Indirect Rule, Cash Crop Production, and Development in Africa

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Abstract

Colonial governance in Africa varied considerably in its extent of indirect rule through precolonial institutions. Assessing the developmental consequences of indirect rule, this paper argues that it strengthened populations' bargaining power and increased public service provision in return for taxation of agricultural produce, in particular cash crops. To test this argument, I exploit variation in the indirectness of colonial rule: whereas British indirect rule increased in the centralization of precolonial institutions, the French implemented more uniform direct rule. I furthermore measure public service provision with georeferenced education outcomes of individuals born and raised under colonial rule and use soils' suitability for cash crop production as an exogenous proxy for real production. Supporting the theoretical claim, the effect of cash crop suitability on primary education increases with precolonial centralization in former British colonies, but not in French ones. Comparisons of education rates in neighboring ethnic groups with different levels of centralization and ethnic groups cut by British-French boundaries reaffirm this result. Contemporary development outcomes show patterns consistent with persistent effects of indirect rule in cash crop producing areas. The findings underscore the joint importance of political institutions and resource endowments in determining local development.

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Introduction

In search of the roots of currently low and unequal levels of economic development in Africa, scholars have increasingly focused on the persistent impact of political and economic institutions that defined colonialism. One of the distinguishing political features of colonial rule was its partial reliance on native institutions in schemes of indirect rule. Economically, colonialism revolutionized economies to become major producers of cash crops. This article shows that these two elements jointly affected local colonial and post-colonial development. I argue that indirect rule promoted the translation of colonial states' resource rents into local public services, fostering economic development in resource-rich areas. Since indirect rule was best applied to ethnic groups with strong precolonial institutions and enacted mainly by the British but not the French, this effect led to substantial variation of local colonial development within and across colonial empires.

The paper extends a large body of literature on the effects of colonial institutions on contemporary socio-economic outcomes. Extending the works of Acemoglu, Johnson and Robinson (2001, 2002) on the negative impact of extractive colonial institutions, some scholars have focused on the extent to which precolonial political institutions were integrated into schemes of indirect governance (Boone 2003; Iyer 2010; Lange 2009).[1] Indirect colonial rule came with the delegation of local powers to precolonial political entities, while direct colonial rule brought along a replacement of native institutions (Gerring et al. 2011).

The effects of indirect rule on socio-economic development are contested. On the one hand, some argue that indirect colonial rule established 'decentralized despotism' (Mamdani 1996, 1999), promoting postcolonial governance failure, corruption, and ethnic conflict (Blanton, Mason and Athow 2001; Lange 2004, 2009). Although indirect rule often comes with a weak central state, these accounts pay little attention to variation in indirect rule within states. Disaggregating the colonial state, Iyer (2010) presents the contrasting argument that indirect rule through in-

[1] Others have focused on the impacts of colonial forced labor (Bruhn and Gallego 2012; Dell 2010; Lowes and Montero 2018), the establishment of missions (Woodberry 2012; Lankina and Getachew 2012; Cogneau and Moradi 2014), or the effect of colonial infrastructure (Donaldson 2018; Huillery 2009; Jedwab and Moradi 2016).

digenous institutions in parts of British India fostered responsive local governance, a finding that resonates with the literature on the merits of decentralized governance (Tiebout 1956) and recent findings on traditional authorities in Africa (Baldwin 2016; Nathan 2019). Because indirect rule was based on precolonial institutions (Gerring et al. 2011), this argument also coincides with the enduring positive impact of centralized precolonial institutions on African development (Gennaioli and Rainer 2007*a*; Michalopoulos and Papaioannou 2013*b*).

However, local governments under indirect rule needed the financial means to afford good governance and the provision of public services. Since colonial states were primarily financed through taxes on natural resource production (Austin 2014), I argue that the level of natural resource endowments determined whether indirectly ruled areas could afford to harness their institutional advantages and increase their level of development vis-à-vis directly ruled areas.

Contrary to the view that colonial power uniformly applied indirect rule (Gerring et al. 2011; Herbst 2000), numerous studies suggest that it was a strategy followed mostly by British but not French colonial governments (Hailey 1945; Miles 1994). In particular, the British favored indirect rule where precolonial institutions proved centralized enough for its implementation and resorted to direct rule where they were not. In contrast, the French Empire relied on a centralized system of colonial governance and dismantled precolonial political institutions (Crowder 1968; Müller-Crepon 2020). We therefore need to account for diverging strategies of indirect rule to understand its impact on local development.

Arguing that (pre-)colonial institutions and resource endowments jointly determined socio-economic development, this paper makes two contributions to the literature. First, I argue that state revenues from cash crop production led to more public service provision under indirect rule through precolonial institutions. In contrast to direct rule through newly erected institutions, indirect rule came with more accountable local rulers that had more bargaining power vi-à-vis colonial governments. This tilted the terms of the trade of taxes on cash crops for public services in favor of the local population. Second, I incorporate the empirical distinction between local rule in French and British colonies. Since the British ruled indirectly only over centralized but not decentralized regions while the French ruled

in a more uniform, direct manner everywhere, patterns of indirect rule led to large differences in local public service provision within and across the two colonial empires.

To test the argument that cash crop agriculture led to higher levels of public service provision under indirect than under direct rule, I draw on local colonial education outcomes. These come from contemporary Demographic and Health Survey (2018) data on geocoded individuals born and schooled before decolonization. I combine these data with information on the precolonial political centralization of ethnic groups which proxies for indirect rule in former British but not French colonies. To capture the level of local cash crop production in the absence of geographically disaggregated data on real production, I rely on soil's exogenous suitability for cash crop agriculture.

The baseline empirical model tests the expectation that the marginal effect of cash crop suitability on primary education rates increases in the level of precolonial centralization in British, but not French colonies. Two identification strategies account for potentially endogenous sorting of ethnic groups and colonizers in space. First, I test whether the expected effects hold when I compare individuals within pairs of neighboring ethnic groups with differing levels of precolonial centralization, thereby balancing the natural environment of individuals. Second, I account for endogenous spatial sorting of colonial empires by comparing the effects of cash crop suitability on individuals' education within ethnic groups split by French-British colonial borders.

Together with a set of robustness checks, the analysis shows differing effects of local cash crop suitability on education rates between ethnic groups and colonial empires. In British colonies, the effect of soils' suitability on primary education rates increases in the level of precolonial centralization. These patterns coincides with suggestive evidence from archival budget data from 126 native authorities in 3 British colonies and are not explained by proxies of differential agricultural production or missionary activities. In the French colonial sample, the effect of soils' suitability for cash crop agriculture on education rates, if at all, decreases with precolonial centralization. In sum, the results suggest that British indirect rule provided local populations with more bargaining power and increased their ability

to secure public services in return for taxes on cash crop production. The effect of indirect rule in resource-rich areas in former British colonies still today accounts for variation in socio-economic outcomes, as evidenced by data on postcolonial education rates, current household-level wealth, and nightlight emissions.

State-society bargaining under direct and indirect rule

Under what conditions does extractive governance lead to local public service provision and development? The main theoretical argument of this paper maintains that indirect rule increased the bargaining power of local authorities and the population vis-à-vis the colonial government. Thus shifting the terms of the trade of public revenues for public service provision, I expect that local populations gained more from extractive cash crop production under indirect than direct rule. This section elaborates on this argument against the backdrop of the colonial context examined empirically.

Rulers, in particular colonial ones, aim to maximize their profits of revenue extraction from society. But they cannot prey on society as they wish. Rather, they have to trade the extracted revenue for benefits they provide to the population (Timmons 2005).[2] These benefits consist in services for which the state has comparative production advantages, most importantly the keeping of peace, the enforcement of property rights, and the provision of public services (Levi 1988; North 1981). In the absence of competitors to the state, the terms of trade governments can achieve are constrained by their bargaining power relative to local elites and the population. The lower elites' and citizens' ability to mobilize and hold the government accountable, the better the terms of trade for the government. The better the population can hold their local elites and central government to account, the more public services it receives for paying its taxes.

One important determinant of the distribution of bargaining power in colonies was the *indirectness of rule*, the degree to which colonizers ceded authority to preexisting polities (Gerring et al. 2011; Hechter 1975; Tilly 1975; Weber 1977). On one extreme of the spectrum between direct and indirect rule, the colonial state crushed

[2] On how taxation sparks public demands towards the state, see Weigel (2019).

and replaced indigenous political institutions altogether, seeking to implement its own system of direct rule. On the other extreme, the state fully incorporated pre-existing institutions at all tiers below the center without interfering much in their inner workings. The variety of governance arrangements that exists between these ideal types can be ordered along the fraction of administrative levels (i.e. village, district, region) that retain indigenous political institutions. The more levels are filled by preexisting institutions and elites, the more indirect rule becomes (Gerring et al. 2011; Müller-Crepon 2020).

By leaving preexisting local governance arrangements mostly intact, indirect colonial rule left more power in the hands of local elites than direct rule. In addition, by leaving preexisting institutions that embedded local elites into the local population intact, indirect rule increased the population's influence over them. In combination, indirect rule through indigenous institutions increased public services provided in return for taxation of local resource production.

The first relationship that affects public service provision is the balance of power between the local ruler and the central government. In negotiating the amount of discretion over locally raised state income, local rulers under indirect rule could use their networks of power to mobilize the population against or in favor of the central government and its policies. This bargaining chip allowed indirectly ruled local governments to secure substantive influence over state revenues that originated from their constituency. In contrast, local rulers appointed in schemes of direct rule often lacked the capacity to mobilize, thus not posing much of a threat to an exploitative government. In addition, they oftentimes lacked administrative efficacy, which was higher where centralized governance had existed prior to colonization. Both led to lesser budgetary discretion of local rulers under direct rule.

Perham's (1937, p. 72) account of native treasuries in Northern Nigeria in 1911 reflects this logic. More institutionalized precolonial polities in the area were ruled indirectly and secured a large share of local state revenues and great discretion in their use:

> The highest proportion [of revenue] was retained by the Sultan of Sokoto; most of the Emirates kept a half; a quarter went to the smaller

> units, while in the pagan areas, where no foundation for treasuries existed, the Government took the not very considerable whole and paid small subsidies to the chiefs.

However, while making local rulers more powerful vis-à-vis the central government, indirect rule made them more dependent on the population they ruled and thereby created incentives to pass their revenue on to them. As traditional rulers, local elites under indirect rule based their customary and often inherited power on networks of patronage that extended, via the district- and village-level, down to the subjected population. These networks provided elites with the social ties needed to assemble information and enforce their rule. However, these ties also transported demands upwards, pressuring local elites to act on their constituents' preferences. This combination of information and incentives provided the grounds for comparatively responsive governance (Baldwin 2016; Tiebout 1956). This argument aligns with evidence that decentralized governance increases the quality of governance and public service provision (e.g. Faguet 2004; Fisman and Gatti 2002; Iyer 2010), in turn fostering governments' legitimacy and public tax compliance (Bodea and Lebas 2016; Levi 1988; Timmons and Garfias 2015).

In contrast, newly installed local rulers under direct rule were largely independent and agnostic of their subjects (Cohen 1971*b*,*a*; Crowder 1968). Coming to power as agents of the colonial government, they lacked pre-established ties to the local population. They thus had only sparse information on their people's preferences and experienced less pressure from below through formal or informal institutions. Corrupt and unresponsive governance oftentimes resulted. For example, the so-called "warrant-chiefs" in southeastern Nigeria were highly corrupt and only inadequately overseen by the British officials who had appointed them (Afigbo 1972). Resistance against them and the taxes they collected were key drivers of the 'Women's War,' a widespread tax protest that erupted in 1929 (Martin 1988; Perham 1937). In comparison, less opposition to taxation was found in Northern Nigeria (Hicks 1961), where indirect rule had left local institutions largely intact.

Given the extractive aims of the colonial state and its inability to steer appointed local rules for a lack of personnel (Kirk-Greene 1980), colonial authorities and insti-

tutions did not neutralize the causes of bad local governance. This stands in stark contrast to settings in which state agents are held accountable by strong and capable directly governing states or elections. Here, indirect rule and persistent power of uncontested local autocrats can lead to a lower quality of governance (Acemoglu, Reed and Robinson 2014; Lange 2009; Mamdani 1996).

Indirect colonial rule thus tilts the terms of trade of taxes for services in favor of the local population. The absolute level of services provided to the population in turn crucially depends on the value of resources it produces and pays taxes on. Colonial states in Africa were financed mostly through taxes on agricultural and mineral produce at the ports and, to much lesser degree, at the source (Havinden and Meredith 1993; Gardner 2012). For late colonial Nigeria, Helleiner (1966, 163) estimates that the production of major cash crops such as cotton, cocoa, and palm oil was taxed at rates between 21% and 32%. Estimating the overall level of extraction of rents from cash crop production in French colonies, Tadei (2014) arrives at a similar magnitude of 25% to 40%. Produced mostly by smallholders, the taxation of cash crops set in motion the bargaining between colonial governments, local elites, and the population described above. In comparison, mineral production occurred in few quickly developing towns through large, oftentimes foreign firms that employed wage labor (e.g. Hopkins 1973, p. 210). Indirect rule with its pre-existing networks of power that connected local elites with the population is much less likely to have had a positive impact under these circumstances.

Because cash crop production was the main source of taxation and local indirect rule determined the terms of the trade of taxes for public service provision, I expect that:

Hypothesis *The effect of cash crop production on the provision of public services increased in the indirectness of local colonial rule.*

Indirect rule: French vs. British colonialism

Testing the main hypothesis of this study requires knowledge on the empirical variation of indirect rule in Africa. The application of indirect rule differed in particular between the French and British empires (Crowder 1968; Crowder and Ikime 1970;

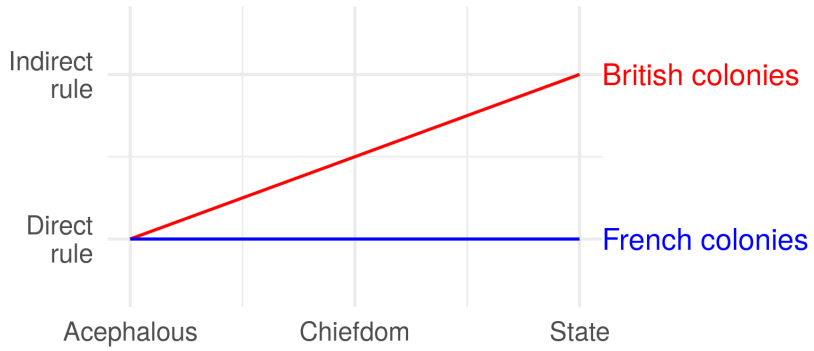


Figure 1: Indirectness of colonial rule in British and French colonies.

Miles 1994; Asiwaju 1970). While the French established a rather uniform system of direct rule, the British strove to rule indirectly. However, this strategy was only implementable where centralized precolonial institutions could be ruled through in an indirect manner. In areas of decentralized, acephalous precolonial institutions, the British lacked such a governance infrastructure and resorted to more direct colonial rule (Crowder 1968; Müller-Crepon 2020). The following section substantiates these two empirical patterns of local colonial rule and derives observable implications for studying how indirect rule affected the trade of tax revenue from cash crop production for local public services.

Republican in spirit (Cohen 1971*a*; Lewis 1962), the French colonial administration strove to rule as directly and uniformly as possible (Crowder 1968; Crowder and Ikime 1970). The power of precolonial elites was reduced, leading to extended resistance by the most centralized ethnic groups (Huillery 2010) and the ultimate demise of the lines of succession in 70% of precolonial states (Müller-Crepon 2020). Local intermediaries were selected on loyalty, lost any (traditional) authority, and directly supervised by French officials (Cohen 1971*a*,*b*; Crowder 1968). Replacing local precolonial institutions with a French administrative blueprint, the French build uniform colonial institutions. However, by relying on local rulers without a traditional power-base and controlled by relatively few French administrators, direct rule provided the incentives for ineffective, unresponsive, and corrupt local rule. As a result, chiefs frequently abused their authority by levying illegal taxes and forced labor; they often became 'the most hated members of their community'

(Crowder 1968, 187).

