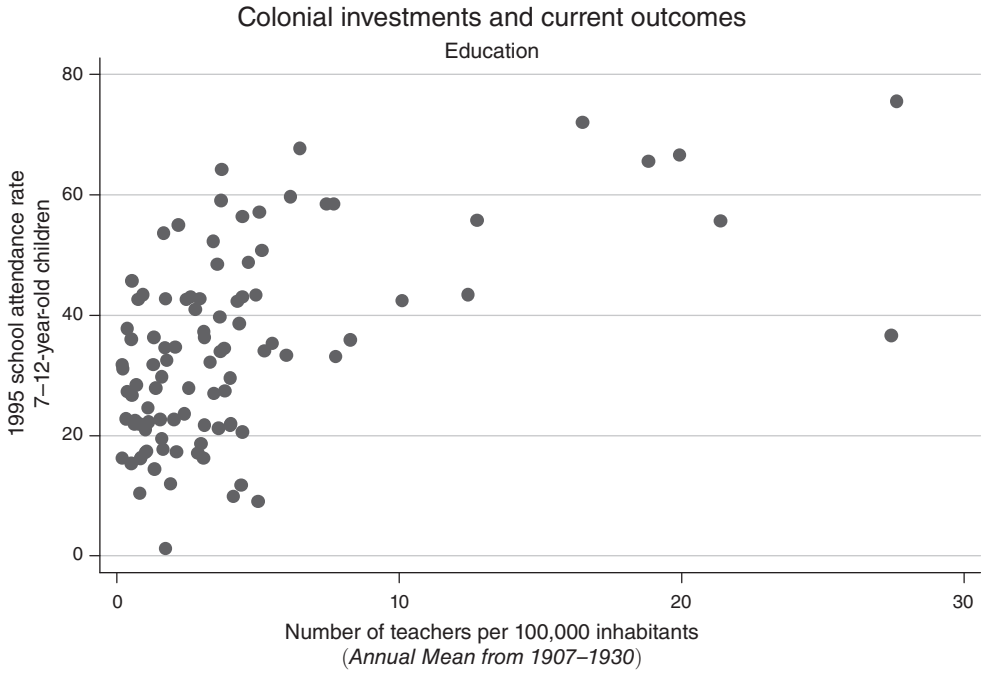


FIGURE 1. THE CORRELATION BETWEEN COLONIAL INVESTMENTS IN EDUCATION AND CURRENT EDUCATIONAL OUTCOMES

early times received more than the others later, which shows differences did not narrow over time. I find the fact that investments continued to be concentrated in areas that already had many of them is more likely 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 investment 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 Colonization

A. *French Political Control of West Africa*

French West Africa officially lasted 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.

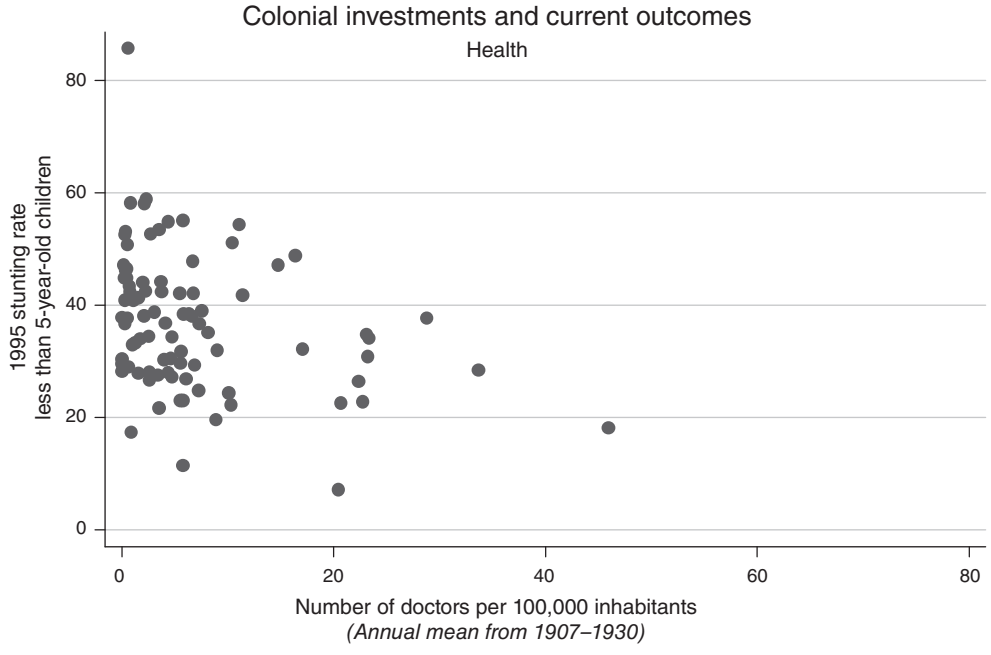


Figure 2. The Correlation between Colonial Investments in Health and Current Health Outcomes

The French first arrived in 1854, landing on the Senegalese coast, led by the famous General Louis Faidherbe. Colonial expansion in the 1850s began from the west of the region. The first military column went from the Senegalese coast eastbound and arrived at the west side of what is currently Mali (Kayes, Satadougou in the late 1850s). A second military expansion was engaged during the 1850s northbound to what is currently Mauritania. A third military expansion took place along the Guinean coast (Conakry, Boffa, Boke, and Forecariah). South Dahomey was the only new expansion in the 1860s. No new expansion occurred during the 1870s. Main colonial expansion occurred in the 1880s from south to north and from west to east. In the 1890s, a last military column progressed from the southeast side of what is currently Mali, east as far as Lake Tchad, joined by a column progressing from Benin's coasts, going 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 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 a few coastal localities. Local chiefs' prerogatives, in particular, were, in general, still intact, their military obedience being materialized by friendship treaties. Hostile chiefs suffered from French military repression. Civil administration took place progressively in the whole territory from 1900–1920. Thus, we can consider that an administrative occupation has been in effect in the major part of the territory from approximately 1910–1960.

B. *Financial and Administrative Organization of French West Africa*

The French colonial administration was structured as a pyramid. At the top of the pyramid was the general governor of the federation. Next, were Lieutenant governors, at the head of the colonies (Senegal, Guinea, Dahomey, Soudan, Upper-Volta, Ivory Coast, Niger, and Mauritania). Administrators were below lieutenant governors, at the head of the districts, about 15 per colony. In 1925, French West Africa had 120 districts (see Figure 3). The largest districts were divided into subdivisions that were also managed by French administrators (in 1925, there were 164 subdivisions or districts, when the districts had no subdivision). At the bottom of the pyramid, under French administrators, were African chiefs. The colonial administration nominated local chiefs as village's chiefs and limited their influence to small areas.

In this pyramidal organization, the effective power was concentrated at the third stage. The district administrators were "the real chiefs of the French empire" (Robert Delavignette 1939). Their tasks, which included 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," were very important.[2] The official tasks of African chiefs were to collect taxes, recruit a workforce for hard labor, and recruit military reservists. The number of reservists to recruit and the amount of taxes to collect was defined by French district administrators. African chiefs were quartered to auxiliaries of French colonial administrators. The administrative organization was officially centralized but effectively decentralized. French district administrators could manage their local policy in an almost independent way thanks to physical distances and no means of communication. Neighbor districts could therefore experiment with different colonial policies.

The French colonial financial system in West Africa was organized with three 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, the local budgets of the colonies were credited with local taxes. Each colony had to use its own resources to finance French colonization costs (except Mauritania, which benefited from federal subsidies). According to the statistics I computed,[3] 60 percent of colonies' budgets came from the capitation tax. Direct taxes (capitation tax, trading tax, and property tax) represented 89 percent of the total resources of the colonies. Local budgets had to cover all expenses except for military expenses and some of

[2] In French, called the "code de l'indigénat." This code was exclusively devoted to African people.
[3] These statistics were calculated from the budgets of 71 districts in 8 colonies between 1907 and 1930.

the biggest large-scale public works projects. The cost of colonization was endured by local populations rather than French taxpayers, and, more precisely, mostly by households rather than firms. The government and central services of the colonies absorbed 30 percent of the colonies' resources. Districts received the other 70 percent, on average, distributed as follows: 40 percent for administration expenses, 10 percent for public works, 15 percent for education and health expenses (personal and material), and 5 percent for miscellaneous expenses. Investments in infrastructure, health, and education in the districts amounted to 25 percent of the colonies budgets. All expenses in the colonies, and a fortiori in districts, were carried out by local budgets, except for some very large-scale public works projects (almost exclusively railway works) which were financed by federal resources.

