Where Local Kings Rule: Long-Term Impacts of Precolonial Institutions and Geography on Access to Public Infrastructure Services in Nigeria [*]

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Abstract

Although previous works have discussed the benefits of precolonial centralization for development in Africa, the findings and the mechanisms provided do not explain the heterogeneity in access to public services of formerly centralized states. Using new survey data from Nigeria, I find a significant negative effect of centralization on access to certain public services in centralized regions whose leaders failed to comply with the autocratic federal regime, and whose jurisdictions were subsequently punished by underinvestment in these services, with lasting impacts till today. The results are robust to extensive controls and instrumenting for precolonial centralization with an ecological diversity index.

JEL classification: O10, O43, N37, P48

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1 Introduction

Institutions matter for economic development. The institution that has generated most of the interest in the recent literature is political centralization of precolonial states[1]. Recent studies have documented a positive relationship between public goods provision and economic development in African countries and the centralization of their ethnic groups' precolonial state (Gennaioli and Rainer, 2007; Michalopoulos and Papaioannou, 2013). Despite increased evidence on the importance of precolonial centralization for development outcomes in Africa, relatively little is known about why and how centralization matters for development. Additionally, there are no studies to date which explain the heterogeneity in current outcomes of previously centralized states. Correctly identifying the mechanisms through which precolonial centralization might affect current development is particularly important given the persistence of many of these institutional arrangements in African countries (Acemoglu, Reed, and Robinson, 2014).

In this paper, I use new survey data[2] on infrastructure provision at public primary schools in Nigeria, historical analysis and anthropological data on precolonial centralization to identify these mechanisms and explain why the homelands of some historically centralized states have the worst public service access rates today. For example, many areas in present-day Northeast and Northwest Nigeria, including the current states of Bauchi, Borno, Gombe, Kebbi and Kaduna, to name a few, shown in Figure 1a were part of centralized, so called, ethnic states in the precolonial era[3] and have some of the poorest development outcomes in the country today (Archibong, 2016). Two questions posed in this study are then, "what could explain this 'reversal of fortunes' of formerly centralized states if centralization has strong positive associations with current development as posited in the previous literature?" and "what does this 'reversal' tell us about why and how precolonial centralization matters for current development?"

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[1]Where "precolonial" is presumed to be circa 1850 in Africa, and centralization is defined as a proxy for political complexity and a measure of state sovereignty. A simple measure of precolonial centralization is an indicator for the presence of a state sovereign around year 1850 (Michalopoulos and Papaioannou, 2013; Obikili, 2016). Details about the measure are provided in Section 4.

[2]In Archibong (2016), I repeat the analysis using DHS survey data over 1990-2013, with the results remaining largely unchanged. See section 4 for details on the data collection and data choice for this paper.

[3]Namely the Hausa and Bolewa precolonial ethnic states in present-day Bauchi, the Kanuri in present-day Borno, the Bolewa in present-day Gombe, the Hausa and Reshe in present-day Kebbi and the Hausa in present-day Kaduna.

The findings presented here, showing a nonlinear relationship between precolonial centralization and the provision of certain public services currently, are contrary to the existing literature which has emphasized the positive relationship between precolonial centralization and current development outcomes. In contrast with the current literature, results suggest that the mechanism through which precolonial centralization impacts current public service provision is not "local accountability" as posited in previous research (Gennaioli and Rainer, 2007; Herbst, 2014) but through payoffs from compliance under bargaining between leaders from centralized ethnic states and federal autocratic regimes. In other words, the reason why precolonial centralization matters at all for current development outcomes is that centralized states, which by definition possessed an identifiable sovereign in contrast with their non-centralized counterparts, had leaders that were able to bargain with federal regimes for access to public services whose allocation the federal regime could directly control.

Under a simple conceptual framework of bilateral bargaining between local ethnic state leaders and federal autocratic regimes, leaders that were compliant with federal regimes were able to bargain successfully for access to these public services for their regions. When local leaders were non-compliant or rebelled against the federal regime, they were "punished" by underinvestment in these services[4]. I hypothesize that a testable implication of this framework is that members of groups from areas subject to the punishment regime should have relatively less trust in federal institutions as compared to their own traditional institutions today. Another testable implication is that, following the literature on ethnic favoritism (e.g., Alesina, Baqir, and Easterly (1999); Easterly and Levine (1997); Hodler and Raschky (2014)), the effects of the punishment by the federal autocrat should be mitigated by having an autocrat originate from the same region as the non-compliant local leader (referred to as being a "favored" state here).

The first set of empirical results focuses on access to public energy and health infrastructure. Public infrastructure services are categorized according to federal or local administration and the degree of federal control over administration as shown in Figure 2. Note, the grouping of goods into federally and locally administered categories reflects policy choices made by the federal government

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[4]This framework is similar to the "punishment regime" described in Magaloni (2006).

rather than any technological capacity for provision of the public service at the local or federal levels[5]. While being a centralized, compliant ethnic state is strongly associated with a 6 to 13 percentage points increase in access to grid based electricity and a 2.4 to 7 percentage points increase in access to flush toilets depending on favored status (From relatively low bases: 13 percent and 12 percent for grid based electricity and flush toilet access respectively), being a centralized, non-compliant ethnic states is associated with a significant decrease in access to electricity and flush toilets by 1 to 4 percentage points and 2 to 3 percentage points respectively, depending on favored status. I also find that individuals belonging to ethnic groups that were part of ethnic states exposed to the punishment exhibit lower levels of trust in federal institutions over traditional/local institutions today.