The British ruled differently, through rather than against indigenous institutions. Upon colonization, precolonial political structures and elites were integrated into the colonial state but retained most of their powers while being advised rather than directed by local colonial officials (Crowder 1968; Hailey 1945; Lange 2009; Lugard 1965). However, such indirect governance went most smoothly where the British could incorporate centralized precolonial institutions, such as those of the Yoruba, of Sokoto or Buganda into the tiers of the administration (Gerring et al. 2011; Hicks 1961). However, new institutions had to be created where political power was decentralized, in order to bridge the gap between precolonial village-level institutions and colonial capitals (Crowder 1968; Hicks 1961). This is why chiefs were appointed by warrant in southeastern Nigeria, where no institutions existed that could have been ruled through indirectly (Afigbo 1972; Perham 1937). As a result and in contrast to French direct rule, the directness of British rule corresponded closely to the level of centralization of precolonial institutions: Centralized areas were ruled significantly more indirectly than decentralized ones (Figure 1; Gerring et al. 2011; Müller-Crepon 2020).

Observable implication

Taken together, the observable implication of the above made arguments is that the effect of local resource production on the provision of public services increased the level of the indirectness of colonial rule. Drawing on the difference between the British and French application of indirect rule, I expect that the effect of cash crop production on public services increased in the centralization of precolonial polities under British rule. I do not expect such an effect in former French colonies, which were ruled in a more uniform, direct manner.

Data and empirical strategy

To test the hypothesis that cash crop production led to more provision of public services under indirect than under direct rule, I analyze data on the level of education of individuals born at least 6 years before independence in 24 British and French

colonies in Africa. I proxy the extent of local cash crop production with data on soils' suitability for cash crops agriculture. Following Figure 1, I capture the degree of local indirect rule by relying on data on the precolonial institutions that formed the basis of indirect rule in British, but not French colonies. After introducing these data, I discuss the empirical strategy.

Data

To measure the extent of public service provision during the colonial period, I rely on the level of education of individuals raised before independence. Education was among the central public services provided by the colonial powers. Not only was education important to recruit capable colonial agents (Gifford and Weiskel 1971), but it was also in high demand among local populations and elites (Cogneau 2003; Hicks 1961; Mair 1971). However, there were large differences between the education policies of the British and the French colonial governments, some of which can be connected to the differences in the model of colonial rule they applied (Cogneau 2003; Cogneau and Moradi 2014; Gifford and Weiskel 1971). Schooling in French colonies was provided in French, free of charge, in a secular manner, and under the control of the colonial administration. Following their preference for decentralized institutions, British administrations relied heavily on local governments and missionaries, providing much more widespread education (Gifford and Weiskel 1971).

To make up for the lack of detailed official statistics on local public service provision from the colonial period, I rely on education data from contemporary surveys. In particular, the Demographic and Health Surveys (DHS 2018) offer georeferenced data on the educational achievements of about 250'000 individuals born at least six years before the independence of their respective French and British colonies. By taking these data to proxy public service provision via individuals' primary education attainment, I exploit the fact that educational outcomes are determined during childhood after age six (see e.g. Cogneau 2003; Franck and Rainer 2012). The DHS (2018) has been fielded since the late 1980s across most countries in Africa. The DHS includes standardized questions on respondents' and their household members' age and educational attainment, most importantly whether a

household member has attended primary school. I multiply the respective dummy by 100 so that we can directly interpret marginal effects as percentage points. Crucially, many surveys provide the geographical coordinates of survey clusters. Assuming that individuals oftentimes live where they grew up and and that migration is unbiased,[3] I use this information to match the DHS data with geographical data on precolonial institutions, soils' suitability for cash crop production, and the colonial ruler of an area.

Note that the main analysis draws on the data for all household members in the data. Only 10 percent of these were interviewed directly by the DHS, but as part of these interviews, respondents were asked to provide information on the remaining household members. As a robustness check shows (see Appendix D.5), baseline results between the full ('Household Member Recodes') and reduced samples ('Individual' and 'Men's' Recodes) are very similar. However, some of the specifications estimated below require the power of the full sample.

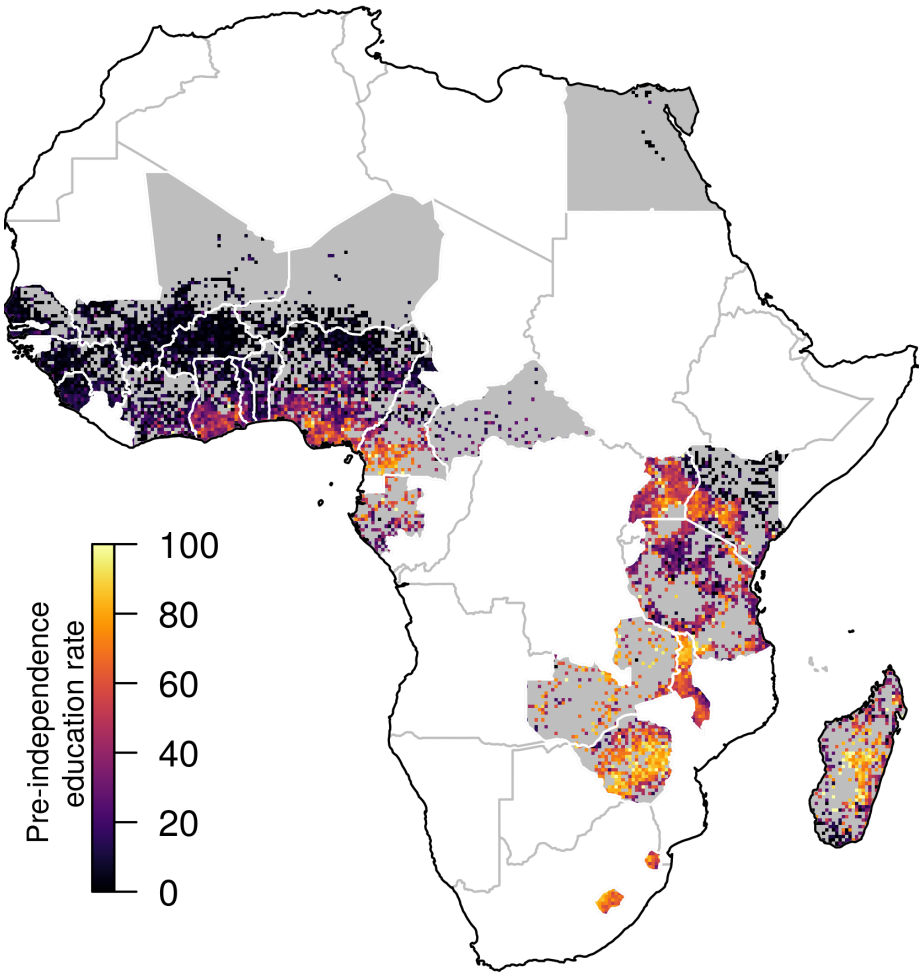
Figure 2a illustrates the education rates of georeferenced DHS respondents aged six and above at independence. The difference in overall education rates between French and British colonies is striking (Cogneau and Moradi 2014). Among French colonies, only Cameroon and Madagascar exhibit levels similar to those in the British colonies.[4] As the trends plotted in Figure 2b show, this difference between the two empires has persisted for decades. In contrast to former French colonies, most former British colonies have come close to achieving universal primary education by the 1990s. In addition to the cross-colony variation, the map highlights substantial spatial variation within the colonies. This variation is the main explanandum of the analysis.

To measure the main treatment, cash crop production, and its mediator, indirect rule, I recur to the theoretical argument outlined above. In the absence of continent-wide real production data,[5] I build on (Nunn and Qian 2011) and use soils' suitability for cash crop production as an exogenous proxy for real production. This

[3] Note that a robustness check in Appendix D.4 provides evidence that the results are not driven by migrants in the sample.

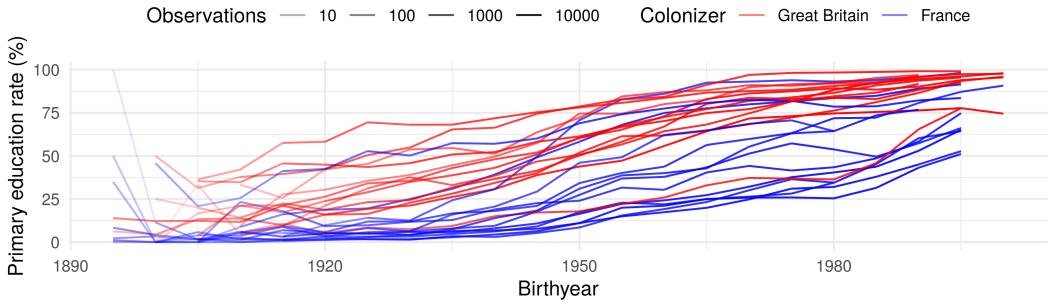
[4] The British outlier is Sierra Leone, which has caught up only since the 1980s.

[5] Single maps on cash crop production (as in Jedwab and Moradi 2016) that are not standardized across colonies are ill-suited for the cross-empires scope of this analysis.



(a) Primary education rates among pre-independence cohorts in the sample.

Note: The map plots average education rates of individuals born at least six years before their country's independence per 25×25km grid cell. Grey grid cells do not contain any observations. White areas were not colonized by the British or French or lack geocoded DHS surveys.



(b) Primary education rates in the sample over time.

Note: Education rates are aggregated into five-year bins.

Figure 2: Primary education rates over space and time in colonial and postcolonial Africa.

approach has the advantage that, in contrast to real production, soil suitability depends only on geographical and climatic features, all of which are exogenous to the observed outcomes.

Nevertheless, cash crop suitability as a proxy for real production comes with two caveats. First, cash crops were not grown in every suitable region of the continent. Second, the functional form of the relationship between soils' suitability and real production is unknown. Given these shortcomings, the proxy thus captures nature's 'intention to treat' a location with cash crop production, with the actual treatment being unobserved.[6] I calculate the local cash crop suitability (CCS) by taking the local maximum suitability across the eight main cash crops with values ranging between 0 (no suitability) and 1 (perfect suitability) as provided by the GAEZ database (FAO 2015).[7]

To measure local indirect rule, I exploit the fact that the British ruled more indirectly where high levels of precolonial political centralization allowed them to do so. The French, in turn, ruled in a more direct manner throughout their colonies. Mirroring this logic, I take the interaction between the level of precolonial centralization (PCC) from Murdock's (1967) Ethnographic Atlas and a dummy for British colonial rule as a proxy for indirect rule. The Atlas classifies the levels of administrative hierarchies of ethnic groups' precolonial political institutions, ranging from 0 levels in acephalous societies to 4 levels in large states, and is mapped via Murdock's map of ethnic groups (1959, Nunn and Wantchekon 2011).[8] To facilitate the interpretation of the results, I will for the most part show the results of models estimated separately for the French and British samples. While I expect that the effect of cash crop suitability increases in the level of precolonial centralization in the British colonies, this should not be the case in the French territories. The latter mainly serve the purpose of illustrating the counterfactual situation of no variation in indirect rule that would affect the impact of soils' suitability on education rates.

[6]Note, however, that Roessler et al. (2018) show that soils' suitability for cash crop production is a valid predictor for real production in the late-colonial era.

[7]These are: cocoa, coffee, cotton, groundnut, oil palms, sugarcane, tea, and tobacco. For details on the measure, see Figure A1 in Appendix A. For robustness checks that draw only on the five most important cash crops and take the mean instead of the max, see Appendix D.

[8]The data is available here: http://worldmap.harvard.edu. Michalopoulos and Papaioannou (2013*c*) provide a slightly different mapping that does not changes the results (Appendix D.3).

Empirical strategy

With the data on individuals' primary education achievement, local soils' suitability for cash crop production (CCS) and precolonial centralization (PCC), I estimate the following baseline model on the French and British samples:

$$Y_i = \alpha_{c,t} + \gamma_s + \beta_1 \text{PCC}_l + \beta_2 \text{CCS}_l + \beta_3 \text{PCC}_l \times \text{CCS}_l + \boldsymbol{\delta} \boldsymbol{X}_l + \epsilon_{i,l,c,t,s} \qquad (1)$$

To isolate the joint impact of cash crop suitability and precolonial centralization on the education level of respondent i measured by the DHS across 24 colonies c and a total of 87 surveys s of varying composition, I include rigid fixed effects in all models. Since the main focus lies on cross-sectional effects, I include country×birth-year ($\alpha_{c,t}$) fixed effects. Survey fixed effects (γ_s) capture variation in the design of DHS surveys over time and across countries. I cluster standard errors on the level of ethnic groups nested in colonies.

Just as the main two independent variables, the composition of the vector of controls $\boldsymbol{X}$ accounts for individual-level, geographic, as well as ethnic-group level covariates. As the minimalistic baseline, I control for respondents' age and its square,[9] as well as a dummy for female individuals. To account for the main omitted variables that influence the suitability score of soils for cash crop production and economic development, I control for local geographic and climatic conditions.[10] In order to distinguish the effect of precolonial centralization from that of other precolonial attributes of ethnic groups that may affect their centralization and later public service provision, I control for their dependence on agriculture and husbandry, and the intensity of their agricultural activities (all from Murdock 1959, 1967).

Because the main variable of interest is the interaction between cash crop suitability and precolonial centralization, I include all control variables as constitutive terms as well as in interaction with either the measure for cash crop suitability

[9] The age within each cohort varies with the year in which surveys are taken. This controls for biases from well-educated people that die later.

[10] The local mean annual temperature, precipitation, evaporation, and the ratio of precipitation and evaporation, as well as the mean altitude and slope of an area, all from FAO (2015), the local agricultural suitability score from Ramankutty et al. (2002),[11] and locations' logged distance to the coast, border, and closest navigable river.

(for ethnic controls) or the measure for precolonial political centralization (for geographic controls). This ensures that potential omitted variable bias does not sneak in through the backdoor of the interaction term.[12] I pool the samples from the British and French colonies where I assess the difference in the marginal effect of the interaction of cash crop suitability and precolonial centralization between the two empires. When doing so, I include the full set of interaction terms, interacting each term on the right hand side of Equation 1 with a dummy for British rule.[13]

With this baseline empirical strategy, biasing factors that might have influenced the spatial sorting of ethnic groups and colonial empires remain unobserved. To counter this threat to inference, I employ two strategies below. First, I identify the effect of precolonial institutions in interaction with cash crop suitability on education rates by only comparing respondents from contiguous ethnic settlement areas with diverging levels of precolonial centralization (see also Michalopoulos and Papaioannou 2013*c*). This limits the potential bias of unobserved geographical, climatic, and soil-related variables.[14] Second, I exploit differences within ethnic groups split by French-British borders (see e.g. Ali et al. 2018; Michalopoulos and Papaioannou 2013*a*) to identify the effects of the differing application of indirect rule. This strategy minimizes the potential bias from colonial powers endogenous responses to precolonial ethnic institutions and environmental conditions.

Results

The following empirical analyses support the hypothesis that British indirect rule fostered the translation of rents from cash crop production into public services. The results show that the effect of cash crop suitability on primary education increases with precolonial political centralization in British, but not French colonies. Within

[12] Controlling for the square terms of the main constitutive terms to rule out non-linear effects oes not change the results (see Appendix D.5).