C. *Public Goods Investment Policy*

Colonial administration invested in three public goods: education, health, and infrastructure. Every year French administrators had to define how many teachers, schools, doctors, and hospitals were needed and how much money was alloted for public works in determining the local budget. In the education field, administrators had to decide how many European teachers, African teachers, and teaching assistants, as well as how many teaching materials were needed. In the medical field, they decided how many European doctors and nurses, African doctors and nurses, medical assistants were needed, and how many medical materials were needed. Finally, they decided how much financial resources were needed to cover their infrastructure expenses such as roads, wells, tracks, buildings, and bridge repair and construction. 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 infrastructure were not proportional to district 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 for the initial contributions of each district. Some districts contributed a lot in local budgets but received low investments, others contributed a lot in local budgets and received high investments, and vice versa. As a consequence, the correlation between tax revenue and public investment was positive but small (about 0.2). No explicit investment strategy can be found in local budgets. Motivations reported at the beginning of each local budget explain the general level of annual resources and modifications in resource employment but do not motivate the spatial distribution of public goods provision. However, all historical documents on the French colonial administrative system mention the relative autonomy of French district administrators and their power in terms of policy making (William B. Cohen 1973, Joseph Ki-Zerbo 1978, and Denise Bouche 1991). Biographies of former French colonial administrators also give evidence on their initiating role in the investment decision process (Robert Delavignette 1939; Hubert Duchamps 1975). The influence of administrators on investment policy was certainly very high. Thus, their personality or educational background could be an exogenous source of differences in colonial public investments. But some

Figure 3. Territorial Organization of French West Africa (1925)

intrinsic characteristics of the districts certainly also influenced administrators' investment policy and therefore constituted 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 investment in public goods on the development of current districts, 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. Figure 3 shows the district configuration that the paper refers to, which is the configuration in 1925. At this time, French West Africa included 120 districts in 8 colonies. On average, districts had 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, the French colonial system was, in fact, decentralized, and variations therefore arose at the district level rather than at the state level. District was thus the pertinent unit with respect to the historical effects focused on in this paper. The drawback is that no district-level data is available, so I had to compute current and historical data myself.

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, the Gross National Product (GNP) percapita for the Ivory Coast ($690) was four times higher than that of Niger ($190).[4] In 1995, primary net enrollment rate varied from 25 percent in Niger to 75 percent in Benin.[5] The literacy rate amounted to 13.5 percent in Niger, around 20 percent in Mali and Burkina Faso, 32 percent in Senegal and Benin, 38 percent in Mauritania, and 44 percent in the Ivory Coast.[6] The inequalities between countries are thus consequent. However, the greatest inequalities in former French West Africa do not arise at the state level, but at the district level. District-level data on current development used in this paper come from national household surveys implemented in the 1990s.[7] Unfortunately, I could not use any survey for Benin, which is therefore excluded from the sample. The number of available districts is therefore 101. Development indicators that can be computed from each national household survey are: (a) the proportion of 7–12-year-old children attending school, (b) the proportion of 0–5-year-old children suffering from stunting, and (c) the proportion of households connected to electricity, having access to a private water tap, and using a modern fuel.[8] The Mauritanian survey does not contain information about the weight and the height of the children, so (b) excludes Mauritanian districts.

The top portion of Table 1 (labeled 1995 districts' development) presents summary statistics on those five development indicators. On average, per district, in 1995, 34 percent of the 7–12-year-old children attended school, 37 percent of 0–5-year-old children suffered from stunting, 12 percent of households were connected to electricity, 10 percent had access to a private water tap (as opposed to public sources of water like fountains or natural sources like streams), and 14 percent used a modern fuel for cooking. Data 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 infrastructure development indicators, as shown by the high values of standard errors and gaps between means and medians or between twenty-fifth and seventy-fifth percentiles.

Figure 4 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 colored, those of the third tercile are dark colored. We can observe some regional tendencies ("light" areas versus "dark" areas), Northwest of West Africa and south of the vory Coast that are 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 show an important heterogeneity between neighboring districts. To measure the importance of being in a particular country, I decomposed the total variance of each indicator in two parts: the vari-

[4] Source: World Bank statistics.
[5] Source: World Bank statistics.
[6] Source: World Bank statistics.
[7] See Appendix 1 for further details on data.
[8] Surveys count, on average 450 households, 620 7–12-year-old children and 370 less than 5-year-old children per district.

ance within countries and the variance between countries. I calculated the share of total variance due to variance within countries, and it clearly shows the predominance of within-country variance which represents around 80 percent of total variance. Country or geographical position is a small part of the story. What we have to explain are inequalities at the district level rather than at the state level.

B. *Colonial Public Investments*

Data on colonial investments come from annual local budgets for the period 1910–1928. 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 used the average number of teachers per 100,000 inhabitants as a proxy of colonial investments in education. I used the same variable for colonial investments in health substituting medical staff for teachers. Finally, I collected annual public works material expenses per district between 1910 and 1928 and used the average amount of public works expenses from 1910–1928 per capita as a proxy of colonial investments in infrastructures.[9] Public works consisted of roads, wells, tracks, building and bridge repairs and construction.

Data on large-scale public works projects financed with federal resources are not included for two reasons. First, it would have required the collection of federal budget data in addition to local budget data, which represents an important additional effort. Second, federal budgets do not decompose investments at the district level or at the state level, which would make any repartition between districts very hypothetical. This exclusion produces an understatement of colonial investments inequalities: large-scale public works financed with federal resources were mostly devoted to main towns or main axes of each colony; those that were already advantaged by local budgets. Actual colonial inequalities in infrastructures were probably larger than was measured here.

It is well known that Christian missionaries were 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 and 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 do not mention the role of missions except in Dahomey,[10] which is not included in my study. The omission of Christian missionaries in this paper should therefore not affect my results. In addition to Christian missionaries, there were also Koranic schools in some areas, but I will not take them into account because these schools dispensed a very specific education that focuses on religious achievement.

[9] 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.

[10] Bouche (1991) explains that this colony had a significant number of missionary schools because the demand for education was far more important than the supply from public services in this colony.

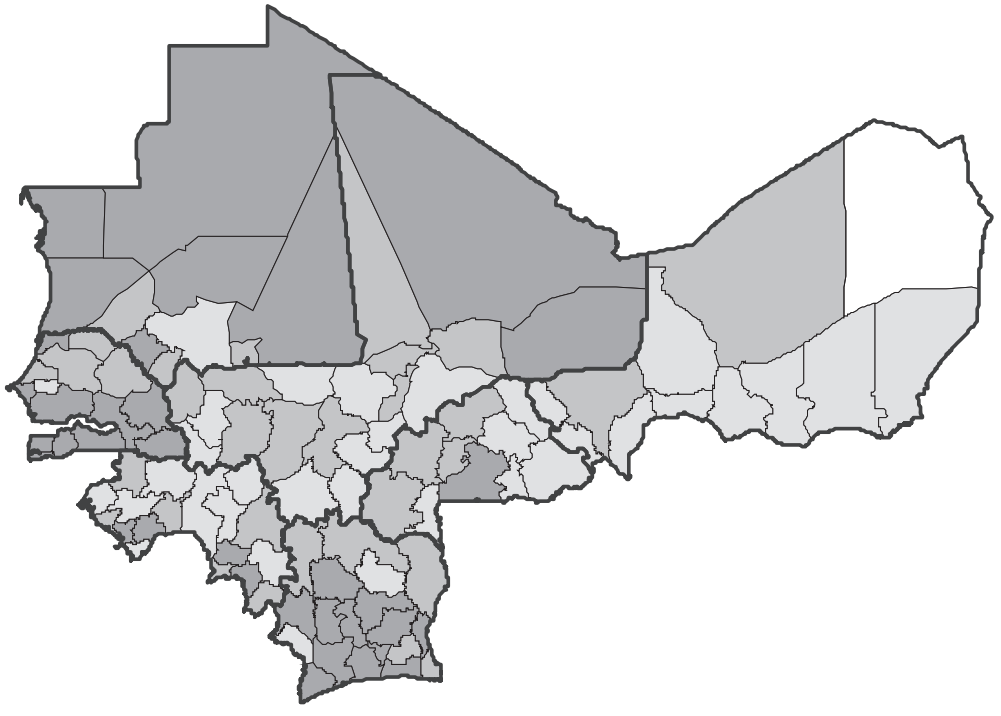


FIGURE 4. PERCENT OF 7–12-YEAR-OLD CHILDREN ATTENDING SCHOOL

Note: Lowest tercile in light color, highest tercile in dark color.

As shown in the middle of Table 1 (labeled Colonial period), colonial investments per district were very low: 4 teachers and 8.5 medical workers per 100,000 inhabitants and 0.44 FF[11] per inhabitant for public works, on average, per year from 1910–1928. Standard deviations per mean unit are high and the difference in terciles' means is huge. This gives evidence that colonial investments were very unequal. Figures 5 and 6 show the geographical distribution of colonial investment in education and health. It is clear that colonial investment policy was unbalanced. Upper Volta and the region southeast of Niger have been disadvantaged in terms of human capital investments. Investments in infrastructures were more concentrated in coastal areas of Senegal, Guinea, and the Ivory Coast, which reflects the structure of the French colonial economic system based on trade with European countries. In addition to regional discriminations, it is also noticeable that many neighbor districts received very different colonial treatments. The average gap between two neighbor districts is equal to five teachers and ten doctors, which is large compared to the average number of teachers and doctors per district.