Though I find a robust negative relationship between precolonial centralization and federally controlled public services for states identified as non-compliant with the military government in particular, these findings might not be taken as conclusive evidence that punishment from federal autocratic states caused the heterogeneity in access to public services among formerly centralized states. An alternative hypothesis is that precolonial centralization might be correlated with unobserved ethnic state characteristics, resulting in biased estimates of the nonlinear effect of precolonial centralization on access to public services.

To better understand the reason behind the nonlinear relationship between precolonial centralization and access to federally controlled public services, I investigate numerous strategies. First, following Nunn (2008), I review the evidence from African historians on the relationship between

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[5]Figure 2 captures a snapshot of administration and control of goods in the 2012 period in which the survey data was collected. This analysis has been repeated using less extensive DHS data from 2008 and 2013 with similar results in Archibong (2016). The classification of 'medium' or 'high' for federally administered goods reflects direct investments made and the length of time the good has spent under federal state control. So high state control goods like grid based power access reflect investments made from starting in 1886 and largely in 1950 through the present and flush toilet access reflects investments made largely around 1977 through the 1980s in Nigeria by the federal, most notably military, regime. On the other hand, medium federal state control goods like immunization availability have been mostly administered by the local government (LGA), with exceptions; a notable one being in 2012, the year of our survey data, where the federal government spearheaded administration of immunization availability with the first ever national vaccine summit hosted in this year (Erchick and Wonodi, 2012) and directly solicited ethnic state/traditional leaders' participation/compliance in ensuring maximum availability of the vaccines. Locally administered services like pit latrine access and most water access at public primary schools have generally been under the responsibilities of the LGA in Nigeria and offgrid access at public primary schools, our primary unit of observation, would also fall under the general purview of the LGA authority as well.

ethnic state leaders and federal autocratic regimes through the colonial and postcolonial eras. I use historic data on taxation to understand the relationship between centralized states and federal regimes in regards to the provision of public services. The evidence shows that bargaining between ethnic state leaders and federal regimes for access to federal goods was emblematic of the relationship between these parties. Second, using the historical evidence as a guide, I construct a measure for compliance and non-compliance of ethnic state leaders that allows me to show significant, robust negative effects of non-compliance on access to federally controlled services for centralized states. I also adapt Fenske (2014)'s ecological diversity index and use it as an instrument for precolonial centralization in alternate specifications. The IV coefficients are qualitatively identical to the OLS coefficients, supporting the results of a nonlinear relationship between precolonial centralization and access to federally controlled public services. I also conduct a number of falsification tests, evaluating alternative hypotheses regarding the role of other socioeconomic and environmental factors in explaining the results.The results support the conceptual framework and provide strong evidence for the persistent, nonlinear effects of precolonial centralization on current economic development in Africa through the mechanism of compliance/reward and non-compliance/punishment between ethnic state leaders and federal autocratic regimes.

These findings add to the understanding of the role of historical institutions in determining persistent within country group based inequality and contribute to the literature on the long-term impacts of precolonial centralization for development (e.g. Gennaioli and Rainer (2007); Michalopoulos and Papaioannou (2013); Osafo-Kwaako and Robinson (2013); Alsan (2015); Fenske (2014); Papaioannou, Dalrymple-Smith et al. (2015); Bandyopadhyay and Green (2016)). The conceptual framework presented here contributes relevant insights into the logic of public service provision under authoritarian regimes, with general applications for states outside of Africa as well. The paper also contributes to the general social science literature on the persistent impacts of historical institutions (North, 1990; Acemoglu, Reed, and Robinson, 2014; Acemoglu, 2001; Falola and Ogundiran, 2005; Herbst, 2014; Mamdani, 1996; Man, 1988; Iyer, 2010), and Acemoglu, Johnson, and Robinson (2002)'s work on the "reversal of fortunes" thesis. The paper is also related to a growing literature on the determinants of social capital in Africa (Nunn and Wantchekon,

2011).

The organization of the rest of the paper is as follows. Section 2 provides some historical background, and Section 3 presents a simple conceptual framework following from the historical account. Section 4, describes the data, methods and empirical specification used in this study. Section 4.4 includes robustness checks for omitted variable bias using an instrumental variable approach. Section 5 examines the nonlinear effect of precolonial centralization on federally administered goods. Section 6 examines alternative hypotheses. Section 7 concludes.

2 Historical Background

2.1 Ethnic State Leaders, British Colonial Autocrats and Public Service Provision

An extensive literature has explored the impacts of British and French colonialism on modern development outcomes in Africa through the relationship between colonizers and local elites (Acemoglu, 2001; Herbst, 2014; Mamdani, 1996; Nunn, 2008). Following the literature and historiography, the relationship between the ethnic state leaders and federal autocratic regimes can be conceptualized as two distinct but related sequential move games corresponding to two distinct but related historical periods- the colonial era and postcolonial era [6]. The first period, described in this section, marks a game between the British colonial autocrats and local elites in the form of ethnic state leaders spanning the years, 1885-1960[7].