[13] This results in the following Equation:

$$Y_i = \alpha_{c,t} + \gamma_s + \beta_1 \mathsf{PCC}_l + \beta_2 \mathsf{CCS}_l + \beta_3 \mathsf{PCC}_l \times \mathsf{CCS}_l + \beta_4 \mathsf{PCC}_l \times \mathsf{British}_l + \beta_5 \mathsf{CCS}_l \times \mathsf{British}_l + \beta_6 \mathsf{PCC}_l \times \mathsf{CCS}_l \times \mathsf{British}_l + \boldsymbol{\delta X}_l + \boldsymbol{\delta X}_l \times \mathsf{British}_l + \epsilon_{i,l,c,t}$$

Due to this full set of interactions and except for the numerically negligible impact of non-nested survey fixed effects (surveys in Cameroon took place in former British and French areas), this specification yields results that are equivalent to those of the split sample regressions. To avoid further complexity, I therefore report the pooled results only in the Appendix.

[14] Appendix Table A2 reports balance tests.

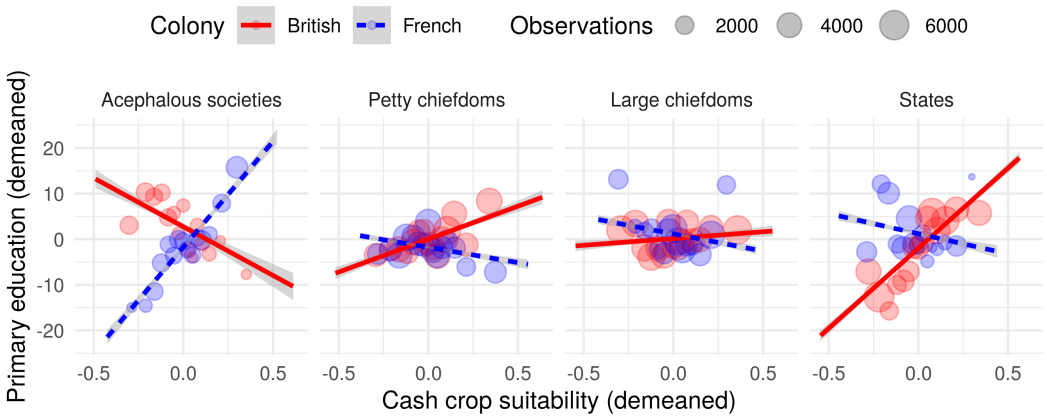


Figure 3: Correlation of cash crop suitability and primary education by level of precolonial centralization in French and British colonies.

Note: Primary education and cash crop suitabilities are demeaned with the colony×birth-year and the survey fixed effects. Lines plot linear regression coefficients, points show observed values after clustering CCS into 15 bins of equal size.

colonies, these results hold when the analysis is restricted to variation among neighboring ethnic groups. I also find a consistent, yet less precisely estimated difference between the French and British patterns within ethnic groups split by French-British borders. Additional analyses reveal coinciding patterns in local budget data from native administrations under British rule, and show that the main results are not caused by alternative mechanisms such as colonial infrastructure or missions. Finally, I also report that British indirect rule in resource rich-areas is associated with long-term effects on current education rates, household wealth, and economic activity.

Baseline results

Providing a first visual impression of the relationship of soils' suitability for cash crop production and primary education, Figure 3 plots the raw correlation of the two variables (demeaned through the main fixed effects) by level of precolonial centralization and identity of the colonizer. While the correlation between soils' suitability and finishing primary school is negative in acephalous societies under British rule, it turns positive in precolonial states. In French colonies, the change of the correlation over the levels of precolonial centralization is reversed. We see a positive correlation between suitabilities and education rates in acephalous soci-

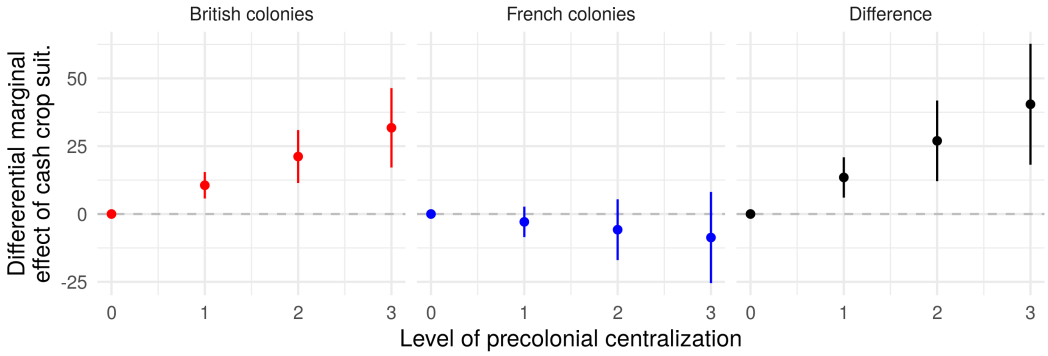


Figure 4: Differential marginal effect of cash crop suitability on primary education across observed values of precolonial centralization, with a value of 0 (acephalous societies) as the baseline for comparison.

Note: Calculated from the fully specified model with all controls estimated on the pooled sample (see Appendix Table A4).

eties, but a negative one in centralized ethnic groups, a pattern mostly driven by acephalous areas.

Table 1 and Figure 4 present the results of the main specification estimated separately for respondents born at least 6 years before independence and interviewed in former British and French colonies. Primary education rates among respondents from former British colonies exhibit the expected pattern: education rates increase in the level of cash crop suitability to a greater extent in precolonially centralized than non-centralized ethnic groups. This change in the marginal effect of cash crop suitability is statistically significant and large. In the 'British' Model 1, an increase in the local degree of cash crop suitability by one standard deviation (0.18) insignificantly decreases education rates in an acephalous society ($\mathsf{PCC} = 0$) by -1.7 [-6, 2.6] percentage points but increases the same by 5.1 [2.5, 7.6] percentage points in a precolonial state ($\mathsf{PCC} = 3$). In the sample of individuals from former French colonies, the results from the same specification do no show an increase in the marginal effect of cash crop suitability on the primary education rates. Here the sign of the interaction effect points towards a *negative* interaction effect. This implies that education provision increases less with local cash crop suitability in centralized than in non-centralized areas.

To account for other factors that might drive this interaction effect, I add the vectors of geographic and ethnic control variables in columns 2-3 and 5-6 of Table

Table 1: Indirect rule, cash crops, and colonial education

	Primary Education (0/100)					
	British colonies			French colonies		
	(1)	(2)	(3)	(4)	(5)	(6)
Precol. centr. (PCC)	−7.600***	41.583*	43.243*	5.840***	72.733**	78.087**
	(2.847)	(23.726)	(24.474)	(2.154)	(35.700)	(31.492)
Cash crop suit. (CCS)	−9.262	−11.150*	−31.756	20.182	10.527**	68.052**
	(12.184)	(6.045)	(21.942)	(13.054)	(4.749)	(26.624)
PCC × CCS	12.328**	13.160***	10.618***	−11.399*	−8.594***	−2.862
	(5.363)	(2.955)	(2.488)	(6.265)	(2.736)	(2.861)
Colony×Birthyear FE	yes	yes	yes	yes	yes	yes
Survey FE	yes	yes	yes	yes	yes	yes
Ind. controls:	yes	yes	yes	yes	yes	yes
Geo. controls:	no	yes	yes	no	yes	yes
Ethn. controls:	no	no	yes	no	no	yes
Mean DV:	49	49	49	18	17	17
Observations	192,650	184,872	184,872	150,072	147,539	147,539
Adjusted R^2	0.211	0.271	0.275	0.265	0.315	0.318

Notes: OLS linear probability models. Standard errors are clustered on ethnic groups within colonies. Individual controls consist of respondent's sex and age. Geographical controls consist of their distance to the coast, border, and the closest navigable river (all logged), the local altitude and slope, mean annual temperature, precipitation and evapotranspiration, the ratio of the two, and the local suitability for agriculture. Ethnic controls consist of groups' dependence on agriculture and husbandry as well as the intensity of agriculture. Geographical controls are interacted with the level of precolonial centralization, ethnic controls with the cash crop suitability score. Significance codes: *p<0.1; **p<0.05; ***p<0.01

1. The interaction effect for the British sample remains stable in the second specification, but decreases in size when I add the vector of ethnic control variables. In substantive terms, the result implies that moving from an acephalous society to a precolonial state under British rule increases in the effect of a one standard deviation increase of cash crop suitability by 5.7 percentage points. For the French sample, the estimate of the interaction effect remains negative but becomes indistinguishable from zero in the full specification. Throughout, however, the interaction term remains significantly smaller in the French than in the British sample (Figure 4).[15] It should be noted that one cannot interpret the constitutive terms CCS and PCC in Models 2, 3, 5, and 6 because the two variables are interacted with the additional control variables. The constitutive terms therefore capture uninformative conditional marginal effects at an unrealistic value of zero for all controls.

[15]See Appendix Table A4.

Comparing neighboring ethnic groups

In order to reduce the potential for omitted variable bias due to unobserved geographical or climatic factors, I restrict the exploited variation to respondents born in the same year that live across borders between ethnic groups with different levels of precolonial centralization.[16] In econometric terms, I thus add ethnic-pair×cohort fixed effects to the baseline model 1 and restrict the sample by setting a cutoff for the distance of respondents to their neighboring ethnic group.[17]

At a cutoff of 100km of respondents to their neighboring ethnic group, the design improves the balance on the vector of geographic controls in both samples.[18] However, imbalances remain in both and differ between them. In the British sample, ethnic groups' dependence on agriculture is imbalanced. In the French sample, imbalances relate to local altitude, the climatic evaporation to transpiration ratio, and the intensity of ethnic groups' agricultural activities. In addition to these patterns, the estimated effect of the interaction term PCC × CCS might still be driven by interactions of either PCC or CCS with the control variables. To preclude omitted variable bias to affect the results, the main specification includes all controls and their interaction terms.[19]

Figure 5 visualizes the main results for this specification, varying the cutoff of the distance of respondents to the ethnic border between 25 and 500km (the maximum value observed in the sample). As expected from the imprecise geographic data on ethnic borders, the main interaction term PCC × CCS is insignificant at a small distance of 25km to the border. However, as the cutoff is raised, its coefficient increases in the British sample, reaching statistical significance at a cutoff of 75km. The respective coefficient is only insignificantly slightly smaller than that estimated with the baseline specification. In contrast, coefficinets are consistently

[16] Ethnic groups are only paired within colonies.

[17] This use of ethnic settlement borders coded by Murdock (1959) deviates from the ideal regression discontinuity design insofar as no trends towards the border are included in the model. This is due to the imprecision of Murdock's original map (Murdock 1959) and the fact that the authority of precolonial polities faded towards the periphery of their territory (Blanton and Fargher 2008; Wilfahrt 2018). In addition, polygon-based ethnic maps fail to accurately reflect the mixed local ethnic demographics (Müller-Crepon and Hunziker 2018).

[18] I test the balance on all 'geographical' and 'ethnic' controls by estimating the baseline specification without any controls and using each variable as an outcome. See Appendix A.

[19] Dropping all controls in Appendix Table A5 increases the estimated interaction effect.

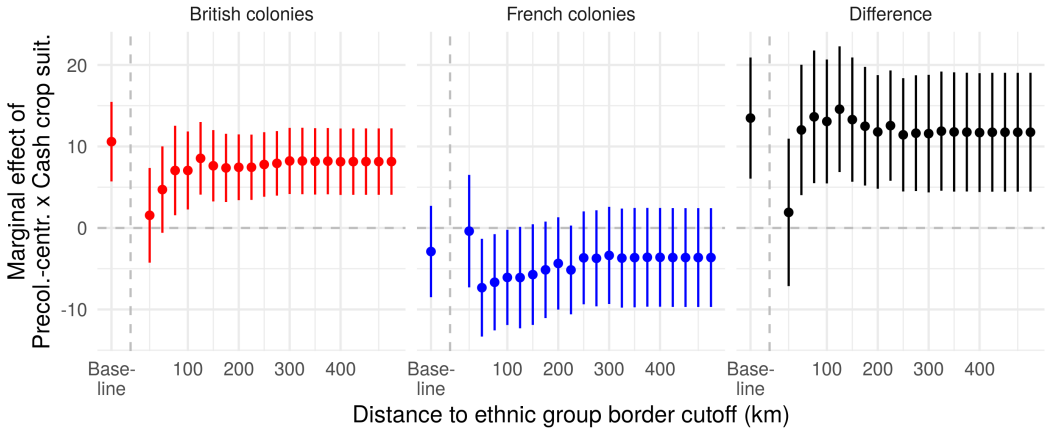


Figure 5: Results from the ethnic-pair design: Marginal effects of the interaction of cash crop suitability × precolonial centralization across varying maximum distances of individuals to their neighboring ethnic group.

Note: Calculated across varying cutoffs on the basis of the full specification with ethnic-pair×birth-year fixed effects estimated on the British and French (see Appendix Table A5), and the pooled samples. The pooled model adds an interaction term of a dummy for British rule with each variable in Equation 1. Baseline estimates result from the fully specified baseline specification.

negative, though not significant in the French sample. At a cutoff of 50km and beyond, the difference between the coefficients from the two empires is statistically significant and close to the baseline difference. Mirroring the results from the baseline analysis, these findings suggest that spatial sorting of (de)centralized ethnic groups does not bias the baseline results.

Using split ethnic groups to identify differential effects in British and French colonies

A second caveat of the baseline results relates to the potentially endogenous spatial sorting of the colonial empires that might have responded to precolonial ethnic institutions or the natural environment. To address this threat to inference, I follow Michalopoulos and Papaioannou (2013*a*) and Ali et al. (2018) and exploit the fact that the colonial borders drawn during the Scramble for Africa cut through many precolonial ethnic groups. Exploiting variation from within these ethnic groups, I assess the double difference in the marginal effect of cash crop suitability on primary education rates within centralized and non-centralized groups governed by the British and the French. Econometrically, this research design requires (1) adding

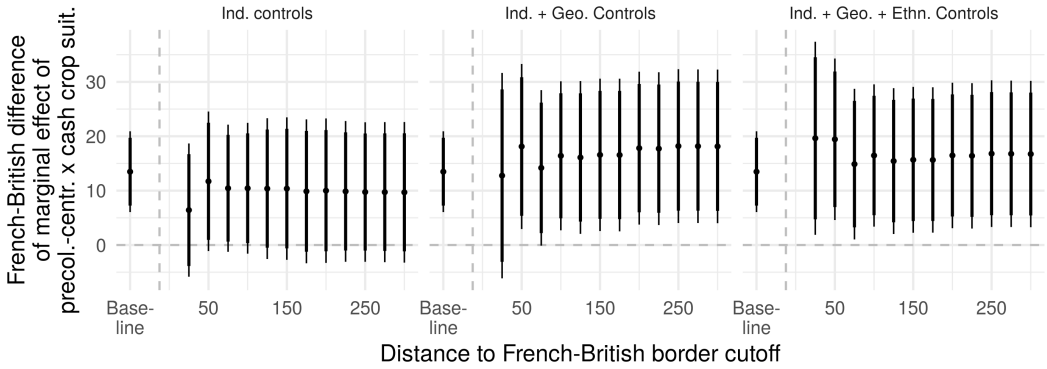


Figure 6: Results from the split-ethnic-group design: Marginal effects of the interaction of cash crop suitability $\times$ precolonial centralization across varying maximum distances of respondents to the closest French-British boundary.

Note: Calculated across varying cutoffs and adding the main vectors of controls (with interaction with the British dummy) with ethnic group$\times$birth-year fixed effects estimated on the pooled sample (see also Table A6 in the Appendix). Baseline estimates plotted to the left of each panel result from the fully specified baseline specification.

an ethnic group$\times$birth-year fixed effect to the baseline specification and (2) restricting the pooled sample to respondents who live in ethnic settlement areas split by French-British borders.

With the resulting specification, balance tests show French-British differences in the marginal effect of the interaction of PCC $\times$ CCS on precipitation ($p< .1$, Appendix Table A2). This is not all too surprising given that I test balance on 11 covariates.[20] However and to prevent the possibility that it is not the interaction of British $\times$ PCC $\times$ CCS but a covarying interaction term with one of the covariates that is driving the results, I sequentially add the covariates and their respective interaction terms to the Models.