Totalling average investments per district from 1910–1928 shows that there were, on average, only 700 teachers and 1,230 medical workers in all of French West Africa (of which a large majority were Africans). Thus, the colonial investment

[11] Monetary data are calculated in constant 1910 FF.

TABLE 1—SUMMARY STATISTICS ON DISTRICTS

	Mean	Standard deviation	25th percentile	Median	75th percentile	Min	Max	Observations
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 center	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 from 1910–1928	4	5	1	3	4	0.2	28	99
Medical staff per 100,000 hbt from 1910–1928	8.5	15	1	4.4	9	0	111	98
Public works expenses per capita from 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 from1930–1939	1.7	2.4	0.3	1.4	2.5	–11	9.5	99
Local chiefs' wages per 100,000 hbt from 1930–1939	92,319	113,797	28,827	46,931	97,021	0	582,889	99
Index of hostility toward colonial power from 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	2,125	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	1,516	0	0	420	0	7,726	99
Pre-colonial 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
Europoean trade counter dummy	0.04	0.2	0	0	0	0	1	99
Geographical characteristics								
Altitude (feet)	816	594	242	859	1,161	0	3,044	99
Annual rainfall average over 1915–1975 (mm)	1,050	718	500	890	1,546	17	3,248	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

Notes: See Appendix 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 percent 0–5-year-old children suffering from stunting is missing for Mauritanian districts. Data on medical staff per 100,000 people is missing for Conakry.

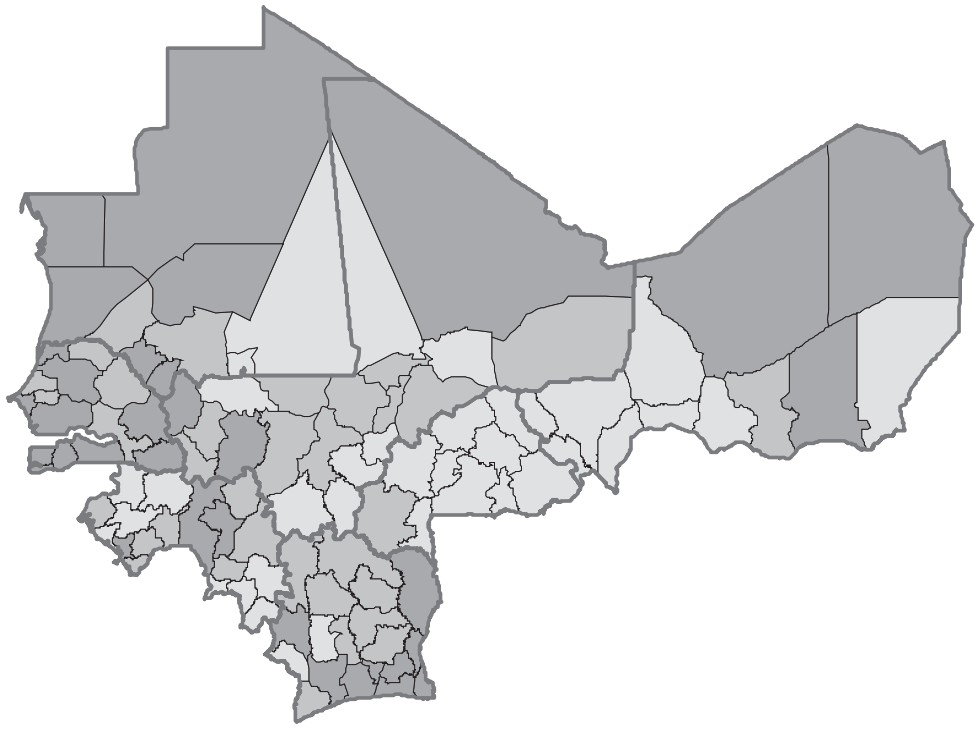


FIGURE 5. NUMBER OF TEACHERS PER 100,000 INHABITANTS
(*Annual mean, 1910–1928*)

Note: Bottom tercile in light color, top tercile in dark color.

effort was not massive. But these investments were unequally distributed. Colonial public investments' policy was therefore an important source of inequality between districts.

C. *Other Characteristics of Districts*

At the end of the nineteenth century, French West Africa was a vast territory of 4,800,000 km^2 inhabited by a scarce population of around 12,000,000 people.[12] Population density was very low (2.5 people per km^2). As stated in the introduction, an advantage of limiting the study to a geographically restricted area is that sources of variation can be much more easily identified than in the case of very different historical, anthropological, geographical, and institutional backgrounds. This section identifies characteristics of districts that potentially determined colonial investments and development performances. I collected a fair amount of observable characteristics of the districts. All data are original.

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

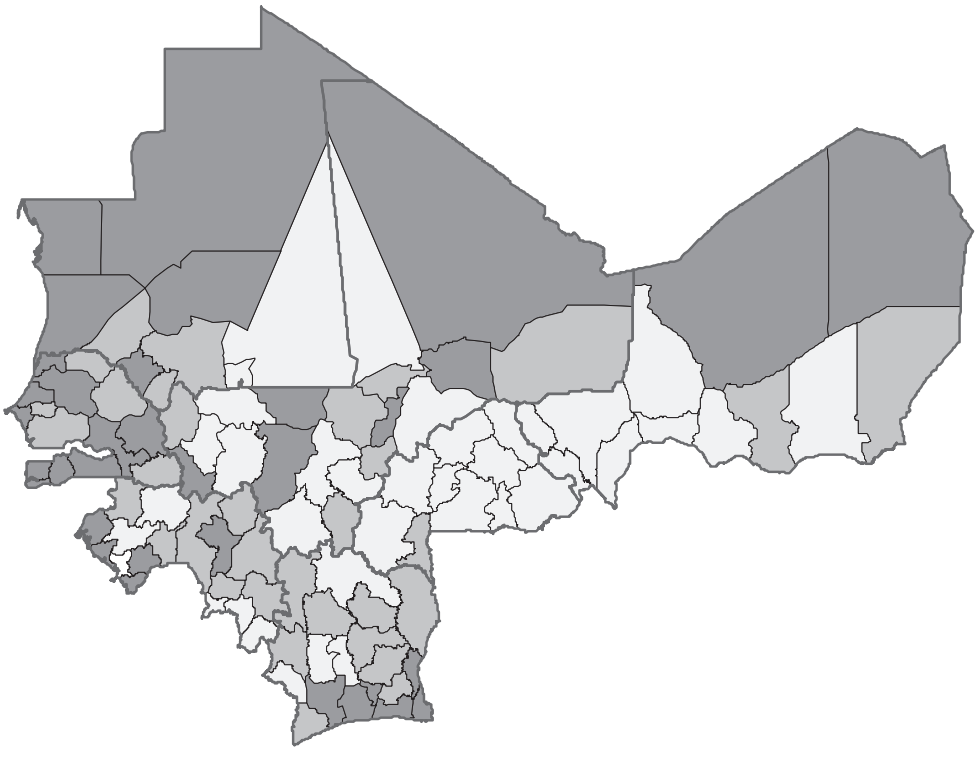


FIGURE 6. MEDICAL STAFF PER 100,000 INHABITANTS
(*Annual mean, 1910–1928*)

Note: Bottom tercile in light color, top tercile in dark color.

Geographical Characteristics.—Geographical characteristics of districts are potentially important determinants of their development path. They condition soil fertility, climate severity or mildness, accessibility to water, etc. (David E. Bloom and Jeffrey D. Sachs 1998). Climate, proximity to the coast, or access to practicable rivers could also have influenced colonial investments through their impact on the accessibility and attractiveness of districts. I use geographical characteristics reflecting the accessibility and attractiveness of districts as control variables. These characteristics are altitude, annual precipitation, 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 labor 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). Philip Curtin et al. (1995, 447) write 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 characteristics of pre-colonial districts. First, I capture the pre-colonial

economic prosperity with the initial population density. As documented by Thomas Malthus (1798) and Bairoch (1993), only prosperous areas could support high population densities because more natural resources and agrarian prosperity are necessary to nourish a large population. This measure is therefore more 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.[13] Pre-colonial population density was concentrated in five 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 the 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 a 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 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 Nicola Geneaioli and Ilia Rainer (2003).

French Conquest Characteristics.—Colonial conquest could reveal some intrinsic characteristics of disticts 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 first year of the French colonial conquest, 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 when compared to the length of the colonial era itself. Colonialism's timing might be correlated with both colonial investments (early conquered districts could have an advantaged over districts conquered later, or may be disadvantaged since colonization was extractive) and development potentialities (more affluent areas could have been colonized sooner). Second, I use African people's resistance against French colonial power as a control variable because it might be correlated with colonial investments (rewards or punishments in response to local attitudes) and development potentialities because resistance might reflect some cultural, anthropological, or political characteristics. Third, I use the indemnities of local chiefs as a 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

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

people resisted, collaboration between traditional and colonial power might be correlated with colonial investments and development potentialities.