Existing local institutional arrangements just prior to British arrival could be classified into two broad types, namely centralized ethnic states, with at least one identifiable state sovereign and non-centralized states (so called "stateless societies") with no identifiable state sovereign as shown in Figure 1c (Falola and Ogundiran, 2005; Murdock, 1967; Obikili, 2016). The region that became Nigeria began as two separately administered colonies under British control. In the south,

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[6]There is some debate about the distinctness of these two categories among historians (Falola and Ogundiran, 2005; Mamdani, 1996), but for simplicity, they are referenced as two separate but related periods here

[7]The 1885 date marks the Conference of Berlin to partition African states among European colonizers. The British first set up government in Nigeria in 1861 with the colony of Lagos. By 1885, this colony had extended to include the coastal areas including the Oil Rivers Protectorate and the interior named the Niger Coast Protectorate in 1893 (Hicks and Phillipson, 1951)

there was the Colony and Protectorate of Southern Nigeria and in the north, the Protectorate of Northern Nigeria. Both regions were amalgamated into what became the Colony and Protectorate of Nigeria in 1914 under the Governor-Generalship of Sir (and later Lord) Frederick Lugard (Hicks and Phillipson, 1951). A primary goal of Sir Lugard was to maintain internal stability in the new colony, while minimizing costs to the "British taxpayer", by promoting revenue raising activities like taxation, trade and the related construction and expansion of the railway system which was labeled "a principal project of development" (Lugard, 1968).

To accomplish this goal, Sir Lugard proposed a system of decentralized British rule through local ethnic state leaders known as indirect rule (Lugard, 1968; Okauru, 2012). He firmly believed in the superiority of direct taxation in maintaining internal stability (Lugard, 1968; Hicks and Phillipson, 1951; Okauru, 2012). Key to the functioning of this system was that when an ethnic state leader could be found[8] (as in a centralized state), they could be "convinced" to comply with the mandate of British rule. The form of this convincing, prior to 1900, most often took the form of violent suppression of ethnic state leaders or kings who rebelled against British authority, usually by staging uprisings[9]. Punishment of these uprisings was swift and often brutal, with leaders deposed, beheaded and or exiled as deterrence for future non-compliance[10]. Once the centralized ethnic state leader "complied", a "pacifist" approach involving correspondence and negotiations with the British on issues of local governance became the dominant strategy (Ogbomo, 2005). This system became known as the Native Administration system with the ethnic state leader becoming an official representative of local government known as a "Native Authority" under indirect rule (Mamdani, 1996).

Key to signaling compliance with the British autocrats was that the ethnic state leader worked to maintain Lugard's desired internal stability, in particular, by collecting tax revenue

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[8]When a leader could not be found, an individual, sometimes from another ethnic area and with no cleavage to the community to which he was assigned and who was essentially direct agent of the colonial government, known as a "Warrant Chief" was assigned to that area (Mamdani, 1996; Okauru, 2012).

[9]Two notable examples are the oppositions led by King Jaja of Opobo and Oba Ovonranmwen of Benin in 1897 (Ogbomo, 2005).

[10]The bloody, destructive "punitive expedition" of 1897 deposing the king of the Benin empire, Oba Ovonranmwen, and looting the empire of artifacts, many of which remain in Britian till this day, is one memorable example (Ogbomo, 2005; Otoide, 2005).

for the regime (Frankema, 2011; Gardner, 2012; Hicks and Phillipson, 1951; Lugard, 1968). In exchange for compliance, the ethnic state leader was granted the benefit of increased political autonomy in their region through control of police, courts of law and access to a salary from the Native Treasury[11] (Hicks and Phillipson, 1951; Lugard, 1968). They could also, and did, bargain for access to aforementioned "principal project[s] of development" executed by the British regime like the railroad system[12] (Ayoola, 2006).

While the above account gives a general overview of the relationship between the British autocrats and the centralized state leaders during this period, there was significant heterogeneity in British relations with the centralized northern versus southern ethnic states of the colony. Almost a century before British arrival, there existed in the north, the Sokoto Caliphate, an Islamic empire founded in 1809 by Usman dan Fodio's jihad (the extent of the Caliphate is shown in Figure 1d). The Caliphate had a very sophisticated system of direct taxation and an impressive bureaucracy based on Islamic law and enforced by local kings or Emirs[13]. In contrast, the southern states exhibited more heterogeneity in their fiscal capacities, with capacities ranging from the reasonably organized bureaucracies of the Oyo Empire in Yorubaland to the more decentralized community fee systems of the Igbo (Okauru, 2012). Lugard was so impressed with the high bureaucratic tax capacity of the Muslim north's Sokoto Caliphate, that he crystallized the direct taxation system into law in the Muslim north, with the Native Revenue Proclamation No. 2 of 1906[14]. Although direct taxation was introduced in the south by 1928, nevertheless, the combination of a less sophisticated tax bureaucracy, proximity to the coasts and access to seaport trade, meant that custom and excise duties were more prevalent and profitable as forms of taxation in the region (Okauru, 2012; Gardner, 2012; Frankema, 2011). Consequently, while direct taxation was a smaller[15] but significant share

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[11]Crystallized in a series of legislations starting with the Native Courts Proclamation in 1900 and followed by the Native Revenue Proclamation in 1904

[12]Most famous of these bargains was with the northern ethnic state leaders for the extension of the railway to their region in the Bornu area started in the 1950s and concluded in 1964 with a 400 mile extension of the railway to the region. See Ayoola (2006) for details.

[13]Some examples of taxes included "the *Kurdin kasa* (an agricultural tax on non-Moslems), *Khanraj* (a Moslem community tax), *Gausua* (festival present), *Gado* (death duties which amounted to confiscation of the estate), *Haku Binerum* (graduated income tax in Bornu), and *Jangali* (cattle tax)." (Okauru, 2012).

[14]Okauru (2012).