Figure 6 visualizes the the estimate difference between the interaction of PCC $\times$ CCS observed among the French and British sides of the split ethnic groups. To test for the robustness of the results near the colonial borders, I estimate the model with the sample of observations reduced by cutoffs of their distance to the border between 25 and 300km (the maximum distance observed). The results show three consistent patterns. First, across the three specifications the point estimates of the French-British difference in the coefficient of the interaction term PCC $\times$ CCS are

[20]The ethnic group fixed effects automatically balance the sample on the three variables that originate from Murdock's (1967) Ethnographic Atlas.

close to the baseline difference. Second, the estimates are consistent across different distance-to-the-border cutoffs. This suggests that there are no biasing geographic trends towards the border. Third, the estimates come with more uncertainty than at the baseline. Statistically significant only in the second specification, they hover around the $p < .1$ threshold for the first specification and become more precise with covariates. This uncertainty is mainly driven by the smaller cross-border sample and the demanding ethnic group$\times$birth-year fixed effects.

Robustness checks

Having addressed threats to inference arising from potentially endogenous spatial sorting of ethnic groups and colonizers, the following summarizes a number of additional robustness checks to the baseline model. Appendix D discusses all robustness checks in detail.

A first set of additional analyses assesses alternative measures of (1) educational outcomes, (2) soils' suitability for cash crop production, and (3) precolonial centralization. The results show that the effect of cash crop suitability on secondary and tertiary education rates increases in the level of precolonial centralization in British, but not in French colonies. The size of the estimated marginal effects is comparable to that estimated for primary education. I obtain results very similar to those discussed above when varying the indicator of cash crop suitability, aggregating across the five instead of eight most prominent cash crops, and taking the local mean rather than the maximum suitability. Lastly, I replace the indicator for precolonial centralization mapped to ethnic groups by Nunn and Wantchekon (2011) with (1) the slightly different coding from Michalopoulos and Papaioannou (2013*c*) and (2) indicators for either the presence of or minimal distance to a precolonial polities' capital in 1885 recorded in Steward's (2006) *Encyclopedia of African States and Rulers*. The results from the respective models are consistent with the baseline results.

One risk of using contemporary survey data to draw inferences about individuals' childhood relates to individuals who self-select into or out of their local colonial treatment through migration. I test for such bias by recurring to the more informa-

tive but much smaller sample of DHS respondents born at least six year before independence that went through the full DHS interview – only 10% of all individuals used in the baseline analysis. Identifying those who have not always lived in their current place of residence as migrants, the results show that the effects reported above are not driven by differential migration rates. In the British sample, non-migrants exhibit no different interaction effect of $\mathsf{PCC} \times \mathsf{CCS}$ as those presented in the baseline results. In the French cases, the marginal effect of cash crop suitability decreases more strongly in the level of precolonial centralization among migrants, and the interaction effect is estimated around zero among non-migrants.

Lastly, Section D.5 of the Appendix presents results from a number of additional specifications. In particular, I add further controls,[21] vary the rigidity of the fixed effects,[22] weight respondents so that either colonies or colony-cohorts receive equal weight, and cluster standard errors in alternative ways.[23] None of these robustness tests leads to substantive changes in the results.

Mechanisms

The analysis has so far consistently demonstrated that precolonially centralized ethnic groups in British colonies profited more from soils suitable for cash crop production than non-centralized groups. This relationship is absent or even reversed in French colonies. However, the raw association of primary education rates with the main interaction term of interest, $\mathsf{PCC} \times \mathsf{CCS}$, provides little information about the underlying historical mechanism at work. In light of the historical literature, we can confidently point to indirect rule as the main driver of the difference in the patterns observed in the British and French colonies. However, we cannot conclude that the effects are solely due to bargaining processes that lead to more publicly provided education in fertile areas under British indirect rule. Instead, they might be caused by alternative factors, such as generally higher levels of economic activity or more missionary activity in these areas. Drawing on data from Native Treasuries' budgets in British colonies, mission locations, and transport infrastruc-

[21] The local disease environment and additional precolonial characteristics of ethnic groups.

[22] Starting with simple colony and ending with full colony×survey×birth-year×sex fixed effects.

[23] Implementing two-way clustering on the colony and ethnic group levels as well as on the colony and cohort levels.

ture, this section provides suggestive evidence on the first pathway, and suggests that the two alternative mechanisms do not explain the results.

Native treasuries' revenues and expenditures: I first test whether indirectly ruled local governments indeed redistributed gains from cash crop taxation back to the local population. To capture outcomes that mirror this mechanism, I draw on newly collected data on per capita[24] expenditures in general and on social matters and education in particular from 126 Native Treasuries in the British Gold Coast, Nigeria, and Uganda. These data are as digitized from archival reports,[25] and log-transformed to account for the right-skewed distribution of the outcome.

Table 2: Indirect rule, cash crops, and Native Treasuries' per capita expenditures (logged, in £) under British rule

	Full sample		Drop outliers	
	Total	Educ. & Social	Total	Educ. & Social
	(1)	(2)	(3)	(4)
Precol. centr. (PCC)	2.367	−5.141	−1.286	−10.452
	(7.808)	(9.619)	(6.506)	(9.340)
Cash crop suit. (CCS)	−10.228	−4.155	−9.771*	−2.868
	(6.298)	(5.722)	(5.341)	(5.369)
PCC × CCS	1.914**	1.487**	1.092*	1.079
	(0.777)	(0.593)	(0.645)	(0.715)
Colony FEs:	yes	yes	yes	yes
Geo. controls:	yes	yes	yes	yes
Ethn. controls:	yes	yes	yes	yes
Mean DV:	1.5	-0.4	1.5	-0.4
Observations	126	126	118	118
Adjusted R^2	0.650	0.790	0.681	0.800

Notes: OLS linear models. Standard errors are clustered on the province level. Geographical controls consist of districts' distance to the coast, border, and the closest navigable river (all logged), the average altitude and slope, mean annual temperature, precipitation and evapotranspiration, the ratio of the two, and the local suitability for agriculture. Ethnic controls consist of the average dependence of districts' ethnic groups on agriculture and husbandry as well as their intensity of agricultural activities. Geographical controls are interacted with the level of precolonial centralization, ethnic controls with the cash crop suitability score. Significance codes: *p<0.1; **p<0.05; ***p<0.01

The results in Models 1 and 2 Table 2 show a consistent positive impact of precolonial centralization on the marginal effect of local cash crop suitability on total expenses and education spending in particular. An increase in soils' suitability by

[24] I use population estimates from Goldewijk, Beusen and Janssen (2010) for the year 1930 to adjust for local population.

[25] See Appendix B for details on the data. District shapes are digitized from colonial-era maps and used to aggregate all covariates to the district level by taking their spatially weighted average.

one standard deviation (.18) comes with a 80 percentage points greater increase in per capita education expenditures in a precolonial state than in an acephalous region. However, dropping the 5% observations with the highest and lowest spending in Models 3 and 4 shows that these results are substantially affected by a few outliers. The coefficient of the interaction term drops in size but remain positive, and becomes much more uncertain ($p = .09$ and $p = .13$ in Models 3 and 4, respectively). With the small sample of available data, this test ca thus only provide suggestive evidence in favor of the hypothesis.

Agricultural production: The first alternative explanation follows directly from the caveat that this analysis approximates tax-generating cash crop production with soils' suitability for planting cash crops – nature's 'intention to treat.' However, indirect rule might have fostered farmers' uptake of cash crop agriculture in fertile areas. The results reported above might then arise from greater cash crop production, household wealth, and demand for education. This mechanisms would be only inconsistent with the main hypothesis if it occurred for reasons other than greater expected benefits local citizens received in return for taxation by the colonial governments.

As argued by Jedwab and Moradi (2016), transport infrastructure was an important precondition for cash crop production. I build on this logic to gauge whether indirect rule had a direct effect on the use of good soils for cash crop production that increased education rates through private wealth. In particular, I reestimate the fully specified baseline model, adding post-treatment controls for the local presence of rail and road infrastructure in the 1960s.[26] While education rates increase with local transport infrastructure, the bad controls do not substantively affect the estimated coefficient of the main interaction term. Hence, although indirect rule might have led to more production in fertile areas, the extent to which local transport infrastructure captures this pathway does not explain the main result.

Mission stations: A second alternative mechanism may consist of missionary education, in particular important in British colonies (Cogneau and Moradi 2014; Gif-

[26] Data on railroads comes from Jedwab and Moradi (2016); data on roads comes from pan-African Michelin road maps in the early 1960s.

ford and Weiskel 1971; Lankina and Getachew 2012). Although governments often co-financed missionary education, missionaries settled in wealthier and healthier places first (Jedwab, zu Selhausen and Moradi 2018) and might have been attracted by precolonial states in fertile regions (Gifford and Weiskel 1971). To control for historical path-dependencies triggered by endogenous settlements of missionaries, I include post-treatment measures of the distance to and presence of missions as recorded in 1924 (Roome 1924; Nunn 2010).

Doing so only slightly decreases the interactive effect of indirect rule and cash crop suitability in the British sample from 10 to a still sizable and statistically significant 7 percentage points. This indicates that missionary education only drives a relatively small portion of the reported results. No changes are discernible for the French sample. In line with the literature (e.g. Cogneau and Moradi 2014; Lankina and Getachew 2012), the effect of missions on education in itself is substantive and significant. Finally, a specification that combines the two alternative explanations reaffirms that they account only for a small portion of the observed effects.

Long-term effects on education, wealth, and economic activity

What were the long-term consequences of local populations' bargaining power under indirect colonial rule on development in Africa? If state revenues from resource production increased public service provision under indirect rule, this colonial advantage should have had effects on local development today. As highlighted before, long-term effects of precolonial and colonial institutions have been documented by a rapidly growing literature.[27] I here add to these findings by focusing on the joint impact of precolonial institutions, colonial modes of governance, and resource endowments on contemporary education, household wealth, and economic activity.

Education: To analyze the longevity of the combined effect of indirect rule and cash crop suitability on education, I divide the sample of DHS respondents into respondents born by the decade between 1920 and 1999. Using primary, secondary,

[27] See, among others, Acemoglu, Johnson and Robinson (2001, 2002), Dell (2010), Dell and Olken (2018), Gennaioli and Rainer (2007*b*), Iyer (2010), Lowes and Montero (2018), and Michalopoulos and Papaioannou (2013*c*).

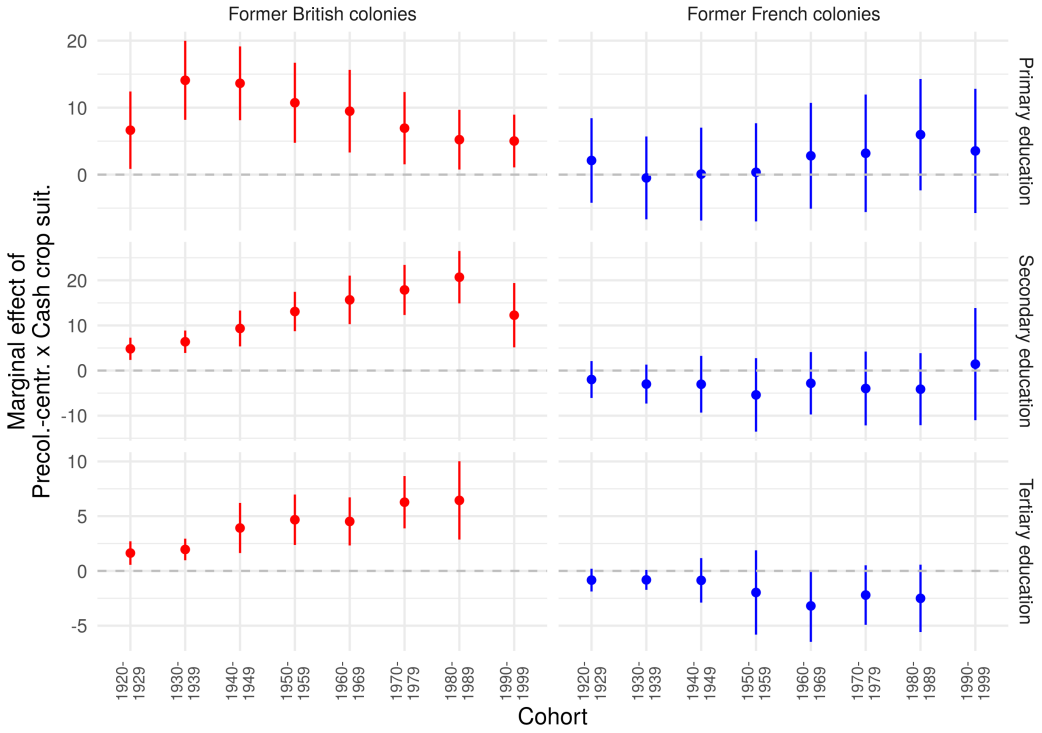


Figure 7: Interaction effect of cash crop suitability × precolonial centralization educational outcomes by 10-year cohorts in former British and French colonies.

Note: Marginal effects are calculated on the basis of the full baseline specification estimated on the British and French samples split into 10-year cohorts.

as well as tertiary education as outcomes, I estimate the fully specified baseline model on each subsample.[28]

For former British colonies, the results in Figure 7 show a remarkable persistence in the difference of educational outcomes between precolonially centralized and decentralized areas with soils suitable for cash crop agriculture. Formerly British regions with centralized precolonial institutions and good soils stayed comparatively advantaged up to this day. Only advantages in primary education are withering away with time, likely due to saturation effects (see Figure 2b above). In contrast, the early advantages lead to increasingly large inequalities in secondary and tertiary education rates.[29] Consistent with the baseline results for the French

[28]Respondents used to assess primary education rates are older than 12, older than 18 for secondary education, and older than 25 for tertiary education rates.

[29]The drop in the effect on secondary education rates in the 1990s can be explained by the relatively low age threshold of 18 years. Many students finish secondary school after that age.

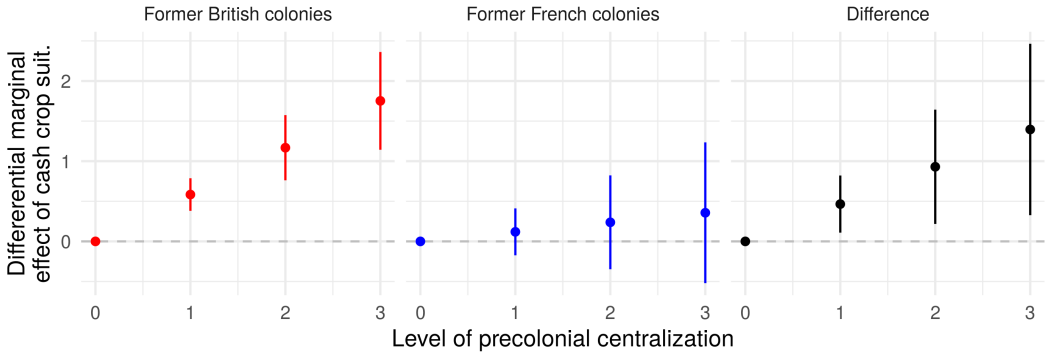


Figure 8: Differential marginal effect of cash crop suitability on household wealth across observed values of precolonial centralization, with a value of 0 (acephalous societies) as the baseline for comparison.

Note: Calculated on the basis of the full specification estimated on the pooled sample in Appendix Table A4. The pooled model adds an interaction term of a dummy for British rule with each variable in Equation 1.

sample, the estimated effect of the interaction term PCC $\times$ CCS are zero with large standard errors for primary education rates, and negative for secondary and tertiary education rates.

Household-level wealth: Differences in the provision of public services, in particular education, likely translate into differences in local wealth. Using geocoded data on households from the DHS (2018), I reestimate the baseline specifications using the DHS's wealth-index[30] as the dependent variable and the household as the unit of analysis.