Early European Settlement.—According to existing literature, European settlement encouraged good colonial treatment (Acemoglu, Johnson, and Robinson 2001). In West Africa, very few Europeans settled in comparison to other colonies such as Australia, Canada, etc. Early French settlement can reflect districts initial attractiveness, however. 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 European settlers tended to settle in more prosperous areas. Moreover, European settlement, per se, could positively influence 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 of crucial concern. 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 the characteristics of districts compared to colonial supply of public goods simply because the supply of public goods was almost nonexistent at the beginning of colonial times. The year 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 the colonial investments they received between 1910 and 1928 by running ordinary least squares regressions of the form

$$Y_i = \alpha + \beta CI_i + \mathbf{OCI}_i\gamma + X_i\lambda + u_i, \tag{1}$$

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

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 proportion 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 performance, the impact of colonial investments in health on health performance, and the impact of colonial investments in infrastructure on infrastructure development. As colonial investments in education, health, and infrastructure are highly correlated, I want to disentangle the effect of each investment. I 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 $\mathbf{OCI}_i$ in equation (1)). When Y_i is districts' proportion of 7–12-year-old children attending school, CI_i is districts' average annual number of teachers per 100,000 capita, and vector $\mathbf{OCI}_i$ 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 infrastructure development indicators, CI_i is districts' average annual amount of public works per capita, vector $\mathbf{OCI}_i$ being the two other colonial investments. Since districts that received many teachers received many doctors and a lot of infrastructure (correlations between these three variables are between 0.60 and 0.80), the impact of colonial investments 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), it is interesting to isolate the specific impact of each kind of investment, and it also brings an additional control for the potentially unobserved characteristics that 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 III: geographical variables (precipitation, altitude, latitude, longitude, coastal border dummy, and practicable river dummy), pre-colonial prosperity (centralized 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 large number of the endogenous factors.

Dakar and Saint-Louis had a very specific status during the 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 has been the capital of French West Africa since 1902. These two cities were not exactly "districts" because they 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 greater 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, from 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 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 Dakar and Saint-Louis from the sample.

Our coefficient of interest is 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 infrastructure performances.

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	Geographical controls	Pre-colonial controls	Conquest controls	Attractiveness controls	Country fixed effects	Other investments controls
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Percent 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)
R^2	0.30	0.41	0.42	0.50	0.50	0.56	0.50
Observations	98	98	98	98	98	98	97
Panel B: Percent 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)
R^2	0.27	0.30	0.32	0.34	0.34	0.41	0.37
Observations	88	88	88	88	88	88	88
Control variables							
Geographical characteristics	N	Y	Y	Y	Y	Y	Y
Pre-colonial characteristics	N	N	Y	Y	Y	Y	Y
Colonial conquest	N	N	N	Y	Y	Y	Y
Initial attractiveness	N	N	N	N	Y	Y	Y
Country fixed effects	N	N	N	N	N	Y	N

Notes: Standard errors are in parentheses. 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 percent 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 and trade taxes per capita collected in 1914. Colonial conquest control variables are: year of colonial conquest's beginning, local resistance length, local resistance length^2, and local chiefs' indemnities. Pre-colonial characteristics control variables are: centralized political power dummy, European trade counter dummy, and 1910 population density. Geographical characteristics control variables are: annual rainfall average from 1915–1975, altitude, longitude, latitude, coastal dummy, and river dummy.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

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 variables. In column 6, I add dummy variables that indicate the country districts' location after independence. These are included because 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.

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 investment controls (7)
Panel A: Percent 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***** (1.1)	**6.96***** (1.11)	**9.05***** (1.36)	**8.69***** (1.29)	**5.29***** (1.43)	**5.72***** (1.39)	**1.16** (2.50)
R^2	0.38	0.58	0.61	0.67	0.73	0.78	0.70
Observations	98	98	98	98	98	98	97
Panel B: Percent 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***** (0.92)	**5.62***** (1.00)	**6.92***** (1.25)	**6.80***** (1.27)	**5.74***** (1.52)	**5.82***** (1.54)	**3.11*** (1.85)
R^2	0.31	0.41	0.44	0.47	0.49	0.54	0.50
Observations	98	98	98	98	98	98	97
Panel C: Percent 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***** (1.37)	**6.75***** (1.35)	**9.88***** (1.63)	**9.58***** (1.36)	**7.49***** (1.60)	**7.70***** (1.55)	**3.14** (2.81)
R^2	0.30	0.51	0.56	0.72	0.74	0.79	0.72
Observations	98	98	98	98	98	98	97
Control variables							
Geographical characteristics	N	Y	Y	Y	Y	Y	Y
Pre-colonial characteristics	N	N	Y	Y	Y	Y	Y
Colonial conquest	N	N	N	Y	Y	Y	Y
Initial attractiveness	N	N	N	N	Y	Y	Y
Country fixed effects	N	N	N	N	N	Y	N

Notes: Standard errors are in parentheses. Each cell represents the coefficient from an OLS regression of the dependent variable on the independent variable. In column 7, 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, and trade taxes per capita collected in 1914. Colonial conquest control variables are: year of colonial conquest's beginning, local resistance length, local resistance length2, and local chiefs' indemnities. Pre-colonial characteristics control variables are: centralized political power dummy, European trade counter dummy, and 1910 population density. Geographical characteristics control variables are: annual rainfall average 1915–1975, altitude, longitude, latitude, coastal dummy, and river dummy.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

The general picture that emerges from these tables is that districts that received more investments from 1910–1928 have significantly better performances today. The size of the impact of colonial investments is important. Adding one teacher per 100,000 inhabitants from 1910–1928 would lead the percentage of 7–12-year-old children attending school in 1995 up to about 1 point. Adding one doctor per 100,000 inhabitants from 1910–1928 would drop the percentage of 0–5-year-old children suffering from stunting in 1995 to about 0.5 points. Finally, adding one franc per capita public works from

1910–1928 would the percentages of households having access to a private water tap and using a modern fuel to raise 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. Table 2 clearly shows that colonial investments in health and infrastructures did not have an impact on current school attendance, per se, and that colonial investments in education and in infrastructures did not have an impact on current health performances, per se. These findings highlight the specific impact of colonial investments in education on educational performance and the specific impact of colonial investments in health on health performance, which gives strong evidence that the nature of public investments matters even in the long run. This is also an important point with 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 correctly identify the causal impact of a specific investment rather than other correlated factors.

We can notice that the explanatory variables in this paper account for about 40 percent of the variation in 1995 health performances, 50 percent of the variation in 1995 school attendance, and 70 percent of the variation in 1995 access to infrastructures. More importantly, each specific colonial investment alone accounts for about 30 percent of the variation in 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 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 performance is driven by selection. Second, I use a "natural experiment" approach that compares neighbor 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 Malthus and Bairoch's arguments. Table 4 shows the relationship between population density in 1910 and colonial investments in education (health, infrastructures, respectively). The data give evidence that the colonial supply of public goods was equal in the most and least

Table 4—Historical Evidence on Selection During Colonial Times

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

Notes: Standard errors are in parentheses. Each cell represents the coefficient from an OLS regression of the dependent variable on the independent variable.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

prosperous areas. With respect to education and health, the advantage even turned slightly in favor 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 toward zero.

A second potential source of selection may be that politically well-structured societies have selected into colonial investments. Pre-colonial kingdoms were politically unified and therefore benefited from a greater social cohesion. As a consequence, they were more likely to claim a larger share of the new public goods than decentralized and heterogeneous societies (Banerjee, Iyer, and Rohini Somanathan 2008). But data give evidence that districts located in pre-colonial kingdoms were less impacted by colonial investments than the others. In the period 1910–1928, the average annual number of teachers per 100,000 inhabitants was 3.5 compared to 5.2, the average annual number of doctors per 100,000 inhabitants was 6.3 compared to 10.6, and the average annual expenses in public works was 0.24 compared to 0.64 (all of these differences are significant at the 5 percent 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 a physical determinant for European settlement since Europeans arrived by boats and were more likely to settle in areas near the coast. If colonial supply of public goods followed European settlement (because European demand for schools, hospitals, and infrastructure was high), we would expect colonial investments to be correlated negatively to the distance from the coast. Table 4 shows the correlation between colonial investments in education, health, and infrastructure, and distance from the coast. The correlation is significantly negative (or nil in the case of investments in health), which confirms that something accidental

influenced overall colonial investment patterns. But the correlation does not explain much of the variation in colonial investments (8 percent, 2 percent, and 9 percent, respectively). In particular, test for weak instrument shows that distance from the coast is not a valid instrument.