[15]Direct taxes were about 24% of overall tax revenue from 1933-1956 and about 16% of total government revenue in the same period.

of both overall tax revenue and total government revenue during the colonial period, as shown in Figure 3, direct taxation played a more significant role in the north where over 40% of regional tax revenue was from direct taxes as compared with 14% in the south over the 1948 to1950 period as shown in Figure 4.

Given Lugard's conviction in the power of direct taxation for internal stability, he was eager to secure compliance of the Muslim north's ruling elite. To accomplish this, he bargained with the centralized leaders of the high majority Muslim north, to pursue a policy of complete non-intervention in their region particularly "in matters of religion or tradition" (Dudley, 2013; Mustapha, 2006). This doctrine, of increased hegemonization of authority of the centralized, northern Emirs, was institutionalized in the Native Authority Proclamation of 1907, and marked a break and augmentation of the authorities of these centralized ethnic state leaders relative to the 1850, precolonial period [16]. As a consequence of the bargain between the centralized Muslim Emirs and Lugard, missionaries and accompanying mission schools were discouraged and actively prohibited from entering Muslim northern territory[17]. In contrast, in the southern and non-Muslim states, the spread of Christian missionaries bringing Western education led to the rise of a new educated, political elite that subsequently began to challenge the right to rule of their Native Authority leaders and agitate for more political authority within the colonial system[18]. By 1950, as independence drew near, the southern states and their less Muslim northern counterparts had largely received their wish, as democratically elected "local government councils" replaced the Native Authority system in the south through decree of the Local Government Ordinance of 1950. The Ordinance relegated southern centralized ethnic state leaders to ceremonial, advisory roles in a near complete erosion of

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[16]While the Emirate system, for example, was highly hierarchical, there had existed "various middlemen" in the "traditional", precolonial system who acted as checks for the power of the Emir (Dudley, 2013; Mustapha, 2006). With the hegemonization of Emirate authority, these middle men had their posts abolished, leading to unprecedented, near despotic levels of power afforded to Emirs among the centralized leaders of the majority Muslim north, and prompting FW de St Croix to remark that "Not only was the authority of the Emir unchecked by his Council,...,the Emir quickly became an absolute ruler" (Dudley, 2013).

[17]Reporting on Lugard's views, one report states he thought education was a divisive influence that "had produced men discontented, impatient of any control and obsessed with their own importance" and he was suspicious and often critical of the role of the education of Christian missionaries in spurring revolt against the Native Authority system and disturbing the internal stability of his colony (Dudley, 2013; Mustapha, 2006; Lugard, 1968).

[18]Thus proving that Lugard's fears about the dangers of education were not unfounded, (Dudley, 2013).

political autonomy[19]. Meanwhile, a countervailing movement ensued in the high majority Muslim northern states as further hegemonization of authority in the hands of centralized state leaders was crystallized in the Native Authority Law of 1954. The Law further consolidated power in the hands of high majority Muslim Emirs and allowed for the introduction of justice systems based on Sharia law (Dudley, 2013; Tonwe and Osemwota, 2013).

By the end of the colonial era and independence in 1960, there were two sets of centralized ethnic state leaders in Nigeria: one set in the high majority Muslim north, where Emirs were afforded near absolute power over their jurisdictions under the Native Authority system and another in the south and non-high majority Muslim north where more democratic systems of local governance had emerged to erode the authority of centralized ethnic state leaders in the area. At this time, investment in large scale public infrastructure like electricity by the British was minimal and largely catered to the needs of British residents with the notable exception of the railroad which was completed under colonial oversight in 1964 (Frankema, 2011; Ayoola, 2006). In Section 2.2, I make the case for why these hegemonized- centralized and high majority Muslim (referred to as supermajority Muslim leaders here) - leaders were more likely to choose non-compliance to subsequent military policy in the post-independence period.

2.2 Ethnic State Leaders, Military Postcolonial Autocrats and Public Service Provision

The eviction of the British in 1960, after the discovery of oil in 1956, preceded a brief democratic period from 1960 to 1966, followed by a civil war from 1967 to 1970 partly over the control of oil resources in the country that highlighted tensions between federal and subnational governing authorities[20]. This was followed by military rule for most of the next three decades until 1999. The oil boom and huge windfalls for the military regime in the 1970s shifted the structure of federal

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[19]Dudley (2013); Mustapha (2006).

[20]The case of a mostly Igbo led secession in the state of Biafra is well studied in the literature and beyond the scope of this paper. It is interesting to note that the Igbo as members of a centralized but non-hegemonized ethnic state present an interesting case of where punishment fails even in the presence of short-term rebellion from a non-hegemonized state, given the inability of autocratic regimes to reliably monitor and target punishment in non-hegemonized states.

revenue from an agricultural tax base to over 80% from petroleum as shown in Figure 3. This stream of new revenue transformed the tax base, elevating direct taxation, through the petroleum profit tax, above custom duties as the main source of tax and government revenue. It also spurred significant investments in public infrastructure services particularly in the area of electricity and certain sanitation services[21]. The military regime also made significant investments in improving public primary education, passing the 1976 Universal Primary Education (UPE) scheme to expand primary education enrollment in the country(Csapo, 1983). Figure 7 illustrates the effect of the UPE which played a significant role in doubling the total number of schools post the 1976 period.