Consistent with the previous findings, the results suggest that indirect rule in the British empire led to long-lasting effects on local wealth levels. The estimated marginal effect of cash crop suitability on household wealth rises significantly in the level of precolonial centralization. Increases in the cash crop suitability by one standard deviation (0.2) in a precolonial state are associated with a change in household wealth that is 0.34 [0.22, 0.46] index points larger than in an acephalous society. Because the wealth index is normalized, this difference can be directly interpreted in terms of standard deviations. The estimated interaction effect is close to zero in the French sample (Figure 8). The rsulting difference between the effects in both

[30]The wealth-index is a factor score of socio-economic assets held by surveyed households. It is normalized within DHS country-rounds to a mean of 0 and a standard deviation of 1.

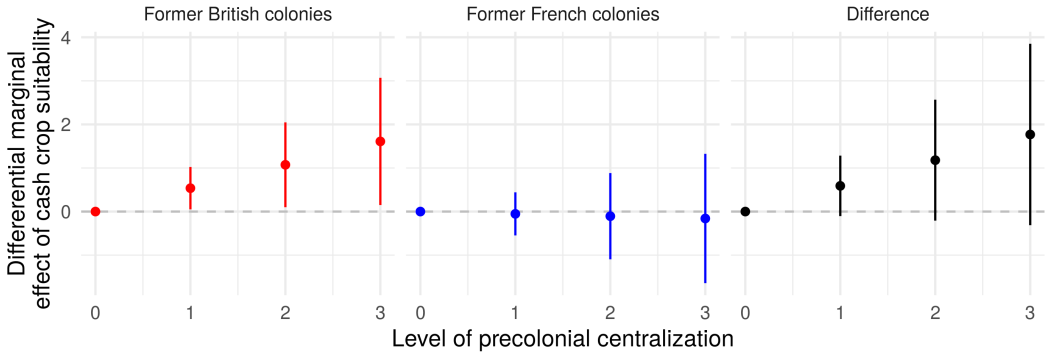


Figure 9: Differential marginal effect of cash crop suitability on per capita nightlight emissions (logged) across observed values of precolonial centralization, with a value of 0 (acephalous societies) as the baseline for comparison.

Note: Calculated on the basis of the full specification estimated on the pooled sample. See Subsection F in the Appendix. The pooled model adds an interaction term of a dummy for British rule with each variable in Equation 1.

samples is positive and statistically significant.

District-level economic activity The last analysis captures the long-term effect of resource extraction under indirect rule going beyond survey measures of local development. To proxy for local economic wealth and activity, I use districts' average per-capita nightlight emissions between 1992 and 2013 (e.g. Henderson, Storeygard and Weil 2012; Weidmann and Schutte 2017).[31] Baseline covariates are aggregated to the district level by taking their spatial average. I also control for the logged size of the rural and urban population (CIESIN et al. 2011) as well as the area of each district to account for the limited sensitivity of satellite sensors that do not detect lights at low levels of light emissions in rural areas and are saturated at high levels of urban emissions.

The results indicate a continuous developmental effect of cash crop production in areas under indirect British rule (Figure 9). The model associates an increase of local soils' suitability by one standard deviation (0.17) in a precolonial state with a change in local nightlights per capita that is 32 [2.8, 70] percentage points larger

[31] $Y_d = ln(0.001 * mean(\text{nightlights}_d^{1992,\ldots,2013})/\text{pop}_d^{2000})$, where d indexes districts observed in 2013 (from FAO 2014). Data on local population counts in 2000 come from (CIESIN et al. 2011). Nightlight emissions are measured by the National Geophysical Data Center (2014). The logarithm of nightlight emissions limits the influence of outliers (Cogneau and Dupraz 2014). To the same intent, I drop districts with nightlight measures spoiled by gas flaring from oil fields (Lujala, Rød and Thieme 2007).

than in an acephalous society. The difference in the marginal effects of cash crop suitability on nightlight emissions between the two types of precolonial societies is close to zero in former French colonies. The effects in the former British Empire are primarily driven by nightlight emissions from rural areas (see Table A17). This suggests that most persistence stems from rural areas suitable for cash crop production rather than from higher levels of urban development.

Conclusion

Rather than governing over a 'tabula rasa,' colonial rule in Africa oftentimes rested on precolonial institutions integrate into schemes of indirect rule. This paper analyses the developmental effects of such 'colonialism on the cheap.' It argues that indirect as compared to direct rule promoted more responsive local governance and improved the populations' terms in the trade of public service provision of taxation of cash crop production. But not all colonial empires relied on indirect rule to the same extent across their territories. In particular, the British ruled most indirectly where precolonial institutions proved sufficiently centralized to incorporate them into the colonial state and ruled more directly elsewhere. In contrast, the French relied on a more uniform direct rule and stripped precolonial institutions from many of their accustomed powers. Hence, the developmental effects of indirect rule were limited to resource-rich and precolonially centralized areas under British rule.

The analysis of geographically referenced survey data on late-colonial educational attainment supports this argument. Approximating local cash crop production with an exogenous measure of soil suitability for growing cash crops, it is shown that the effect of this suitability on primary education rates increases in the degree of precolonial centralization in British, but not in French colonies. This effect is not due to endogenous spatial sorting of precolonial institutions or colonial empires, as evidenced by analyses of educational outcomes across ethnic and colonial empire borders. Local budget data from Native Administrations under British rule roughly coincide with these findings, which are not caused by potentially confounding transportation or missionary infrastructure. The developmental effects of British indirect rule in resource-rich areas impact local development until the

present day, as evident in contemporary education levels, household wealth, and economic activity.

This article shows that indirect colonial rule, varying widely within and across empires, gave local populations the power to reap the benefits of resource-wealth and had a persistent impact on socio-economic outcomes. While it contributes to our understanding of the historical origins of (unequal) local development in Africa, future research should be devoted to the implications of this finding for long-term political and economic development. Did indirect rule make ethnic groups more likely to rise to power at the national level as Paine (2019) and Wucherpfennig, Hunziker and Cederman (2016) suggest? Was this effect fostered by some regions' endowments with natural resources? Or did postcolonial governments try to overcome indirect rule in these areas in order to appropriate greater shares of the respective resource rents (Boone 2003)? Similarly, the finding raises questions on the effects of indirect rule in resource-rich areas on local politics, in particular on traditional institutions (Acemoglu et al. 2014; Baldwin 2016), land rights (Berry 1992; Firmin-Sellers 2000; Honig 2017) and their distributive effects. The theoretical argument and empirical evidence presented here may present a useful starting point for further disentangling the impact of indirect rule in these regards.

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Appendix

Indirect Colonial Rule, Cash Crop Production, and Development in Africa

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A Summary statistics, and balance tests

Table A1: Summary statistics of individuals in the colonial sample

Statistic	N	Mean	St. Dev.	Min	Max
Primary education	361700	34.99	47.69	0	100
Secondary education	361700	9.21	28.92	0	100
Tertiary education	361700	2.41	15.32	0	100
Precol. centr. (PCC)	380769	1.69	0.97	0	3
Cash crop suit. (CCS)	402750	0.38	0.18	0.00	1.00
Distance to coast	402814	402.17	324.24	0.003	1768.57
Distance to navigable river	401906	158.18	146.53	0.06	1018.72
Distance to border	402814	72.41	71.69	0.01	570.38
Altitude	402785	579.46	576.99	−2	3589
Slope	402785	4.04	1.58	1	9
Mean temperature	402785	24.53	4.16	5.85	30.23
Evapotranspiration	402785	1650.98	274.00	1004	2678
Precipitation	402785	1164.85	581.39	1	3291
Evapotransp./Precip.	402785	4.34	1.45	1	8
Agricultural suitability	390927	0.39	0.23	0.00	0.99
Dependence on agriculture	392808	2.02	1.23	0	9
Dependence on husbandry	392808	5.96	1.27	0	9
Intensity of agriculture	381036	2.27	0.57	0	4
Cash crop suit. (max; 5 crops)	402750	0.34	0.18	0.00	1.00
Cash crop suit. (mean; 5 crops)	402750	0.17	0.11	0.00	0.75
Cash crop suit. (mean; 8 crops)	402750	0.16	0.10	0.00	0.67

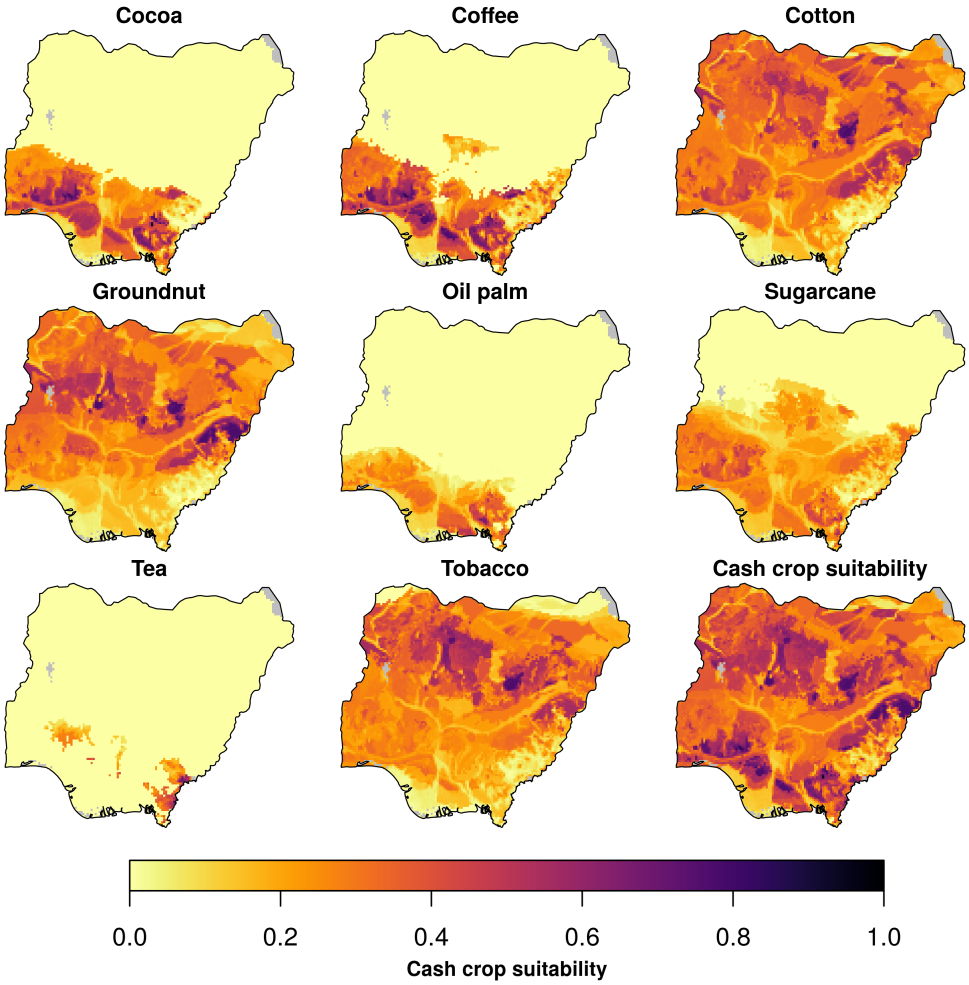


Figure A1: Cash crop suitabilities for the eight main cash crops and the aggregate cash crop suitability score in Nigeria.

Note: Grey value indicate missing raster data in water-covered areas. The eight cash crop suitabilities are aggregated by taking the maximum value in each grid cell.

Table A2: Balance test of pre-treatment covariates and precolonial centralization × cash crop suitability

	Baseline			Ethnic pairs			X-Border
	British	French	Diff.	British	French	Diff.	Diff.
Dep. variable							
Distance to coast	−0.58	0.02	−0.56	0.19	0.01	0.16	−0.05
	(0.39)	(0.23)	(0.44)	(0.14)	(0.11)	(0.17)	(0.26)
Distance to navigable river	0.35	0.39	−0.10	−0.03	0.07	−0.10	0.52
	(0.24)	(0.37)	(0.46)	(0.09)	(0.28)	(0.30)	(0.42)
Distance to border	−0.28	−0.48*	0.21	0.10	−0.03	0.14	0.82
	(0.31)	(0.27)	(0.41)	(0.19)	(0.15)	(0.24)	(0.53)
Altitude	−0.36	0.27	−0.53	−0.08	0.32*	−0.24	0.57
	(0.29)	(0.37)	(0.36)	(0.28)	(0.18)	(0.33)	(0.46)
Slope	−0.44***	0.37	−0.76***	−0.10	−0.23	0.08	0.50
	(0.15)	(0.23)	(0.24)	(0.21)	(0.21)	(0.28)	(0.55)
Mean temperature	0.25	−0.09	0.31	0.10	−0.21*	0.22	−0.35
	(0.28)	(0.25)	(0.32)	(0.29)	(0.12)	(0.30)	(0.38)
Evapotranspiration	0.18	0.01	0.14	0.07	−0.04	0.09	0.01
	(0.35)	(0.31)	(0.45)	(0.30)	(0.09)	(0.26)	(0.11)
Precipitation	−0.11	0.27	−0.38	−0.05	−0.08	0.03	−0.31*
	(0.16)	(0.22)	(0.27)	(0.05)	(0.09)	(0.10)	(0.17)
Evapotransp./Precip.	−0.26	0.08	−0.31	−0.09	−0.15*	0.09	−0.24
	(0.23)	(0.23)	(0.33)	(0.12)	(0.08)	(0.13)	(0.18)
Agricultural suitability	0.00	0.99***	−0.92***	−0.22	0.09	−0.29	−0.09
	(0.23)	(0.24)	(0.31)	(0.21)	(0.15)	(0.25)	(0.59)
Dependence on agriculture	−0.33	−0.27	−0.14	−0.46**	0.26	−0.73**	0.00
	(0.21)	(0.23)	(0.30)	(0.19)	(0.35)	(0.34)	(0.00)
Dependence on husbandry	−0.21	0.90***	−1.00**	−0.10	0.12	−0.21	0.00
	(0.33)	(0.32)	(0.45)	(0.35)	(0.32)	(0.47)	(0.00)
Intensity of agriculture	−0.02	0.29	−0.33	−0.22	0.26**	−0.48	0.00
	(0.37)	(0.27)	(0.45)	(0.44)	(0.13)	(0.45)	(0.00)
Colony×Birthyear FE	yes	yes	yes	yes	yes	yes	yes
Survey FE	yes	yes	yes	yes	yes	yes	yes
Ethnic pair FE	no	no	no	yes	yes	yes	no
Ethnic group FE	no	no	no	no	no	no	yes
Cutoff (km)	–	–	–	100	100	100	–
Obs	192650	150072	342722	132407	101611	234018	40162

Notes: Balance tests for the French and British samples result from split sample regressions, whereas the estimate of the differential effect of precolonial centralization × cash crop suitability is estimated from the pooled sample. Standard errors are clustered on the country-specific ethnic group. Significance codes: *p<0.1; **p<0.05; ***p<0.01.

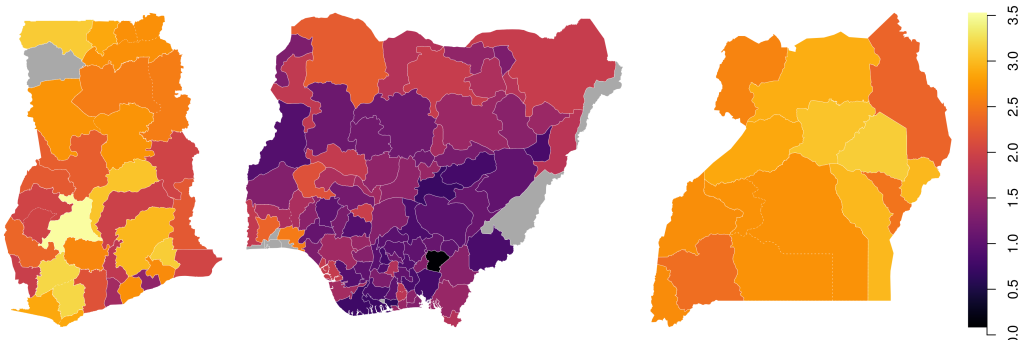
B Data on Native Administrations Budgets

I digitize financial information on the budgets of native administrations from the collection of *Annual Departmental Reports* available from the British Library for Nigeria, the Gold Coast, and Uganda. As summarized in Table A3, the reports cover local administrations budgets for varying years. All expenditures are transformed to 2016 £. To account for the varying number of years by colony, I use the district-level average across years as the outcome of the analysis discussed in the main text. District level statistics are mapped onto the geographical area of district which is retrieved from colonial-era maps (see Figure A2). All covariates used in the analysis are mapped onto districts by taking their spatially weighted average.