To conclude, the variation in the characteristics of districts leaves 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 percent, and the share attributable to distance from the coast does not exceed 9 percent). 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 historical 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, district administrators were largely autonomous as explained in Section I. All testimony from former administrators attests to the fact that they controlled every aspect of district management and drew their own policy (William B. Cohen 1973, Delavignette 1939, Association des anciens élèves de l'école coloniale 1998, and Colombani 1991). Second, there was a large heterogeneity among administrators. Cohen (1973) reports five types of administrators: former soldiers (apparently the most brutal and violent with local populations), former metropolitan civil servants (inappropriate for colonial service), former governor secretaries (good for administrative work but not for management), former administrators' assistants (not well educated but well informed on administrator's work), and former pupils of French "Ecole Coloniale" (well educated, part of the French elite). Third, Cohen (1973), 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, particularly 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 World War I, they had relatively shorter tenures, typically three years). According to historians, 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 1973, 76), the variation in the "quality" of the administrators constitutes an exogenous source of variation in public goods policy.[14]

B. *Matching Estimates*

The strategy that I pursue is to use a matching approach that consists of comparing neighbor districts. This strategy exploits the spatial discontinuities of investment policy. The underlying idea is that geographic neighbors had similar unobservable

[14] I do not use the identity of the administrators as an instrument because of the lack of data. Such data probably exists, but I do not know exactly where (probably in Dakar) or what can be found on administrators' characteristics. It is not certain that those characteristics that influenced the supply of public goods were observed by the French administration.

characteristics before being separated by a border under colonial rule. Differences in neighbors' outcomes are, then, unlikely to be due to differences in omitted variables. This approach is very close to a matching approach. In the case of French West Africa, there are good reasons to think that neighboring districts were very similar before colonial times. District borders did not exist in the pre-colonial era and were created at the beginning of French colonial rule. Most are natural borders (rivers), some are simply straight lines between two points. The aim of colonial power was to build districts that represented 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 district borders was often a matter of administrative charges rather than a matter of intrinsic characteristics. Colonial power also divided some communities in order to have greater control of them. District administrators' annual reports relate many cases of unrest at the borders due to the fact that people continued to ignore the borders and went here and there without worrying about colonial administrative rules. Pre-colonial and colonial maps show that the borders of pre-colonial kingdoms have been ignored, as have ethnic differences. This fact is obvious on colonial district maps. These maps indicate the ethnic groups present in each district, and we can see that an ethnic group was often present on both sides of a border. District borders are thus somewhat arbitrary.

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

$$Y_i = \alpha + \beta CI_i + \mathbf{OCI}_i\gamma + X_i\lambda + \theta_j + u_i. \tag{2}$$

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

The outcome differential between two districts i and i', belonging to the same neighborhood j, can be written as

$$Y_i - Y_{i'} = \beta(CI_i - CI_{i'}) + (\mathbf{OCI}_i - \mathbf{OCI}_{i'})\gamma + (X_i - X_{i'})\lambda + u_i - u_{i'}. \tag{3}$$

Parameter β can be estimated by running an OLS regression of districts, of the same neighborhood 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 neighborhood, standard errors within neighborhoods are not independent. Standard errors are thus adjusted for clustering at the neighborhood level.

An intuitive definition of neighbor districts would be "districts that share a common border" (Banerjee and Iyer 2005 use this definition with a similar empirical context to mine). But the problem with this naïve definition is that neighborhoods overlap (see more explanations in Appendix 2). In order to circumvent this problem, I need a definition of neighbor districts that create disjointed neighborhoods. I define a neighborhood as a cluster of three districts that share a common border and assume that neighborhood fixed effect is similar within, but not between, clusters. This leads to divide district maps into disjointed neighborhoods which are sets of three districts sharing a common border. Appendix 2 gives further details on matching procedure.[15]

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 possibly were biased upward but not driven by unobservable characteristics shared by neighbor districts. The fact that matching estimates are a little smaller than OLS estimates can also reflect externalities between neighbor districts. The treatment could affect the control group because neighbor districts might benefit from investments in neighboring areas. In this case, matching estimates are downwardly biased. These regressions also indicate that observed geographical, pre-colonial, and colonial characteristics explain between 50 percent and 80 percent of the differences in current performance between neighbor districts.

In the end, we may think that the long-term impact of early colonial investment is too large to be due only 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 present 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 already had many of them at the beginning of the colonial period. I consider the average annual number of teachers over two periods: 1910–1928 (period 1) and 1930–1939 (period 2). The top panel of Figure 7 shows that districts that received more teachers

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

TABLE 5—THE IMPACT OF COLONIAL INVESTMENTS ON CURRENT PERFORMANCES: MATCHING ESTIMATES

	Dependent variables				
Coefficient on	Difference in school attendance rate (1)	Difference in stunting rate (2)	Difference in % of households connected to electricity (3)	Difference in % of households having access to water (4)	Difference in % of households using a modern fuel (5)
Difference in colonial investments					
Number of teachers per 100,000 hbt over 1910–1928	**0.57*** (0.33)	**0.78**** (0.34)	0.22 (0.35)	0.02 (0.19)	0.68 (0.52)
Medical staff per 100,000 hbt over 1910–1928	–0.01 (0.17)	**–0.52***** (0.17)	**0.40***** (0.09)	**0.15**** (0.07)	0.17 (0.12)
Public works expenses per capita over 1910–1928	0.88 (2.4)	–1.93 (1.79)	0.75 (1.44)	**2.5*** (1.3)	**3.1**** (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, and local chiefs' indemnities.					
Difference in pre-colonial 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 rainfall, coastal dummy, and river dummy.					
Observations	71	62	71	71	71
Neighborhoods	30	27	30	30	30
R^2	0.49	0.64	0.65	0.81	0.66

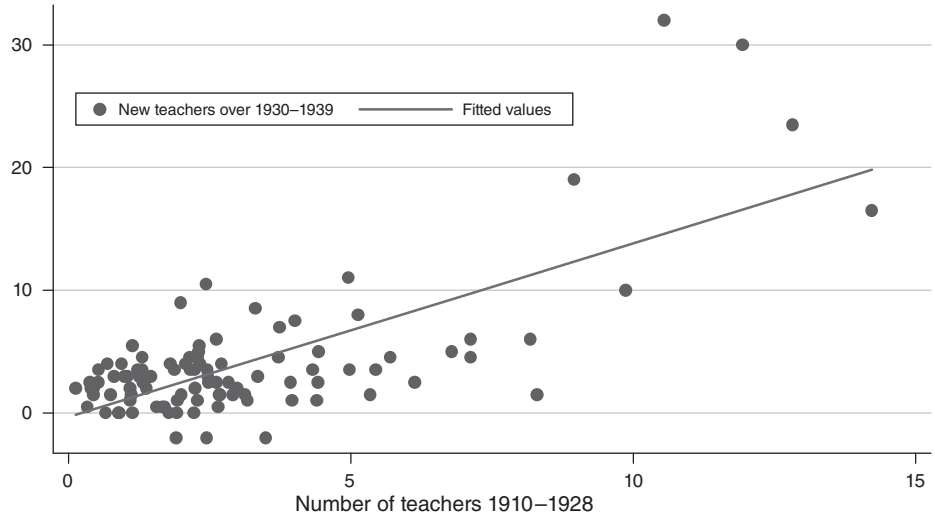
Notes: Dependent and independent variables are the value differences between neighbor districts of the same neighborhood. Results come from 50 OLS regressions of the dependent variable on the independent variables using 50 random neighborhood designs. Reported coefficient is the mean of the 50 coefficients of the dependent variable on the independent variable. Standard deviation in parentheses equals (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 (neighbor districts differences) resulting from the 50 neighborhood designs. Number of neighborhoods is the mean of the 50 numbers of neighborhoods resulting from the 50 neighborhood designs. R^2 is the mean of the 50 R^2 from the 50 OLS regressions. Data on stunting children are missing for the Mauritanian districts. Data on medical staff per 100,000 hbt are missing for Conakry district.

***Significant at the 1 percent level.

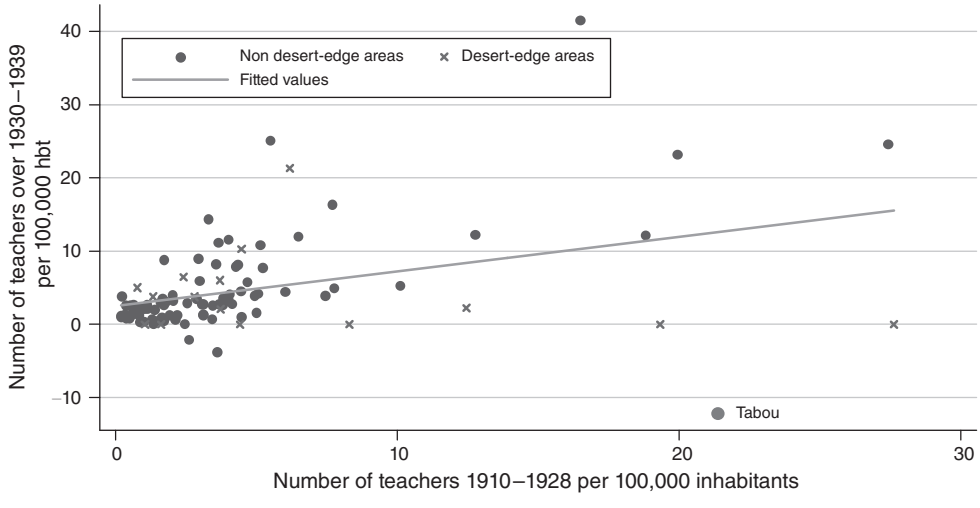
**Significant at the 5 percent level.