Also notable during this period, were the military's attempts at slow erosion of the Native Authority system among the hegemonized, centralized states of the supermajority Muslim north through military officials who wanted to consolidate power and feared the political influence of the Emirs (Mustapha, 2006; Tonwe and Osemwota, 2013). In light of these efforts, the military period has been described as "traumatic for Muslim establishment of northern Nigeria" (Hickey, 1984). At no point was this "trauma" more evident than during the complete demolition of the Native Authority system by decree of the 1976 Local Government Reform law that removed centralized ethnic state leaders from politics and virtually banned them from participation in now democratically elected local governments (Mustapha, 2006; Tonwe and Osemwota, 2013). The law also established the Local Government Area (LGA) as the smallest constitutionally acknowledged unit of local administration in the country and shafted ethnic state leaders to mere advisory roles[22]. The break was "traumatic" for the rule of the Emirs particularly under the centralized, supermajority Muslim states where they had enjoyed near absolute levels of autonomy over their territories for almost a century under British colonial policy. Predictably, the move spurred enormous opposition from ethnic state leaders in these states typified by a slew of uprisings that followed, peaking in the 1980s with the Maitatsine riots[23](Hickey, 1984; Tonwe and Osemwota, 2013). Among centralized ethnic state leaders in the south and less Muslim north however where, as previously mentioned,

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[21]Flush toilets through a direct grant program (Uduku, 1994).

[22]Sometimes less, in some cases (Mustapha, 2006; Tonwe and Osemwota, 2013).

[23]That spilled into the present day states of Kano, Borno and Kaduna. Figure A.4 in the Appendix shows the peak in riot mentions in the literature published and available on Google's database at the time post the 1976 policy.

previous laws had already greatly eroded the powers of centralized leaders, there was little or no opposition to the 1976 law (Hickey, 1984; Tonwe and Osemwota, 2013; Mustapha, 2006).

The new petrol fueled fiscal independence of the military government also meant that, unlike their British counterparts who relied heavily on tax revenue from agricultural commodities and so worried about securing compliance from the centralized ethnic state leaders through the Native Authority system, the military autocrats had less incentive to actively attempt to secure compliance from the centralized, supermajority Muslim rulers through violent suppression in the aftermath of rebellions (Hickey, 1984; Tonwe and Osemwota, 2013). The new autocratic strategy to deal with non-compliance of these ethnic state leaders was a not-so benign neglect of jurisdictions ruled by non-compliant Emirs, typified by underinvestment in infrastructure services whose allocation the military could directly control[24] (Tonwe and Osemwota, 2013; Mustapha, 2006; Blench et al., 2006).

3 Conceptual Framework: Precolonial Centralization, Hegemonization and Non-compliance

The sections below outline a simple conceptual framework driving the empirical specifications and results in this paper. The relationship between ethnic state leaders and the federal autocratic regimes can be conceptualized as two distinct but related sequential move games: Game 1 (during the colonial era, spanning years 1885 to 1960) and Game 2 (during the military era, spanning years 1966 to 1999) . A more parametric specification of this framework is provided in the Appendix.

3.1 Game 1: Sequential-Move Game Between the Ethnic State Leaders (P2) and the British Colonial Autocrats (P1)

The game tree in Figure 5 depicts the outline of a sequential move game (i.e. Game 1) between the British colonial autocrats (denoted as Player 1 or P1) and the ethnic state leaders (Player 2 or P2) lasting from 1885 to 1960. P2 can be from two types of ethnic states defined below:

- I_1= centralized ethnic state in Game 1 (denoted as $Cent_e$= 1 in the empirical specification, includes both $S.Mus_e$= 1 and $S.Mus_e$= 0 populations)

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[24]E.g. grid based electricity investments and the cash grants for flush toilets infrastructure.

- II_1 = non-centralized ethnic state in Game 1 (denoted as $Cent_e = 0$ in the empirical specification, includes both $S.Mus_e = 1$ and $S.Mus_e = 0$ populations)

"Nature" (or ecological diversity as indicated in this paper) determines P2's type. If P2 is of type II_1, the game ends with null payoffs, since bilateral bargaining under a strict form of indirect rule is impossible without an identified sovereign. If P2 is of type I_1, the game proceeds as depicted in Figure 5 with P1 as the initial mover in the first stage. Note, that both centralized and non-centralized states have supermajority and non supermajority Muslim populations.The payoffs of the game are determined by a bilateral bargaining and reward/punishment scheme between the British colonial autocrats and the centralized ethnic state leaders. The British autocrat chooses to set a fiscal policy, like a tax, or not set the policy[25]. The centralized ethnic state leader can then choose to comply or not comply with the fiscal policy. When the centralized ethnic state leaders were compliant with British colonial autocrats, they were rewarded with some proportion of federal benefits (e.g. in terms of public service provision like railroad construction and increased political autonomy in their region). When the centralized ethnic state leaders were not compliant with the British colonial autocrats, they were punished by a withdrawal of these benefits (e.g. forfeited autonomy through bloody depositions and exiles). The proposition here is that in Game 1, the equilibrium outcome was that the British set the tax and centralized ethnic state leaders chose to comply following the account presented in Section 2.1[26].

3.2 Game 2: Sequential-Move Game Between the Ethnic State Leaders (P2) and the Military Postcolonial Autocrats (P1)

The game tree in Figure 6 depicts the average payoffs of a sequential move game (i.e. Game 2) between the military postcolonial autocrats (Player 1 denoted as P1) and the ethnic state leaders (Player 2 denoted as P2) lasting from 1966 to 1999. Proceeding from Game 1 and following differential British policy between the Muslim north and the south of the country, P2 can be from

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[25] A historically imaginary counterfactual, in which case the game ends with some expected payoffs for both players- (A_{11}, B_{11}).