Table A3: Summary of native treasury data

Colony	Districts	Start	End	No. of years	Avg. expenditure	Avg. educ. sxp.
Gold Coast	29	1949	1951	3	12.79	3.04
Nigeria	86	1931	1939	9	3.19	0.31
Uganda	13	1934	1956	22	15.45	2.88

Notes: Note that the number of observations in the data might be smaller than the number of existing districts, because some budget reports report numbers above the district level (e.g. Buganda, Uganda).



(a) Gold Coast 1949-1951 (b) Nigeria 1931-1939 (c) Uganda 1934-1956

Figure A2: Per-capita revenues of native treasuries (logged; 2016 £).

Note: Aggregated to the district level and averaged over all observed years. Dotted lines indicate borders along which I aggregate districts for the analysis of local budgets (see discussion in text).

C Main results

Table A4: Indirect rule, cash crops, and colonial education: British vs. French rule

	Primary Education (0/100)		
	(1)	(2)	(3)
Precol. centr. (PCC)	5.908***	72.634**	77.837**
	(2.179)	(35.677)	(31.433)
Cash crop suit. (CCS)	19.932	10.596**	69.127***
	(13.008)	(4.692)	(26.586)
PCC × British	−13.486***	−30.956	−34.568
	(3.578)	(42.837)	(39.866)
CCS × British	−29.001	−21.695***	−100.876***
	(17.794)	(7.653)	(34.498)
PCC × CCS	−11.404*	−8.681***	−2.892
	(6.309)	(2.736)	(2.859)
PCC × CCS × British	23.648***	21.816***	13.483***
	(8.268)	(4.026)	(3.791)
Colony×Birthyear FE	yes	yes	yes
Survey FE	yes	yes	yes
Ind. controls:	yes	yes	yes
Geo. controls:	no	yes	yes
Ethn. controls:	no	no	yes
Mean DV:	35	35	35
Observations	342,722	332,411	332,411
Adjusted R^2	0.306	0.362	0.365

Notes: OLS linear probability models. Standard errors are clustered on ethnic groups within colonies. Individual controls consist of respondent's sex and age. Geographical controls consist of their distance to the coast, border, and the closest navigable river (all logged), the local altitude and slope, mean annual temperature, precipitation and evapotranspiration, the ratio of the two, and the local suitability for agriculture. Ethnic controls consist of groups' dependence on agriculture and husbandry as well as the intensity of agriculture. Geographical controls are interacted with the level of precolonial centralization, ethnic controls with the cash crop suitability score. Significance codes: *p<0.1; **p<0.05; ***p<0.01

Table A5: Indirect rule, cash crops, and colonial education: Compairing neighbouring ethnic groups (100km cutoff)

	Primary Education (0/100)					
	British colonies			French colonies		
	(1)	(2)	(3)	(4)	(5)	(6)
Precol. centr. (PCC)	−3.551*	43.402***	41.376**	2.885**	8.915	14.266
	(2.061)	(13.534)	(17.809)	(1.215)	(23.583)	(24.738)
Cash crop suit. (CCS)	−10.530	−5.965	−23.003	2.020	8.347	39.684*
	(7.524)	(6.184)	(21.404)	(5.173)	(5.271)	(21.148)
PCC × CCS	8.324**	7.950***	7.054***	−6.805**	−6.711**	−6.068**
	(4.125)	(2.763)	(2.441)	(3.068)	(3.134)	(2.980)
Ethnic pair × Birthyear FE:	yes	yes	yes	yes	yes	yes
Colony×Birthyear FE	yes	yes	yes	yes	yes	yes
Survey FE	yes	yes	yes	yes	yes	yes
Ind. controls:	yes	yes	yes	yes	yes	yes
Geo. controls:	no	yes	yes	no	yes	yes
Ethn. controls:	no	no	yes	no	no	yes
Mean DV:	44	45	45	17	16	16
Observations	132,407	128,640	128,640	101,611	99,589	99,589
Adjusted R^2	0.271	0.283	0.284	0.332	0.338	0.338

Notes: OLS linear probability models. Standard errors are clustered on ethnic groups within colonies. Individual controls consist of respondent's sex and age. Geographical controls consist of their distance to the coast, border, and the closest navigable river (all logged), the local altitude and slope, mean annual temperature, precipitation and evapotranspiration, the ratio of the two, and the local suitability for agriculture. Ethnic controls consist of groups' dependence on agriculture and husbandry as well as the intensity of agriculture. Geographical controls are interacted with the level of precolonial centralization, ethnic controls with the cash crop suitability score. Significance codes: *p<0.1; **p<0.05; ***p<0.01

Table A6: Indirect rule, cash crops, and colonial education: Across borders, within ethnic groups

	Primary Education (0/100)		
	(1)	(2)	(3)
Cash crop suit. (CCS)	−0.962	14.119**	51.588
	(9.843)	(6.399)	(38.679)
PCC × British	−3.966	203.890	353.314**
	(2.766)	(137.552)	(155.241)
CCS × British	1.076	−19.618	−144.634**
	(14.168)	(14.416)	(59.713)
PCC × CCS	−6.864	−14.189***	−13.243***
	(5.172)	(4.993)	(4.240)
PCC × CCS × British	9.694	18.137**	16.737**
	(6.597)	(7.206)	(6.868)
Ethnic group × Birthyear FE:	yes	yes	yes
Colony×Birthyear FE	yes	yes	yes
Survey FE	yes	yes	yes
Ind. controls:	yes	yes	yes
Geo. controls:	no	yes	yes
Ethn. controls:	no	no	yes
Mean DV:	17	17	17
Observations	40,162	39,025	39,025
Adjusted R^2	0.277	0.295	0.296

Notes: OLS linear probability models. Standard errors are clustered on ethnic groups within colonies. Individual controls consist of respondent's sex and age. Geographical controls consist of their distance to the coast, border, and the closest navigable river (all logged), the local altitude and slope, mean annual temperature, precipitation and evapotranspiration, the ratio of the two, and the local suitability for agriculture. Ethnic controls consist of groups' dependence on agriculture and husbandry as well as the intensity of agriculture. Geographical controls are interacted with the level of precolonial centralization, ethnic controls with the cash crop suitability score. Significance codes: *p<0.1; **p<0.05; ***p<0.01

D Robustness checks

D.1 Alternative education-related outcomes

In order to address concerns that the results might be unstable across different education-related outcomes, the baseline results are replicated for dummies of completed secondary and tertiary education. The results, presented in Table A7, exhibit the same pattern as those reported at the baseline. Point estimates for the British sample are of similar size than those for primary education rates and significant throughout. For the French, the interaction terms of interest are again negative and significant. The results thus indicate that cash crop suitability generally increased higher education provision under British indirect rule, but decreased it under French direct rule.

Table A7: Indirect rule, cash crops, and alternative education outcomes

	Primary Education (0/100)			
	British colonies		French colonies	
	Sec. Educ.	Tert. Educ.	Sec. Educ.	Tert. Educ.
	(1)	(2)	(3)	(4)
Precol. centr. (PCC)	10.452	−0.868	44.058***	10.887**
	(17.400)	(4.907)	(16.229)	(4.513)
Cash crop suit. (CCS)	−10.525	2.074	98.339***	31.578***
	(11.193)	(4.421)	(33.175)	(10.646)
PCC × CCS	10.111***	4.294***	−5.022*	−1.755**
	(1.944)	(1.029)	(2.726)	(0.868)
Colony×Birthyear FE	yes	yes	yes	yes
Survey FE	yes	yes	yes	yes
Ind. controls:	yes	yes	yes	yes
Geo. controls:	yes	yes	yes	yes
Ethn. controls:	yes	yes	yes	yes
Mean DV:	12	3.3	6.1	1.3
Observations	184,872	184,872	147,539	147,539
Adjusted R^2	0.130	0.039	0.133	0.042

Notes: OLS linear probability models. Standard errors are clustered on ethnic groups within colonies. Individual controls consist of respondent's sex and age. Geographical controls consist of their distance to the coast, border, and the closest navigable river (all logged), the local altitude and slope, mean annual temperature, precipitation and evapotranspiration, the ratio of the two, and the local suitability for agriculture. Ethnic controls consist of groups' dependence on agriculture and husbandry as well as the intensity of agriculture. Geographical controls are interacted with the level of precolonial centralization, ethnic controls with the cash crop suitability score. Significance codes: *p<0.1; **p<0.05; ***p<0.01

D.2 Alternative measures of cash crop suitability

I here test the extent to which measuring the cash crop suitability on the basis of the local maximum suitability of eight crops[32] affects the results. First, I build an

[32]Coffee, cocoa, cotton, groundnuts, palm oil, sugar cane, tea, and tobacco.

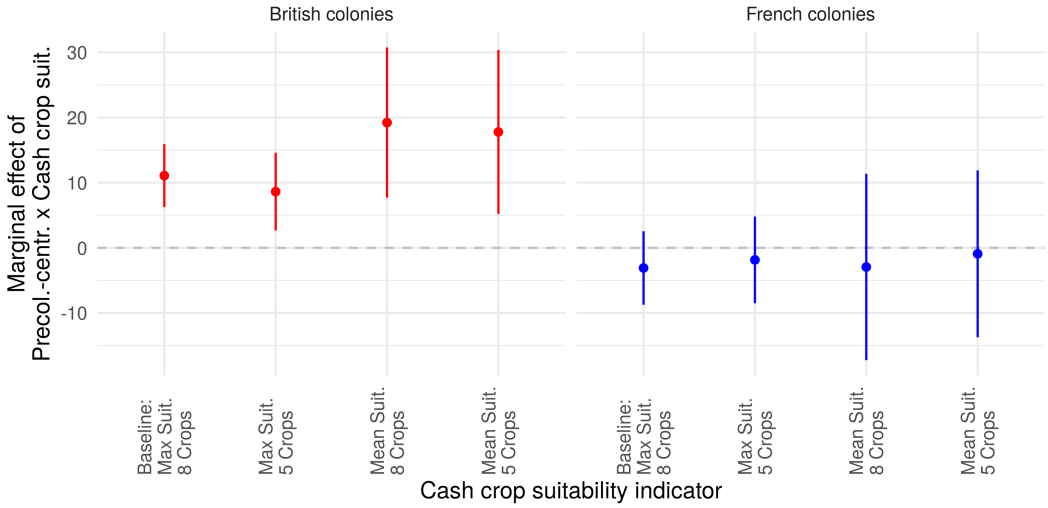


Figure A3: The marginal effect of precolonial centralization × cash crop suitability, using alternative cash crop suitability indicators.

Note: Based on the main specification in Equation 1 in the main text, replacing the main cash cash crop suitability measure with the one indicated on the x-axis.

alternative measure by taking the local maximum of the five most important cash crops, coffee, cocoa, cotton, groundnuts, and palm oil (Hance, Kotschar and Peterec 1961). Second, I construct the measure by taking the local average of the eight and five crops rather than their maximum value. The results, visualized in Figure A3, remain substantially unchanged. The larger coefficients of the interaction terms of the mean suitability scores are due to the lower sample mean of the respective variables as compared those constructed by taking the local maximum (see summary statistics, Table A1). Throughout, I do not find an interactive effect of precolonial centralization and cash crop suitability in the French colonies.

D.3 Alternative measures of precolonial centralization

Beyond the choice of the cash crop suitability indicator, the results might be driven by the particular measure of precolonial centralization. This is based on Murdock's (1967) coding of political complexity in his *Ethnographic Atlas* which was linked to Murdock's map of ethnic groups (1959) by Nunn and Wantchekon (2011). An alternative matching with few but potentially important differences has been implemented by Michalopoulos and Papaioannou (2013). I use their coding as the first alternative source. In addition, we might fear that Murdock's coding was biased by colonial policies. To construct alternative and independent data on precolonial centralization of ethnic groups, I first map the capitals of precolonial polities observed in 1885 and contained in Steward's (2006) encyclopedia of *African States and Rulers*.

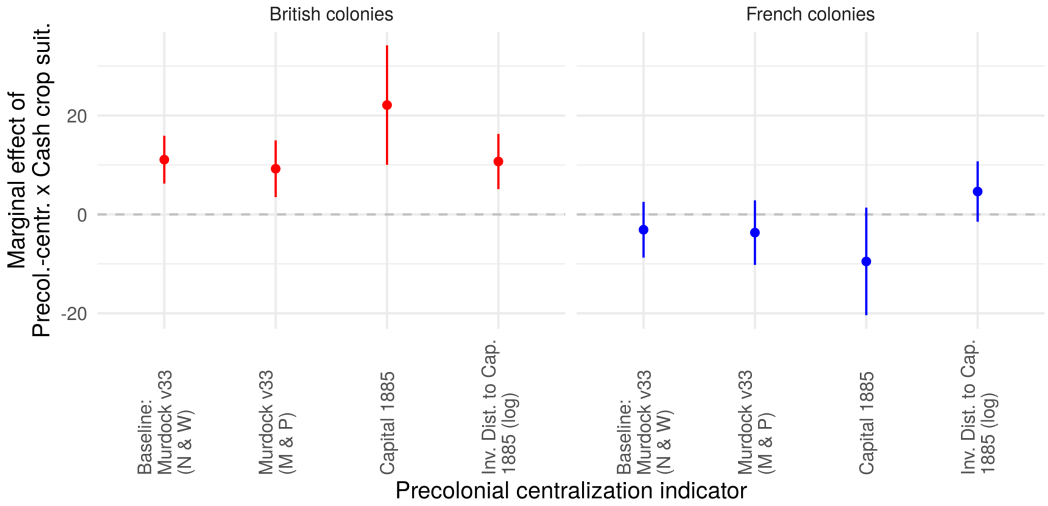


Figure A4: The marginal effect of precolonial centralization $\times$ cash crop suitability, using varying measures of precolonial centralization.

Note: Based on the main specification in Equation 1 in the main text, replacing the main variable precolonial centralization with the measures indicated on the x-axis.

I georeference the capitals of the polities contained in the encyclopedia for the year 1885 using the geonames.org database and create a dummy in each group from Murdock's (1959) map that was home to at least one capital. Second, I calculate the distance of DHS clusters to the closest capital in 1885 and use the logged inverse distance as a rough indicator of the centralization of precolonial institutions.

Re-estimating the baseline model for the British and the French samples with these indicators for precolonial centralization strengthens the confidence in the results. Figure A4 shows that all three alternative measures are consistently associated with increases in the marginal effect of local cash crop suitability. This is not the case in the French sample. Here, the alternative Murdock coding produces results equivalent to the baseline, ethnic groups with a capital in 1885 feature a lower marginal effect of cash crop suitability. Lastly, French areas close to historical capitals feature slightly higher but imprecisely estimated marginal effects of cash crop suitability.