*Significant at the 10 percent level.

during the first period continued to receive more new teachers in the second period. The correlation between the number of teachers in period 1 and 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, in the bottom panel of Figure 7, I also plot the number of new teachers per 100,000 inhabitants from 1930–1939 along the distribution of the number of teachers per 100,000 inhabitants from 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), that had many teachers per population unit from 1910–1928 due to the fact that teachers are lumpy fixed investments. One district, Tabou, lost two teachers between period 1 and period 2, which was not so much in absolute terms but produced a big loss compared to its sparse population (this district appears as an outlier in the bottom panel of Figure 7). Nevertheless, the number of teachers per population unit from 1910–1928 is a positive and significant determinant to the number of new teachers per population unit from 1930–1939, as shown in Table 6,



Note: beta − val = 1.41 sd = 0.13 $N = 99$ $R^2 = 0.52$



Note: beta − val = 1.47 sd = 0.11 $N = 99$ $R^2 = 0.14$

FIGURE 7. THE RELATION BETWEEN LATER AND FORMER INVESTMENTS

columns 1 and 2. This result is robust to the inclusion of my usual control variables, as shown in column 3. Thus, early investments 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

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 from 1930–1939						
Coefficient on:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Teachers per 100,000 hbt from 1910–1928	**0.47***** (0.11)	**0.63***** (0.11)	**0.47***** (0.16)	**0.92***** (0.21)	**0.87***** (0.24)	**0.55***** (0.09)	**0.67***** (0.13)
Medical staff per 100,000 hbt from 1910–1928				**–0.15***** (0.05)	**–0.14*** (0.074)		
Public works exp. per 1 hbt from 1910–1928				–0.07 (1.12)	–0.07 (1.26)		
New schools per 100,000 hbt from 1930–1939						**1.66***** (0.22)	**1.99***** (0.27)
Local chiefs' wages per 100,000 hbt from 1930–1939							
Hostility toward colonial power from 1920–1940							
R^2	0.15	0.25	0.39	0.26	0.38	0.53	0.64
Observations	99	98	98	97	97	98	98
Tabou in the sample	Y	N	N	N	N	N	N
Control variables							
Geographical characteristics	N	N	Y	N	Y	N	Y
Pre-colonial characteristics	N	N	Y	N	Y	N	Y
Colonial conquest	N	N	Y	N	Y	N	Y
Initial attractiveness	N	N	Y	N	Y	N	Y
Country fixed effects	N	N	Y	N	Y	N	Y

	Dependent variable: New teachers per 100,000 from 1930–1939				
Coefficient on:	(8)	(9)	(10)	(11)	(12)
Teachers per 100,000 hbt from 1910–1928	**0.62***** (0.11)	**0.47***** (0.16)	**0.58***** (0.11)	**0.53***** (0.16)	**1.02***** (0.16)
Medical staff per 100,000 hbt from 1910–1928					**–1.86**** (0.9)
Public works exp. per 1 hbt from 1910–1928					–0.0001 (0.0001)
New schools per 100,000 hbt from 1930–1939					**0.83** (1.17)
Local chiefs' wages per 100,000 hbt from 1930–1939	0.0001 (0.0001)	0.0001 (0.0001)			**–0.13***** (0.046)
Hostility toward colonial power from 1920–1940			**3.65***** (1.40)	**3.86***** (1.69)	**1.77***** (0.24)
R^2	0.27	0.41	0.29	0.43	0.66
Observations	98	98	98	98	97
Tabou in the sample	N	N	N	N	N
Control variables					
Geographical characteristics	N	Y	N	Y	Y
Pre-colonial characteristics	N	Y	N	Y	Y
Colonial conquest	N	Y	N	Y	Y
Initial attractiveness	N	Y	N	Y	Y
Country fixed effects	N	Y	N	Y	Y

Notes: Standard errors are in parentheses. 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 are missing for Conakry district. Initial attractiveness control variables are: number of European Settlers per 100,000 population in 1910, and 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), and indemnities paid to pre-colonial African chiefs. Pre-colonial characteristics control variables are: presence of a centralized political power, presence of a European trade counter, and initial population density. Geographical characteristics control variables are: annual rainfalls average from 1915–1975, altitude, longitude, latitude, presence of a coastal border, and 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 toward colonial power from 1920–1940 represents the annual mean of the numbers of events expressing hostility toward colonial power from 1920–1940. New teachers (respectively schools) per 100,000 hbt from 1930–1939 represent the difference in the annual mean of the number of teachers (respectively schools) from 1930–1939 and 1910–1928.

***Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

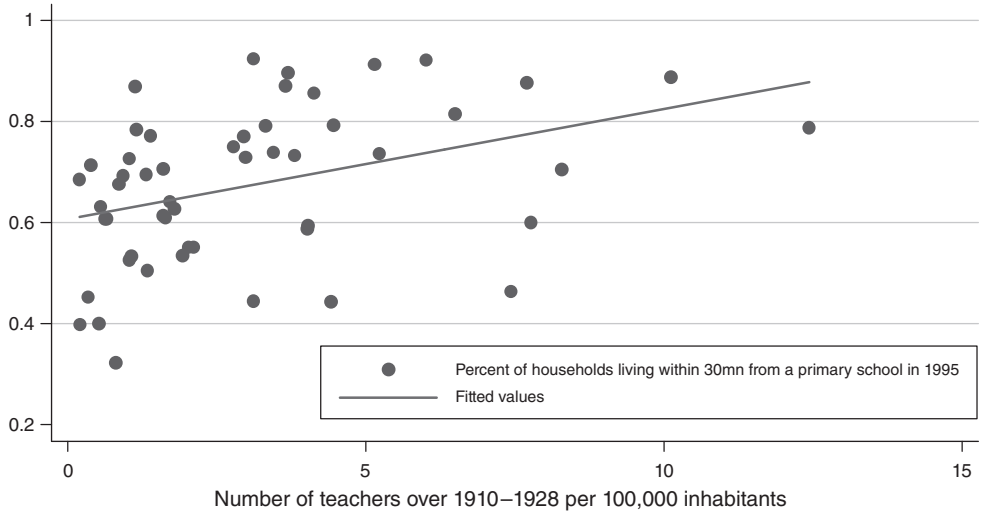


FIGURE 8. THE RELATION BETWEEN COLONIAL INVESTMENTS AND CURRENT ACCESS TO PUBLIC GOODS
(*Panel A: Access to a primary school in 1995*)

Note: beta − val = 0.02 sd = 0.007 $N = 52$ $R^2 = 0.15$

52 districts,[16] I can calculate the proportion of households living within 30 minutes from a primary school, a medical center, and drinkable water. Figures 8A, 8B, and 8C show 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 sufficiently large to make early differences still sensitive, which makes me think that repetition was not just limited to the next period (1930–1939).

I propose to explore what could explain why more teachers were posted in areas that already had many of them, and to test some of the potential mechanisms. One 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 and/or students 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. In columns 4 and 5 of Table 6, I include the other investments from 1910–1928 as additional regressors to the number of teachers per 100,000 inhabitants from 1910–1928. This specification also allows for assessing whether the other investments explain the observed correlation between early and later investments in education. They had a negative impact on the number of new teachers from 1930–1939, which could reflect substitutability rather than complementarity.

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

[16] These are the Senegalese, Malian, Nigerian, and Burkinabè districts.