[26] Although, I have no micro data on riots and rebellions from the colonial era, we can examine the results on access to railroads to see if indeed, as predicted by the framework, centralized states have better access to railroads. It turns out they do.

two types defined as below:

- $I_2|I_1$ = hegemonized ethnic state in Game 2 given was centralized in Game 1 (denoted as $S.Mus_e$ = 1 and $Cent_e$ = 1 in the empirical specification)

- $II_2|I_1$ = non-hegemonized ethnic state in Game 2 given was centralized in Game 1 (denoted as $S.Mus_e$ = 0 and $Cent_e$ = 1 in the empirical specification)

Differential British policy, as outlined in Section 2.1, between the high majority Muslim north and the south of Nigeria led to strengthening of sovereignty among centralized ethnic state leaders in the Muslim north of the country, a process termed hegemonization here. It led to erosion of political autonomy among centralized ethnic state leaders in the south of the country, a process termed non-hegemonization here. Centralized ethnic state leaders in the south[27] were eventually replaced by mostly democratically elected local officials, marking a gradual to near complete loss of sovereignty in their regions by the beginning of the military era with the reverse process occurring in the Muslim north as a result of differential British policy towards both regions as described in Section 2. It was the policy that determined Player 2's type in Game 2.

If P2 is already non-hegemonized then the player has no ability to enact a legal transfer of autonomy to the military autocrat and drops out of the game with some payoff based, partly, on net benefits in Game 1. In the first stage of Game 2, the military autocrat (P1) moves, choosing a legal transfer policy instrument, the 1976 LGA policy here, or not[28]. If the hegemonized ethnic state leader chooses to comply, the expected payoff to the military autocrats is the sum of the political autonomy transferred from the ethnic state leader to the military autocrat, some proportion of the initial wealth and government revenue minus the proportion spent on public benefits or public service provision. The expected payoff to the hegemonized ethnic state leader is the public service provision issued from the military autocrat minus the political autonomy given up, along with the proportion of initial wealth and government revenue given up by the ethnic state leader with the relinquishing of their position as an official local government representative.

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[27]Including the non "super-Muslim" north.
[28]In the ahistorical counterfactual.

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If the hegemonized ethnic state leader chooses not to comply under the legal policy regime, the non-compliant hegemonized ethnic state leader receives an expected payoff of his withheld political transfer and initial wealth minus the withheld public services (or plus a punishment) from the federal regime. The proposition here is that in Game 2, the equilibrium outcome was that the military set the 1976 LGA policy and hegemonized ethnic state leaders (centralized and supermajotrity Muslim leaders) chose not to comply with the policy and incurred a punishment in the form of underinvestment in tightly federally controlled infrastructure services like grid-based electricity. This explains the negative effect viewed for centralized, supermajority Muslim states in the empirical specifications. It also explains the result on trust where residents today from previously "punished" areas have relatively less trust in federal institutions over their traditional or local institutions. I also test the sensitivity of the punishment effect to being a favored state or state where a military president originated from.

4 Data Construction and Empirical Framework

4.1 Data on Precolonial Centralization and Pre-Independence Hegemonization

Today, Nigeria is a federation made up of a democratically elected federal government and 37 administrative "states", or officially 36 administrative states [29] and a Federal Capital Territory (FCT) at Abuja. The states can be further subdivided into 6 geopolitical zones, broadly categorized under the geopolitical North and South, as shown in Figure 1a, with zones strongly correlated with current and historic ethnic group location as shown in Figure 1b[30]. The states can be further subdivided into 774 Local Government Areas (LGAs), the smallest administrative unit in the country[31], which was created by federal military mandate in 1976 to replace the ethnic state leaders as the official arm of local governance in the country. The other level of political geography this paper discusses are the ethnic states delineated in Figure 1c below, showing the ethnicity based

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[29] As mandated by the 1999 constitution.

[30] Broadly, the North-West is dominated by the Hausa and Fulani ethnic groups, the North-East is largely populated by the Kanuri ethnic group, the South-West is dominated by the Yoruba ethnic group, and the South-East is dominated by the Igbo ethnic group. The Ijaw/Edo/Bini/Ibibio weakly dominate the SouthSouth zone while the North-Central is home to the Tiv, Nupe and other smaller ethnic populations (Archibong, 2016).

[31] Its equivalent is outlined in grey in 1a.

state formations c. 1850 (Michalopoulos, 2012; Obikili, 2016; Murdock, 1967).

The data on precolonial centralization used in this study comes from George Murdock's (1967) Ethnographic Atlas showing the spatial distribution of ethnicities across Africa during the mid/late 19th century (Michalopoulos, 2012; Obikili, 2016). Murdock's map includes 843 ethnic areas, 117 of which are contained within the boundaries of present day Nigeria. There is a significant correlation (about .7) between location of Nigerian respondents to the Afrobarometer in 2012 and 2008 and ethnic group location as identified in the Murdock map[32]. 1415 new LGA-Ethnic state partitions are created by intersecting the location of Nigeria's 774 LGAs with Murdock's ethnic state partitions. Murdock's atlas includes 60 variables capturing cultural, geographical and economic traits of 1270 ethnicities around the world. Following Michalopoulos (2012) and Gennaioli and Rainer (2007), precolonial political institutions are proxied using Murdock's (1967) "Jurisdictional Hierarchy Beyond the Local Community Level" . The "jurisdictional hierarchy" is defined in detail by Murdock as the number of:

"sovereign organizations' [with some level of] definitive jurisdiction over some sphere of social life in which the organization has the legitimate right to make decisions having a significant effect on its members, e.g., distribution of food, allocation of productive resources, punishment of delicts, assignment or conscription of labor, levying of taxes, [or] initiation of war or peace'[33](Obikili, 2016)."