D.4 Selection through migration:

I here test whether the effects from the baseline analysis are driven by biased migration patterns. In particular, migration decisions of well- or non-educated people might have differed systematically between ethnic groups and colonial empires so that individuals sampled by the DHS have self-selected themselves into or out of treatment over their lifetime. In order to test whether this is a caveat to the analy-

sis, I draw on the DHS's Individual and Male's Recodes. This data stems from the smaller sample of respondents to the DHS which have gone through the entire interview.[33] I therefore loose 90% of all observations but gain information on whether an individual has always lived in the same location or has moved at some point of her life. I transform this data into a simple migrant-dummy and then interact it with the main interaction term of interest. Models 1–3 in Table A8 show that the interactive effect of $\mathsf{PCC} \times \mathsf{CCS}$ is is no different among migrants and non-migrants in the British sample. In the French sample (Models 4–6), migrants are associated with a much stronger negative interaction effect.[34] However, even among non-migrants, the interaction effect is negative in the lesser specified Models 4 and 5 and turns positive but statistically insignificant in the fully specified Model 6.

[33] For the baseline results based on this smaller sample of DHS respondents see the respective robustness check in Figure A5 in Subsection D.5 below.

[34] A number of education based selection patterns could drive this results, which one exactly we cannot infer from the data lacking information on the places of origin of the migrants.

Table A8: Indirect rule, cash crops, and colonial education: Controlling for migrants

	Primary Education (0/100)					
	British colonies			French colonies		
	(1)	(2)	(3)	(4)	(5)	(6)
Precol. centr. (PCC)	−9.086**	88.371***	104.932***	3.635	47.176	46.689
	(4.007)	(31.297)	(31.443)	(2.472)	(40.475)	(42.312)
Cash crop suit. (CCS)	−11.997	−11.385	−46.224*	13.333	1.554	48.159
	(17.859)	(12.636)	(24.684)	(15.514)	(10.354)	(42.555)
PCC × CCS	17.191**	16.528***	15.960***	−5.523	−3.030	−0.651
	(7.095)	(5.540)	(5.487)	(6.659)	(5.104)	(5.039)
Migrant	27.903***	15.070*	14.245	−10.040**	−7.630**	−6.043*
	(8.560)	(9.059)	(9.126)	(4.712)	(3.663)	(3.327)
Migrant × PCC	−3.323	−0.129	0.148	6.532***	5.590***	4.939***
	(3.184)	(3.646)	(3.707)	(2.378)	(1.772)	(1.614)
Migrant × CCS	−35.634**	−16.875	−13.837	27.317*	17.118	13.296
	(16.247)	(16.514)	(17.084)	(14.364)	(11.667)	(10.574)
Migrant × PCC × CCS	8.395	1.749	0.390	−14.986**	−11.952**	−10.332**
	(6.751)	(7.407)	(7.672)	(7.073)	(5.652)	(5.174)
Colony×Birthyear FE	yes	yes	yes	yes	yes	yes
Survey FE	yes	yes	yes	yes	yes	yes
Ind. controls:	yes	yes	yes	yes	yes	yes
Geo. controls:	no	yes	yes	no	yes	yes
Ethn. controls:	no	no	yes	no	no	yes
Mean DV:	59	59	59	18	18	18
Observations	12,702	12,389	12,389	15,413	15,305	15,305
Adjusted R^2	0.197	0.267	0.271	0.185	0.245	0.246

Notes: OLS linear probability models. Standard errors are clustered on ethnic groups within colonies. Individual controls consist of respondent's sex and age. Geographical controls consist of their distance to the coast, border, and the closest navigable river (all logged), the local altitude and slope, mean annual temperature, precipitation and evapotranspiration, the ratio of the two, and the local suitability for agriculture. Ethnic controls consist of groups' dependence on agriculture and husbandry as well as the intensity of agriculture. Geographical controls are interacted with the level of precolonial centralization, ethnic controls with the cash crop suitability score. Significance codes: *p<0.1; **p<0.05; ***p<0.01

D.5 Additional specifications

This section describes a number of further model specifications mentioned briefly in the main text. To ease the interpretation of the results and reduce complexity, all findings from these robustness checks are summarized in Figure A5.

Fixed effects specifications: In order gauge the robustness of the results, I rerun the analysis varying the main fixed effects employed. In comparison to the main colony×birth-year and survey fixed effects, I first introduce sole colony and survey fixed effects. I then increase the amount of variation soaked up by estimating the main specification with colony×survey×birth-year and lastly colony×survey×birth-year×sex fixed effects. As shown in Figure A5, these variations lead to substantively unchanged results.

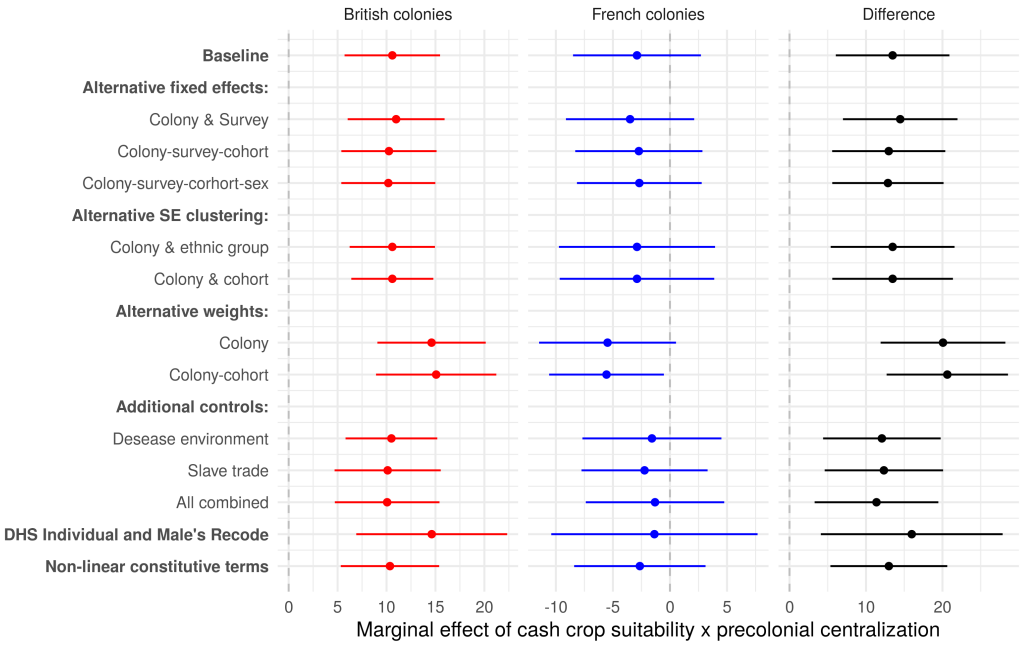


Figure A5: Marginal effect of precolonial centralization × cash crop suitability in a variety of additional specifications.

Note: Based on the main specification in Equation 1 in the main text, implementing the changes indicated on the y-axis and discussed in detail in Section D.5 of this Appendix.

Alternative standard error specifications: To gauge the influence of the main model's custering of standard errors on the ethnic group by colony level, Figure A5 presents results from the fully specififed baseline models, clustering standard errors first separately on the colony and ethnic group level[35] and second on the colony-cohort level. The first alternative leads to lightly larger standard errors, the second to much smaller ones. Both versions do not affect the statistical significance of the results.

Weighting by colony: The DHS has not been fielded symmetrically in the countries studied here. Instead, more developed countries and those with better governance have been surveyed more often and more extensively. In a similar vein, cohorts born early in the 20th century are underrepresented in the surveys as many individuals have died over the years. In order to gauge whether the results are driven by 'oversampled' countries and cohorts, Figure A5 presents results from running the fully specified baseline specification and weighting respondents according to the inverse of the number of respondents living in their respective colony

[35]This is possible because a number of ethnic groups are present in several colonies, which might affect standard errors if errors are systematically correlated within colonies but also within ethnic groups

Table A9: Indirect rule, cash crops, and colonial education: Varying fixed effects

	Primary Education (0/100)					
	British colonies			French colonies		
	(1)	(2)	(3)	(4)	(5)	(6)
Precol. centr. (PCC)	44.114*	39.788*	40.361*	79.551**	78.560**	76.725**
	(24.255)	(24.027)	(23.999)	(32.274)	(31.107)	(30.201)
Cash crop suit. (CCS)	−31.527	−32.329	−32.056	73.280***	67.819**	69.135***
	(22.131)	(21.668)	(21.576)	(27.764)	(26.438)	(26.802)
PCC × CCS	10.963***	10.248***	10.183***	−3.458	−2.729	−2.686
	(2.535)	(2.484)	(2.453)	(2.878)	(2.846)	(2.792)
Fixed Effects:	colony	colony-survey-cohort	colony-survey-cohort-sex	colony	colony-survey-cohort	colony-survey-cohort-sex
Survey FE:	yes	–	–	yes	–	–
Ind. controls:	yes	yes	yes	yes	yes	yes
Geo. controls:	yes	yes	yes	yes	yes	yes
Ethn. controls:	yes	yes	yes	yes	yes	yes
Mean DV:	49	49	49	17	17	17
Observations	184,872	184,872	184,872	147,539	147,539	147,539
Adjusted R^2	0.268	0.276	0.309	0.298	0.319	0.337

Notes: OLS linear probability models. Standard errors are clustered on ethnic groups within colonies. Individual controls consist of respondent's sex and age. Geographical controls consist of their distance to the coast, border, and the closest navigable river (all logged), the local altitude and slope, mean annual temperature, precipitation and evapotranspiration, the ratio of the two, and the local suitability for agriculture. Ethnic controls consist of groups' dependence on agriculture and husbandry as well as the intensity of agriculture. Geographical controls are interacted with the level of precolonial centralization, ethnic controls with the cash crop suitability score. Significance codes: *p<0.1; **p<0.05; ***p<0.01

and attributed to their respective colony-cohort. Doing so leads to slightly larger estimates of the main interaction term PCC × CCS of interest, indicating the the oversampling of countries and cohorts leads me, if at all, to underestimate the impact of indirect rule on the marginal effect of cash crop suitability on primary education.

Additional controls: I also control for the robustness of the results after adding vectors of control that capture important causes of long-term development in Africa. The first is the local disease environment, that had important effects on European's health and thus colonial state building. Second, I control for the extent of the pre-colonial slave trades, which might have affected the development of precolonial institutions. Figure A5 shows that the baseline results are robust to these additions.

DHS Individual and Male's Recode data: The baseline results rely on the full set of individuals born at least six years before independence in the Personal Recode Data of the DHS (2018). About 90%[36] of these individuals have not been interviewed in person but rather reported on by members of their household that went through the entire DHS interview. In order to gauge whether drawing on this

[36]This figure varies across households, countries, and surveys.

Table A10: Indirect rule, cash crops, and colonial education: Alternative SE clustering

	Primary Education (0/100)			
	British colonies		French colonies	
	(1)	(2)	(3)	(4)
Precol. centr. (PCC)	43.243*	43.243*	78.087***	78.087***
	(23.693)	(23.549)	(23.783)	(22.928)
Cash crop suit. (CCS)	−31.756	−31.756	68.052*	68.052*
	(29.565)	(28.917)	(37.606)	(35.934)
PCC × CCS	10.618***	10.618***	−2.862	−2.862
	(2.272)	(2.175)	(3.614)	(3.573)
SE clustering:	Colony & group	Colony & cohort	Colony & group	Colony & cohort
Colony×Birthyear FE	yes	yes	yes	yes
Survey FE	yes	yes	yes	yes
Ind. controls:	yes	yes	yes	yes
Geo. controls:	yes	yes	yes	yes
Ethn. controls:	yes	yes	yes	yes
Mean DV:	49	49	17	17
Observations	184,872	184,872	147,539	147,539
Adjusted R^2	0.275	0.275	0.318	0.318

Notes: OLS linear probability models.
Individual controls consist of respondent's sex and age. Geographical controls consist of their distance to the coast, border, and the closest navigable river (all logged), the local altitude and slope, mean annual temperature, precipitation and evapotranspiration, the ratio of the two, and the local suitability for agriculture. Ethnic controls consist of groups' dependence on agriculture and husbandry as well as the intensity of agriculture. Geographical controls are interacted with the level of precolonial centralization, ethnic controls with the cash crop suitability score.
Significance codes: *p<0.1; **p<0.05; ***p<0.01

'second-hand' information inserts bias into the analysis, Figure A5 reports the results of estimating the baseline specification on the sample of respondents that have gone through the full interview and are therefore included in the DHS Individual and Men's Recodes. The results show that, in the British sample, the interaction effect between cash crop suitability and precolonial centralization is estimated to be larger, in particular in the models without control variables. This deviation is likely due to the fact that women in the reduced sample are born later since the DHS only interviews women up to age 49, thus limiting the extent to which we can travel back into the colonial period. The effects observed in the French sample are very similar to those estimated on the full sample.

Non-linear effects of the constitutive terms: A last robustness check addresses the caveat that the main interaction of interest, PCC × CCS, might be driven by non-linear effects of its constitutive terms. Adding the quadratic terms PCC^2 and CCS^2 to the baseline model, Figure A5 shows that this worry in unwarranted.

Table A11: Indirect rule, cash crops, and colonial education: Varying weights

	Primary Education (0/100)			
	British colonies		French colonies	
	(1)	(2)	(3)	(4)
Precol. centr. (PCC)	−0.364	19.556	101.385***	93.799***
	(21.571)	(26.603)	(29.950)	(33.940)
Cash crop suit. (CCS)	−25.536	−39.416	59.761**	63.754***
	(21.755)	(25.570)	(23.658)	(20.127)
PCC × CCS	14.549***	15.069***	−5.514*	−5.604**
	(2.780)	(3.117)	(3.073)	(2.578)
Weights:	colony	colony-year	colony	colony-year
Colony×Birthyear FE	yes	yes	yes	yes
Survey FE	yes	yes	yes	yes
Ind. controls:	yes	yes	yes	yes
Geo. controls:	yes	yes	yes	yes
Ethn. controls:	yes	yes	yes	yes
Mean DV:	49	49	17	17
Observations	184,872	184,872	147,539	147,539
Adjusted R^2	0.331	0.328	0.355	0.386

Notes: OLS linear probability models. Standard errors are clustered on ethnic groups within colonies. Individual controls consist of respondent's sex and age. Geographical controls consist of their distance to the coast, border, and the closest navigable river (all logged), the local altitude and slope, mean annual temperature, precipitation and evapotranspiration, the ratio of the two, and the local suitability for agriculture. Ethnic controls consist of groups' dependence on agriculture and husbandry as well as the intensity of agriculture. Geographical controls are interacted with the level of precolonial centralization, ethnic controls with the cash crop suitability score. Significance codes: *p<0.1; **p<0.05; ***p<0.01

Table A12: Indirect rule, cash crops, and colonial education: Additional controls

	Primary Education (0/100)					
	British colonies			French colonies		
	(1)	(2)	(3)	(4)	(5)	(6)
Precol. centr. (PCC)	41.672*	45.615*	43.557*	73.316***	61.319**	64.765***
	(24.537)	(25.040)	(24.927)	(27.196)	(25.983)	(23.929)
Cash crop suit. (CCS)	−30.865	−15.571	−14.826	50.890**	81.089***	63.902**
	(21.726)	(19.253)	(18.997)	(24.080)	(30.815)	(28.281)
PCC × CCS	10.529***	10.144***	10.096***	−1.574	−2.189	−1.306
	(2.390)	(2.771)	(2.731)	(3.108)	(2.821)	(3.098)
Disease Environment:	yes	no	yes	yes	no	yes
Slave Trade:	no	yes	yes	no	yes	yes
Colony×Birthyear FE	yes	yes	yes	yes	yes	yes
Survey FE	yes	yes	yes	yes	yes	yes
Ind. controls:	yes	yes	yes	yes	yes	yes
Geo. controls:	yes	yes	yes	yes	yes	yes
Ethn. controls:	yes	yes	yes	yes	yes	yes
Mean DV:	49	49	49	17	17	17
Observations	184,872	184,872	184,872	147,539	147,539	147,539
Adjusted R^2	0.275	0.276	0.276	0.320	0.320	0.322