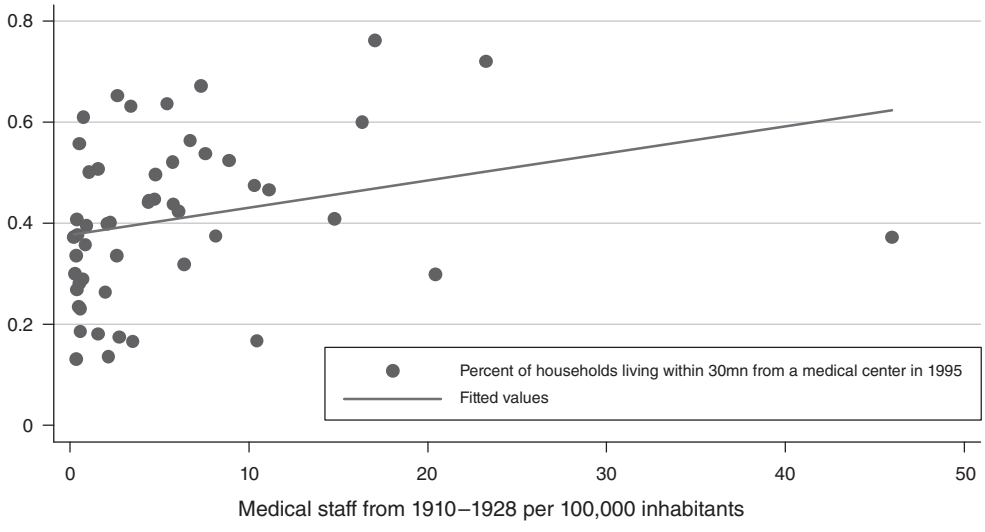


FIGURE 8. THE RELATION BETWEEN COLONIAL INVESTMENTS AND CURRENT ACCESS TO PUBLIC GOODS (*Panel B: Access to a medical center in 1995*)

Note: beta − val = 0.005 sd = 0.002 $N = 52$ $R^2 = 0.07$

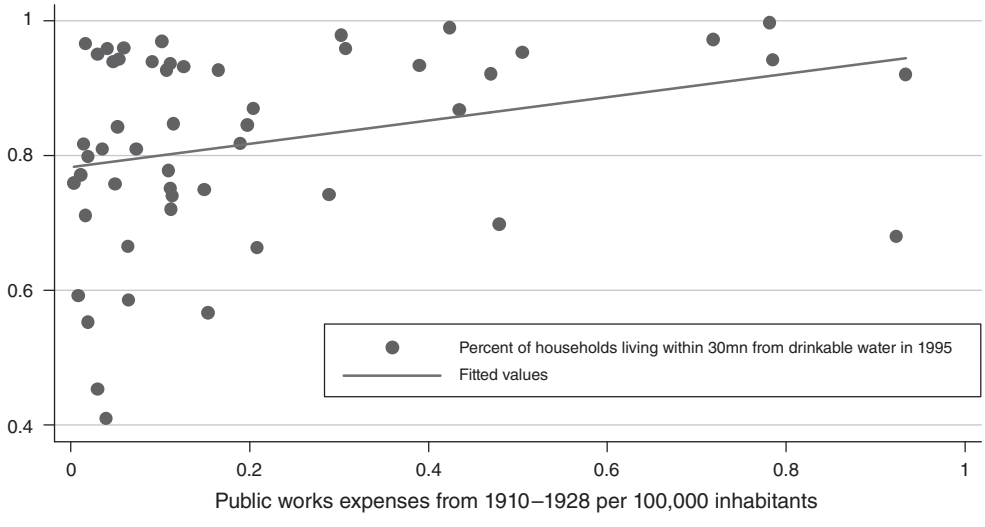


FIGURE 8. THE RELATION BETWEEN COLONIAL INVESTMENTS AND CURRENT ACCESS TO PUBLIC GOODS (*Panel C: Access to drinkable water in 1995*)

Note: beta − val = 0.17 sd = 0.08 $N = 52$ $R^2 = 0.09$

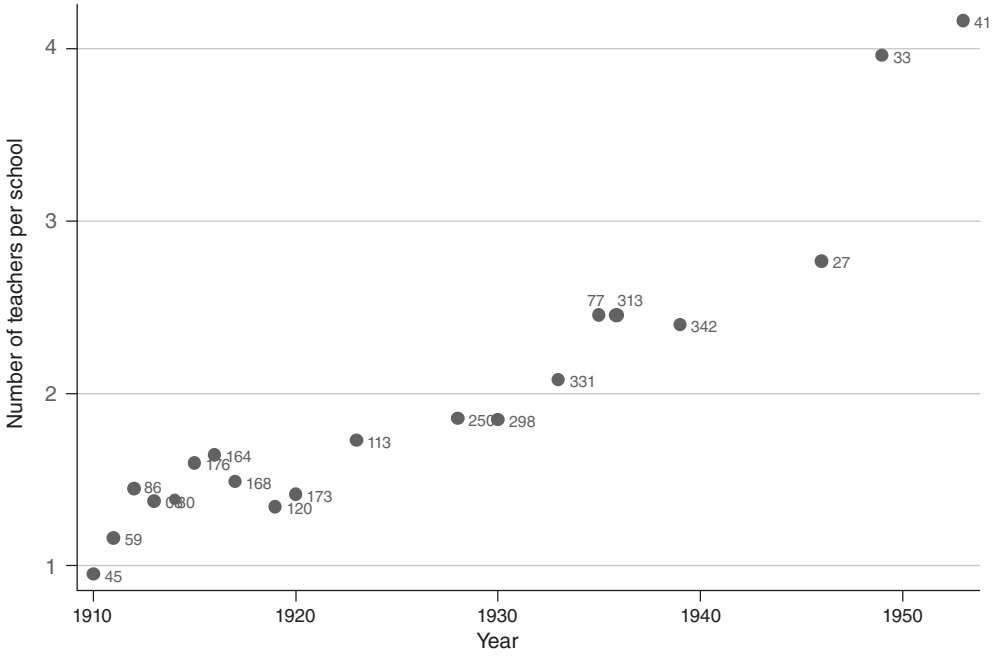


FIGURE 9. THE EVOLUTION OF THE NUMBER OF TEACHERS PER SCHOOL

Note: Markers correspond to the number of schools in the sample.

school for her. If this is true, we expect the number of teachers per school to increase over time. Figure 9 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 one to four between 1910 and 1953. In columns 6 and 7 of Table 6, I include the number of new schools per 100,000 inhabitants from 1930–1939 as an additional regressor. This does not alter the coefficient on the number of teachers per 100,000 inhabitants from 1910–1928, which shows not only that more new teachers were posted in districts that already had many of them, but also that more new teachers were posted in schools that already had many of them. This observation is also consistent with explanations other than the lower cost of using existing physical facilities. Some positive social interactions such as peer-effects or intergenerational externalities can explain that a more educated population produces a higher demand for education (see Dominique Goux and Eric Maurin 2007 for an empirical analysis on peer effects and Flavio Cunha and James 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 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 nearby area.

I also test whether some positive political externalities explain the fact that more teachers were posted in districts that already had many of them. Early investments could have created some positive effects on political voice, as discussed in Banerjee et al. (2008). They relate that the political voice of particular groups may affect public goods provision. The idea is that a group with higher political voice is able to appropriate a larger 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 in period 2, explaining why new teachers in 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 offered solely by French people. Since 1920, some local chiefs have been progressively associated in the colonial administration as intermediaries between local populations and French administrators. It is possible that local chiefs were easier to recruit in places that got more public goods in early colonial times (due to higher human capital) than in places that got few public goods in early colonial times. 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 from 1930–1939 on the amount of local chiefs wages per 100,000 inhabitants from 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 correlated positively with the number of new teachers from 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 from 1910–1928 remains exactly the same, so this story does not explain why more teachers were posted in districts that already had many of them.

Finally, public investments in an area might lead to a more stable political environment, which makes it easier to provide facilities in the future. Since I collected data on the political climate at the district level,[17] I include an index of political instability as an additional regressor in columns 10 and 11. This index is the average annual number of severe events expressing hostility toward colonial power from 1920–1940. If there are political positive externalities, we expect political instability from 1920–1940 to

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

have a negative impact on the number of new teachers per 100,000 inhabitants from 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 from 1906–1920, more teachers from 1910–1928 had a negative impact on hostility from 1920–1940 (results not shown). These findings tell us that colonial power may have 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 from 1910–1928 on the number of new teachers per 100,000 inhabitants from 1930–1939. Therefore, political externalities do not explain why more teachers were posted in districts that already had many of them.

The scarcity of data makes it impossible 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 idea that investment is associated with political power remains 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 explanation for 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) investment location. Early small events or historical accidents might 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 IVA), but as they have become concentrated in one place, any new entrant elsewhere could have been at a disadvantage, and, therefore, might have tended to move into the hub if possible, further increasing the hub's relative efficiency. The mechanism at work is a "virtuous cycle" effect which can explain why small but early public investments in some districts became larger over time and led 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 percentage point of school enrollment (respectively, stunting children). Adding one franc per capita in public works in the early colonial period would lead to about 3 additional percentage points of access to the 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 is by colonial investments in health and current infrastructures' development is 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 already had many of them. The more investments from 1910–1928, the more new investments from 1930–1939, and the more public goods today. Thus, this paper 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.

Appendix 1: Data Description and Sources

A. *1995 Performances*

Data on current performances come 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 people live. I collected the geographical coordinates of household localities on the Web site of Falling Rain Genomics (http://www.fallingrain.com/world/). 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.

Proportion of 7–12-year-old Children Attending School.—This variable is the ratio of the number of 7–12-year-old children attending school to the total number of 7–12-year-old children in the district.