The "Jurisdictional Hierarchy Beyond the Local Community Level" variable is, what he terms, an index of "political complexity" (described here as the precolonial centralization index) which assigns a score between 0 to 4 to each ethnic state unit and describes the number of political jurisdictional hierarchies above the local community level for each unit. The score is defined as follows: 0: so-called 'stateless societies',"lacking any form of political organization", 1 and 2: petty and larger paramount chiefdoms, 3 and 4: large, more organized states as shown in Figure 1c.

Precolonial centralization data is available for 61 of the 117 ethnic states within Nigeria, or

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[32]Nunn and Wantchekon (2011) confirm a significant correlation (about .55) between location of respondents to the Afrobarometer in 2005 and ethnic group location as identified in the Murdock map in the Africa wide sample.

[33]Murdock, 'Ethnographic atlas', p. 269

945 LGA-Ethnic state units in the country and the maximum precolonial centralization score within Nigeria is a 3, represented by large states like the Yoruba and the Edo. Michalopoulos (2012) has provided a cross-validation of Murdock's precolonial centralization index in Africa through a study of African history and this is confirmed here through a survey of the Nigerian historiography on levels of political complexity among precolonial ethnic states (Falola and Heaton, 2008; Falola and Ogundiran, 2005)[34]. The main measure of precolonial centralization used here is an indicator that assigns a score of 0 to "0" coded societies (specified as non-centralized) in the Murdock specification and 1 (specified as centralized) to any ethnic states with scores above 0 and captures any degree of centralization in the sample[35].

To get a measure of pre-independence hegemonization, as outlined in Section 2, the percentage of the Muslim population in each administrative state as of 1952[36], right before independence, is used to create a supermajority Muslim indicator where states are assigned a score of 1 if they have a population of greater than 70% in the upper quartile of the percent Muslim distribution and 0 otherwise[37]. In alternate specifications, an indicator for "no military president" is included as a measure for 'non-favored' status. The indicator assigns 1 ('non-favored') to the area if no military president originated from the state between the 1976-1999 period under which the punishment regime would have been enacted, post the setting of the 1976 LGA policy. Areas with "no military president" are shown in Figure 8b. Figure 8a shows the distribution of the identified supermajority Muslim areas.

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[34]For example, the Yoruba and Edo, who score a 3 on Murdock's index are consistently identified as large, centralized groups in the late 19th century period. The Igbo, who score a 1 on the Murdock indicator with low levels of centralization are identified as having sub-states with more centralized systems, like the trading states of the Aro oligarchy in the 17th-18th centuries (Falola and Ogundiran, 2005).

[35]Some results remain significant when alternate specifications of the centralization index are used, using the binary variable or the full index from Murdock (1967). This specification of the indicator is in contrast with the one used in some of the previous literature as it seems to more appropriately captures the importance of having any identifiable sovereign for the purpose of the indirect rule compliance/non-compliance relationships described in Section 2.1.

[36]Source: Ostien (2012).

[37]The choice of a 70% cutoff is not arbitrary. First, in the multilevel model shown in the robustness checks, when the coefficient on centralization is allowed to vary by administrative state, a notable portion of states where the coefficient turns negative are states resting in the greater than 70% Muslim cutoff, though the results from the model are interpreted with caution due to low power. Second, states in the upper quartile of the percent Muslim distribution are most likely to fit the description of the hegemonized states through the process described in Sections 2.1 and 2.2 and this is confirmed in the historiographic literature. The distribution of the Muslim population by region remained stable through the colonial era. There is a significant correlation of .95 ($p < .01$) between the Muslim population in 1932, the year of the earliest available colonial census, and 1952 used in this study.

4.2 Dependent Variables: Measures of Infrastructure Access, Public Health and Trust

In an effort spearheaded by the Nigerian government, researchers from the country's Office of the Senior Special Assistant to the President on MDGs (OSSAP) in collaboration with the Sustainable Engineering Lab at Columbia University conducted extensive, comprehensive surveys of schools and health facilities at LGAs, receiving responses to questions on power, water and sanitation access, among other indicators, over a 1 year period closing in 2012 (OSSAP, 2012). The surveys were collected from principals in 68,627 schools and over 30,000 health facilities across the 774 LGAs in Nigeria[38]. About 80% of schools surveyed were primary schools, with 86% of the sample from public schools[39]. According to the Nigerian National Bureau of Statistics and the Federal Ministry of Education, there were 69,979 public primary schools in Nigeria as of 2010, so our school sample represents about 70% of the full population[40]. The results remain largely unchanged when only the public primary school sample is used. The dataset used here is an improvement on the previous survey datasets used in the literature (e.g. Demographic and Health Surveys (DHS)) for two reasons.

First and important for the results presented here, a significant portion of the public primary schools and accompanying infrastructure in this dataset were established post the 1970s in Nigeria with the increase in public spending by the military government during that period as a direct consequence of the 1976 Universal Primary Education (UPE) scheme which sought to expand primary education enrollment in the country[41] (Csapo, 1983; Baba, 2011). Figure 7 illustrates this with a more than doubling in the total number of schools post the 1976 period. The post 1976 numbers stayed high and stable around 35,000 schools through 1989 and represent just over 60% of the number of public primary schools in our dataset. Also, declines in government revenues due to the fall in petroleum prices in the early 1980s meant steep declines in state financing of education

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[38]Sampling was quasi-random, with trained enumerators assigned to data collection in each LGA.