Notes: OLS linear probability models. Standard errors are clustered on ethnic groups within colonies. Individual controls consist of respondent's sex and age. Geographical controls consist of their distance to the coast, border, and the closest navigable river (all logged), the local altitude and slope, mean annual temperature, precipitation and evapotranspiration, the ratio of the two, and the local suitability for agriculture. Ethnic controls consist of groups' dependence on agriculture and husbandry as well as the intensity of agriculture. Geographical controls are interacted with the level of precolonial centralization, ethnic controls with the cash crop suitability score. Significance codes: *p<0.1; **p<0.05; ***p<0.01

Table A13: Indirect rule, cash crops, and colonial education: DHS Individual Recode data

	Primary Education (0/100)					
	British colonies			French colonies		
	(1)	(2)	(3)	(4)	(5)	(6)
Precol. centr. (PCC)	−11.589***	63.628**	85.275***	7.695**	60.409*	60.202
	(3.500)	(28.190)	(29.375)	(3.064)	(36.168)	(37.715)
Cash crop suit. (CCS)	−28.708**	−18.878**	−61.322***	25.827	3.347	49.676
	(13.335)	(8.691)	(22.759)	(17.502)	(9.701)	(40.722)
PCC × CCS	21.382***	17.363***	14.658***	−14.243*	−6.034	−1.335
	(5.697)	(4.110)	(3.925)	(8.143)	(4.992)	(4.619)
Colony×Birthyear FE	yes	yes	yes	yes	yes	yes
Survey FE	yes	yes	yes	yes	yes	yes
Ind. controls:	yes	yes	yes	yes	yes	yes
Geo. controls:	no	yes	yes	no	yes	yes
Ethn. controls:	no	no	yes	no	no	yes
Mean DV:	64	64	64	24	23	23
Observations	17,717	17,193	17,193	25,272	24,984	24,984
Adjusted R^2	0.182	0.259	0.263	0.224	0.286	0.288

Notes: OLS linear probability models. Standard errors are clustered on ethnic groups within colonies. Individual controls consist of respondent's sex and age. Geographical controls consist of their distance to the coast, border, and the closest navigable river (all logged), the local altitude and slope, mean annual temperature, precipitation and evapotranspiration, the ratio of the two, and the local suitability for agriculture. Ethnic controls consist of groups' dependence on agriculture and husbandry as well as the intensity of agriculture. Geographical controls are interacted with the level of precolonial centralization, ethnic controls with the cash crop suitability score. Significance codes: *p<0.1; **p<0.05; ***p<0.01

Table A14: Indirect rule, cash crops, and colonial education

	Primary Education (0/100)					
	British colonies			French colonies		
	(1)	(2)	(3)	(4)	(5)	(6)
Precol. centr. (PCC)	−5.784	45.461*	47.751**	2.980	69.631**	73.075**
	(7.058)	(23.268)	(23.944)	(4.804)	(33.246)	(28.853)
Cash crop suit. (CCS)	−8.889	27.609***	5.451	−10.892	3.426	66.444**
	(18.496)	(10.266)	(24.451)	(16.396)	(12.044)	(28.676)
PCC × CCS	12.748***	12.256***	10.378***	−7.910	−7.730***	−2.598
	(4.734)	(2.933)	(2.566)	(5.395)	(2.851)	(2.933)
Precol.-centr.^{2}	−0.643	0.069	−0.278	0.536	0.714	0.735
	(1.819)	(1.001)	(0.955)	(1.404)	(0.796)	(0.762)
Cash crop suit^2	−1.469	−43.274***	−35.559***	33.420	7.586	−0.010
	(17.091)	(9.637)	(9.439)	(20.557)	(12.923)	(13.861)
Colony×Birthyear FE	yes	yes	yes	yes	yes	yes
Survey FE	yes	yes	yes	yes	yes	yes
Ind. controls:	yes	yes	yes	yes	yes	yes
Geo. controls:	no	yes	yes	no	yes	yes
Ethn. controls:	no	no	yes	no	no	yes
Mean DV:	49	49	49	18	17	17
Observations	192,650	184,872	184,872	150,072	147,539	147,539
Adjusted R^2	0.211	0.272	0.276	0.266	0.315	0.319

Notes: OLS linear probability models. Standard errors are clustered on ethnic groups within colonies. Individual controls consist of respondent's sex and age. Geographical controls consist of their distance to the coast, border, and the closest navigable river (all logged), the local altitude and slope, mean annual temperature, precipitation and evapotranspiration, the ratio of the two, and the local suitability for agriculture. Ethnic controls consist of groups' dependence on agriculture and husbandry as well as the intensity of agriculture. Geographical controls are interacted with the level of precolonial centralization, ethnic controls with the cash crop suitability score. Significance codes: *p<0.1; **p<0.05; ***p<0.01

E Alternative mechanisms: Transport infrastructure and missions

The first alternative explanation focuses on the provision of local public infrastructure which was crucial for incentivizing agricultural production. It might be that British colonial governments invested more into local public infrastructure in indirectly ruled areas where they could rely on effective local governments than in directly ruled areas where they had to rely on local elites which were less able to mobilize the material and human resources (often through local traditional 'labor taxes') to build the physical infrastructure. Given that extraction from indirectly ruled areas paid off less for colonial governments, they might also have had the opposite incentive to build more infrastructure where they could rule and extract directly. Differences in the density of local transport infrastructure might have then translated into differential levels of agricultural production, affecting education rates solely through a private wealth mechanisms. I capture this mechanism by adding measures on local transport infrastructure to the main baseline model, in particular the presence and density of roads in 1966 and railroads in 1960.

The railroad data from 1960 comes from Jedwab and Moradi (2016). I create a dummy for whether a DHS clusters is closer than 10km to a railroad, and add the logged continuous distance to the closest railroad line. Data on the local road network in the early 1960s comes from the Michelin Map corpus. Mapped as an excerpt in Figure A6, the maps cover the entirety of the African continent.[37] If first contruct a dummy for whether a DHS survey cluster is closer than 10km to the next road. The I make use of the fact that the maps come with a 6 point road quality scale that correspond to driving speeds between approximately 25km/h for the worst type of road to up to 75km/h for hard surface roads and highways.[38] This allows me to capture the local quality of the road network as quality-weighted road network density[39] calculated within a radius of 20km of DHS survey clusters.

Controlling for these four measures of local transport infrastructure at the end of the colonial period amounts to adding 'bad', that is post-treatment controls, thus biasing the estimated treatment effect of the interaction of PCC $\times$ CCS. As the results presented in Table A15 show, doing so does not change the main results.

The second mechanism in the influence of missionaries. Besides colonial governments, missionaries were the main providers of education, in particular in British colonies (see e.g. Gifford and Weiskel 1971; Cogneau 2003; Cogneau and Moradi 2014). The choices of missionaries where to build their missionary stations was

[37] West Africa in 1965, Central Africa in 1964, and East Africa in 1966.
[38] This data is retrieved from Michelin's online atlas, viamichelin.com.
[39] Calculated as $\sum_{t=1}^{T} length_t * speed_t$, where t indexes the various types of roads.

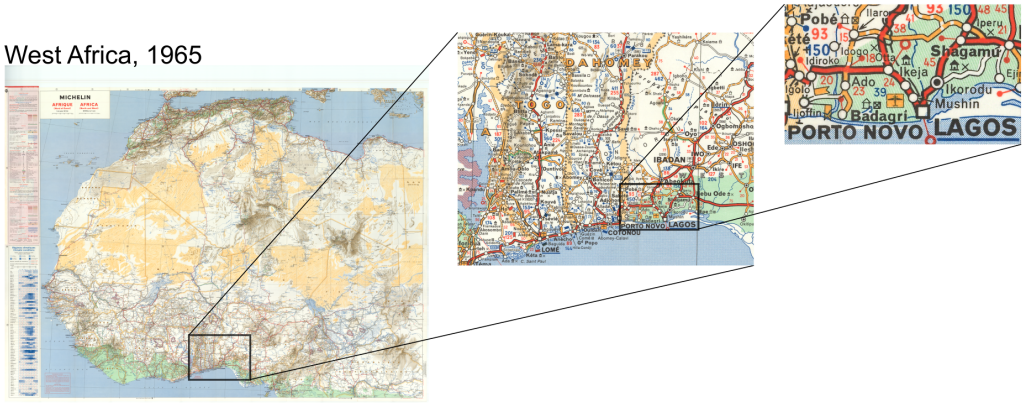


Figure A6: Michelin map for West Africa, 1965

hardly random (see e.g. Jedwab, zu Selhausen and Moradi 2018) and might have been influenced by local economic potentials as well as precolonial institutions. Their settlements might therefore constitute a so far unobserved mechanism that led suitable soils to relate more strongly to education in centralized groups under British rule than elsewhere. To account for that factor, I control for DHS clusters' logged distance to the next missionary station (from Roome 1924; Nunn 2010) as well as a dummy for clusters that are within a 10 km radius to the next mission.[40] Doing so does only slightly reduce the estimate coefficient of the main interaction term PCC $\times$ CCS, suggesting that endogenous missionary settlements do not drive the observed patterns.

[40]Note that recent work by Jedwab, zu Selhausen and Moradi (2018) indicates that there where many more missions in Africa than indicated on Roome's (1924) map. However, their newly collected data on missions only covers the Gold Coast and is not yet openly available.

Table A15: Indirect rule, cash crops, and colonial education: Alternative mechanisms

	Primary Education (0/100)					
	British colonies			French colonies		
	(1)	(2)	(3)	(4)	(5)	(6)
Precol. centr. (PCC)	46.596**	35.178	38.641*	−47.071*	55.065**	−36.551
	(21.795)	(22.636)	(21.472)	(28.140)	(25.674)	(25.770)
Cash crop suit. (CCS)	−27.070	−30.867	−27.699	96.397***	33.091	85.250***
	(19.324)	(19.882)	(18.716)	(20.835)	(22.685)	(19.937)
PCC × CCS	8.980***	7.285***	6.913***	−5.371**	−1.824	−5.086**
	(2.302)	(2.256)	(2.204)	(2.525)	(2.539)	(2.287)
Dist. to rail 1960 < 10km	5.548**		5.541**	6.240***		5.628***
	(2.375)		(2.297)	(1.559)		(1.698)
Dist. to rail 1960 (km; log)	−0.710		0.067	−1.296***		−0.807**
	(0.804)		(0.773)	(0.417)		(0.379)
Dist. to road 1966 < 10km	4.140***		3.646***	2.452***		2.441***
	(0.616)		(0.616)	(0.491)		(0.501)
Roads 1966 (log)	0.472***		0.256**	0.333***		0.290**
	(0.111)		(0.104)	(0.115)		(0.114)
Dist. to Mission < 10km		−0.427	−0.978		6.497***	4.670**
		(1.331)	(1.248)		(2.417)	(2.220)
Dist. to Mission (km; log)		−5.062***	−4.154***		−3.497***	−2.151***
		(0.642)	(0.649)		(0.598)	(0.602)
Colony×Birthyear FE	yes	yes	yes	yes	yes	yes
Survey FE	yes	yes	yes	yes	yes	yes
Ind. controls:	yes	yes	yes	yes	yes	yes
Geo. controls:	no	yes	yes	no	yes	yes
Ethn. controls:	no	no	yes	no	no	yes
Mean DV:	49	49	49	15	17	15
Observations	184,872	184,872	184,872	140,574	147,539	140,574
Adjusted R^2	0.283	0.284	0.288	0.283	0.331	0.288

Notes: OLS linear probability models. Standard errors are clustered on ethnic groups within colonies. Individual controls consist of respondent's sex and age. Geographical controls consist of their distance to the coast, border, and the closest navigable river (all logged), the local altitude and slope, mean annual temperature, precipitation and evapotranspiration, the ratio of the two, and the local suitability for agriculture. Ethnic controls consist of groups' dependence on agriculture and husbandry as well as the intensity of agriculture. Geographical controls are interacted with the level of precolonial centralization, ethnic controls with the cash crop suitability score. Significance codes: *p<0.1; **p<0.05; ***p<0.01

F Contemporary outcomes

F.1 Household wealth

Table A16: Indirect rule, cash crops, and contemporary Household Wealth (DHS Wealth Index)

	DHS Wealth Index					
	former British colonies			former French colonies		
	(1)	(2)	(3)	(4)	(5)	(6)
Precol. centr. (PCC)	-0.371^{***}	-0.732	-0.927	0.277^{***}	0.502	0.595
	(0.102)	(0.726)	(0.667)	(0.091)	(0.400)	(0.426)
Cash crop suit. (CCS)	-1.335^{***}	-0.788^{***}	-0.194	-0.177	-0.081	4.149^{***}
	(0.379)	(0.233)	(0.585)	(0.494)	(0.333)	(1.364)
PCC $\times$ CCS	0.865^{***}	0.629^{***}	0.584^{***}	-0.259	-0.171	0.119
	(0.196)	(0.113)	(0.104)	(0.215)	(0.255)	(0.149)
Survey FE	yes	yes	yes	yes	yes	yes
Former colony FE	yes	yes	yes	yes	yes	yes
HH controls:	yes	yes	yes	yes	yes	yes
Geo. controls:	no	yes	yes	no	yes	yes
Ethn. controls:	no	no	yes	no	no	yes
Mean DV:	0.017	-0.011	-0.011	0.039	-0.0079	-0.0079
Observations	417,567	398,863	398,863	186,771	176,396	176,396
Adjusted R^2	0.050	0.155	0.163	0.072	0.200	0.211

Notes: OLS linear models. Standard errors are clustered on ethnic groups within former colonies. Individual controls consist of the number of HH members and children, both linear and squared. Geographical controls consist of households distance to the coast, border, and the closest navigable river (all logged), the local altitude and slope, mean annual temperature, precipitation and evapotranspiration, the ratio of the two, and the local suitability for agriculture. Ethnic controls consist of groups' dependence on argiculture and husbandry as well as the intensity of agriculture. Geographical controls are interacted with the level of precolonial centralization, ethnic controls with the cash crop suitability score. Significance codes: *p<0.1; **p<0.05; ***p<0.01

F.2 Per capita nightlight emissions

Table A17: Indirect rule, cash crops, and contemporary nightlight emissions

	Nightlights per capita (1992–2013; log)					
	British colonies			French colonies		
	All	Rural	Urban	All	Rural	Urban
	(1)	(2)	(3)	(4)	(5)	(6)
Precol. centr. (PCC)	−1.477	−0.501	−0.390	−0.586	0.229	−2.123**
	(0.931)	(0.668)	(0.848)	(0.593)	(0.673)	(1.035)
Cash crop suit. (CCS)	1.909	2.741**	−1.006	3.725*	2.413	−1.035
	(1.290)	(1.162)	(1.165)	(2.142)	(1.880)	(2.910)
PCC × CCS	0.537**	0.497**	0.302	−0.053	−0.364	−0.219
	(0.248)	(0.203)	(0.332)	(0.253)	(0.244)	(0.407)
Former colony FE	yes	yes	yes	yes	yes	yes
District controls:	yes	yes	yes	yes	yes	yes
Geo. controls:	yes	yes	yes	yes	yes	yes
Ethn. controls:	yes	yes	yes	yes	yes	yes
Mean DV:	-5.4	-5.6	-4.5	-4.7	-4.8	-4.6
Observations	2,107	1,918	1,031	1,767	1,687	825
Adjusted R^2	0.657	0.720	0.604	0.817	0.810	0.661

Notes: OLS linear models. Standard errors are clustered on districts' modal ethnic group. District controls consist of their area, and their rural and urban poplation (in 2000; logged). Geographical controls consist of districts' distance to the coast, border, and the closest navigable river (all logged), the average altitude and slope, mean annual temperature, precipitation and evapotranspiration, the ratio of the two, and the local suitability for agriculture. Ethnic controls consist of groups' dependence on argiculture and husbandry as well as the intensity of agriculture. Geographical controls are interacted with the level of precolonial centralization, ethnic controls with the cash crop suitability score. Significance codes: *p<0.1; **p<0.05; ***p<0.01

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