Proportion of 0–5-year-old Children Suffering from Stunting.—This variable is the ratio of the number of 0–5-year-old children suffering from stunting to 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 with each age (measured in months) to calculate the proportion of stunted 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.

Proportion of Households Connected to Electricity.—This variable is the proportion of households in the district that live in a house connected to electricity.

Proportion of Households Having Access to a Private Water Tap.—This variable

is the proportion of households in the district that live in a house with a private water tap, as opposed to having public fountains or natural sources.

Proportion of Households Using a Modern Fuel.—This variable is the proportion of households in the district that use a modern fuel for cooking, namely, gas, coal, or electricity, as opposed to natural fuels.

Proportion of Households Living within 30 minutes from a Primary School (Medical Center, Drinkable Water).—This variable is the proportion of households in the district for whom it takes less than 30 minutes to go to a primary school, or are located less than 3km from a primary school (respectively, medical center, drinkable water).

B. *Colonial Period*

All data on colonial period, except hostility toward colonial power, come from the annual colonial budgets. In this paper, I use data from each year from 1910 to 1920, and also data from 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. Since district borders evolved over time, I had to choose a constant unit of observation and chose the districts as they stood in 1925. 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[18] or localities' names mentioned in local budgets to know whether district borders were modified. Fortunately, the colonial budgets often detailed the distribution of public resources at the local level. In this case, the location of localities on 1925 colonial maps allowed me to reorganize district level data according to 1925 district configurations.

Number of Teachers per 100,000 Inhabitants from 1910–1928.—This variable is the average annual number of teachers from 1910–1928, divided by 1925 total population, per 100,000 inhabitants units. The teachers reported in colonial budgets were those assigned to public schools only.

Medical Staff per 100,000 Inhabitants from 1910–1928.—This variable is the average annual number of doctors, nurses, and medical auxiliaries from 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 centers only.

[18] These reports can be found at the Archives Nationales in Paris. They were written by the lieutenant governors to inform the general governor of the colonies' political and administrative situation.

Public Works Expenses per Capita from 1910–1928.—This variable is the average annual amount of public expenses devoted to public works materials from 1910–1928, divided by 1925 total population, per 100,000 inhabitants' units. These expenses cover materials for the building and reparation of roads, bridges, housing, ports, airports, wells, sanitation, and electrcity. Since the public works workforce was nourished by coerced labor, public works materials represented the major cost of colonial investments in infrastructure.

New Teachers per 100,000 Inhabitants from 1930–1939.—This variable is the difference between the average annual number of teachers from 1930–1939 and the average annual number of teachers from 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.

New Schools per 100,000 Inhabitants from 1930–1939.—This variable is the difference between the average annual number of schools from 1930–1939 and the average annual number of schools from 1910–1928, divided by 1925 total population, per 100,000 inhabitants' units. The schools reported in colonial budgets were public schools only.

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.

Local Chiefs' Wages per 100,000 Inhabitants from 1930–1939.—This variable is the average annual amount of wages paid to local chiefs enrolled in the colonial administration from 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 oversaw, 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.

Hostility toward Colonial Power from 1920–1940.—This variable is the average annual number of severe events expressing hostility from local population or local chiefs toward 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 into three classes: benign, moderate, and severe. Severe events are those that emerged from the major part of the population and necessitated an intervention from colonial power. Hostility toward colonial power expressed through refusal to pay taxes, refusal to enroll in military forces, refusal to do coerced labor, refusal to obey colonial rules, riots, or rebellions. It differs from resistance to colonial conquest which concerned African peoples' reactions during conquest, whereas hostility refers to African peoples' attitude.

C. *Early European Settlement*

Number of European Settlers per 100,000 Inhabitants in 1910.—This variable is the number of European settlers around 1910, divided by the total population, per 100,000 units around 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 percent of a districts' population (52 Europeans per district), which was extremely low overall, as was the case in most of the African colonies except North and South Africa.

D. *Conquest Characteristics*

Year of Colonial Conquest's Beginning.—I collected district-level data on French military expansion using French military archives (Pierre Deloncle 1934, Albert Alfred Louis 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).

Local Resistance to Colonial Conquest Length.—Data on African peoples' resistance to colonial conquest come from Pierre Deloncle (1934), Albert Duboc (1939), Jean Suret-Canale (1964), Michael Crowder and Obaro Ikime (1970), Joseph 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 the districts' length of African resistance. Data exhibit an average length of resistance of 23 years, which is much longer than what we are told about colonial history. Differences in lengths of resistance are quite important. Some districts posed 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).

Local Chiefs' Indemnities.—This variable is the average amount of indemnities paid to pre-colonial chiefs in exchange for 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 agreed to resign. These indemnities are reported in the colonial budgets under the category "political expenses."

E. *Pre-colonial Characteristics*

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 come from several historian sources: Suret-Canale (1964), Marcel Chailley (1968), Adu A. Boahen (1989), Bouche (1991), Catherine Coquery-Vidrovitch and Henri Moniot (1993), Curtin et al. (1995). I constructed a dummy for the presence of a pre-colonial centralized political power that determines "state" and "stateless" districts. Districts sheltering a kingdom during the nineteenth century are classified as "state" districts.

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, and série G, sous-série 22, Paris. It is more common to divide total population by arable area, but some districts are in the desert and therefore have no arable land.

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 a firms' activity and number of employees. This variable allows me to measure the economic prosperity in addition to population density. Data on trade taxes collected in each district come from the annual colonial budgets.

European Trade Counter Dummy.—This variable equals one if the district sheltered a former European trade counter, and zero otherwise. Data on former trade counters come from Curtin et al. (1995).

F. *Geographical Characteristics*

Altitude.—This variable is the altitude of the main town in each district. The main town in 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 come from the Web site of Falling Rain Genomics.

Latitude.—This variable is the average latitude of the localities where households included in the national surveys are located. Data on the latitude of each locality come from the Web site of Falling Rain Genomics.

Longitude.—This variable is the average longitude of the localities where households included in the national surveys are located. Data on the longitude of each locality come from the Web site of Falling Rain Genomics.

Annual Rainfalls.—This variable is the average annual precipitation in the main town of each district from 1915–1975. The main town in 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 precipitation in each "Chef-lieu"

come from a database collected by ORSTOM which gives the annual precipitation on many towns in Africa from 1915–1975.

Coastal Dummy.—This variable equals to one if the district has access to sea, zero otherwise. Data on coastal borders come from the 1925 colonial maps found at the Documentation Française, Paris.

River Dummy.—This variable equals one if the district has a navigable river, zero otherwise. Data on important rivers come from the 1925 colonial maps found at the Documentation Française, Paris.

Distance from the Coast.—This variable is the distance from the coast of the main town in 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

A. *Definition of Neighborhoods*

An intuitive definition of neighbor districts would be "districts that share a common border" (Banerjee and Iyer 2005 use this definition with a similar empirical context to mine). But the problem with this naïve definition is that neighborhoods overlap. For instance, you can see on the right side of Figure 3 that both Nguigmi and Zinder are neighbors of Goure but are not neighbors themselves. Nguigmi's neighborhood and Zinder's neighborhood therefore overlap. They both contain Goure. In this case, assuming that neighbor districts share similar unobservable characteristics would simply imply that all districts share similar unobservable characteristics because every neighborhood shares common districts with another neighborhood. Therefore, the naïve assumption that districts sharing a common border share similar unobservable characteristics is not convenient in this context of overlapping neighborhoods.

In order to circumvent this problem, I need a definition of neighbor districts that creates disjointed neighborhoods. I define a neighborhood 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.[19] Neighborhood fixed effect is similar within but not between clusters. This leads to dividing district maps into disjointed neighborhoods, which are sets of three districts sharing a common border.

[19] I admit that the number, three districts, used to define neighborhoods is arbitrary and could be changed. The fewer districts in a neighborhood, the weaker the hypothesis on unobservable characteristics. But reducing the number of districts in a neighborhood 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.

B. *Construction of Neighborhoods*

Since there are several possible partitions of the districts into disjointed neighborhoods, I compute neighborhoods by randomly assigning two districts that share a common border to a district. This method potentially keeps some districts out of any neighborhood. When all the districts that share a common border already belong to a neighborhood, a district remains alone. In this case, I randomly choose to assign this district to one of the nearby neighborhoods. As a result, most of the neighborhoods contain three districts, but some contain four districts.

Since I do not want estimates of equation (3) to be driven by a particular neighborhood's design, I run regressions with 50 random neighborhood designs.[20] For each neighborhood design, I construct a dataset containing neighbor districts' differentials. In order to avoid redundant observations, I keep two differentials for three-district neighborhoods and three differentials for four-district neighborhoods. This produces samples of district differentials containing between 65 and 80 observations, with a mean size of 71 observations. For each of the 50 neighborhoods' designs, the estimate for equation (3) provides estimates of β and γ.

C. *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.

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[20] I also admit that the number of 50 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 neighborhood's design.

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