[39]Altogether, public primary schools represent about 70% of the schools dataset.

[40]NBS Annual Abstract of Statistics 2011.

[41]Random sampling of public primary schools across LGAs in Lagos state appears to support this as well: http://lagosschoolonline.com/index.php.

infrastructure (Baba, 2011). Hence, a plausible assumption is that our survey is able to capture a significant portion of the effects of initial direct federal investment in public infrastructure due to the 1976 UPE policy. This is an improvement over indirect measures of public infrastructure investment through household surveys typically used in the literature. Secondly, this dataset provides more detail on certain public infrastructure access/availability metrics[42] not provided by DHS[43].

The construction of the infrastructure access metrics was as follows: for power access, respondents were asked True/False questions about availability and functionality[44]. An aggregate power score of 0 or 1 was assigned to a school depending on if the respondent answered False or True, to the question of whether the respondent had access to functional power from the national grid, functional power from a generator or functional power from a solar system [45]. Similarly, an aggregate sanitation score of 0 or 1 was assigned to a school depending on if the respondent answered False or True to the question of whether the respondent had access to improved sanitation in the form of a functional flush or improved pour flush toilet, or access to a functional improved ventilated latrine or access to a functional pit latrine with a slab. If the respondent responded True to any one of these improved sanitation options, they were assigned a sanitation score of 1, if they responded False to all of the aforementioned options, then they were assigned a sanitation score of 0. For water access, which was potable water access, we assigned an aggregate potable water access score of 0 or 1 to a school depending on if the respondent answered False or True to the question of whether they had access to potable water in the form of functional piped water or functional borehole or tube well water.

Lastly, for each intersected LGA-Ethnic state area, the proportions of schools with individual Grid, Flush, overall Power, overall Water etc scores of 1 were calculated and used as the metric of overall Grid, Flush etc access. Summary statistics for all variables are listed in Tables 1 and 2.

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[42]For example, some data on health facility immunization availability and electricity access (functional availability) by grid and off-grid breakdown.

[43]Analysis is repeated using available DHS data from 1990-2013 with similar results as shown in Archibong (2016).Table 13 in the Appendix shows cross-correlation matrix between the new dataset (OSSAP in 2011-2012) and the DHS dataset from 2013. Table 15 in the Appendix shows a sample of replicated results and more result tables are available in Archibong (2016).

[44]The addition of functionality allows us to proxy maintenance over time.

[45]Power from a generator or solar system are referred to as "offgrid" here.

Note, that "access" refers to available functionality, though strong correlations with LGA-Ethnic mean night light density data as shown in Table 3 suggest that these metrics are a good indication of overall access for the country[46]. Night light density per LGA-Ethnic area is included as a dependent variable and a check in alternate specifications. Available data on child health immunizations and health professional density were similarly calculated for each LGA-Ethnic area. To test the impact of centralization on access to colonial federal infrastructure services, the distance from each LGA-Ethnic state centroid to the railroad, constructed during the colonial period, is used as a dependent variable in falsification tests as well[47].

Also constructed here is a new measure of trust in federal institutions over traditional or ethnic state leaders or "trust in police over traditional leaders" based on the 2012 Afrobarometer survey (Afrobarometer, 2012) [48] for Nigeria where respondents were asked to respond to the question "If you were a victim of crime in this country, who if anyone, would you go to first for assistance?"[49] The measure is a difference between the proportion of respondents who say they would go to police and the proportion of respondents who say they would go to their traditional leaders, two of the top answers in the survey. Alternate measures of trust in federal and local institutions tested include directly reported trust in police and the army and trust in local governing councils[50].

4.3 Estimating Equations and Identification Strategy

To test the main hypothesis of the negative effect of precolonial centralization on access to federally administered high federal state control goods in hegemonized (non-compliant) states, the main OLS

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[46]An additional contrast with previous literature is the use of a novel survey dataset that aggregates point data at the LGA-Ethnic area level to measure outcomes for public service provision. Doing this enables the paper to overcome some of the criticisms of the night lights density data approach taken by previous authors (Michalopoulos and Papaioannou, 2013) regarding the estimates not properly accounting for population effects and the luminosity data being dominated by noise in less densely populated areas (Cogneau and Dupraz, 2014) Night lights data is from the 2012 NOAA DMSP-OLS Nighttime Lights Time Series: http://ngdc.noaa.gov/eog/dmsp/downloadV4composites.html.

[47]The railroad was near completion in the 1930s and the railroad reached its maximum extent in 1964(Ayoola, 2006). The railroad in Nigeria is a colonial government investment. So while we should see an impact of precolonial centralization on this particular high state federal control service, there should be no impact of the supermajority Muslim indicator, a measure that captures the probability of rebellion post the 1976 LGA reforms.

[48]Round 5.

[49]Q12.

[50]Local Governing Council Trust, Army Trust and Police Trust (Reported) are responses to Q59E, Q59I and Q59H respectively in the 2012 Afrobarometer. Under directly reported trust in Q59E, I and H, values of 0= "No trust at all" , 1= "Just a Little", 2= "Somewhat" and 3= "A Lot".

estimating equation is presented in Equation 1 below.

$$Y_{le} = \beta_0 + \beta_1 Cent_e + \beta_2 S.Mus_e + \beta_{12} Cent_e * S.Mus_e + \mathbf{X}'_{le}\gamma + \epsilon_{le} \tag{1}$$

The dependent variable is the survey-based measure of infrastructure access or nationally led health access outcomes in 2012 in LGA l in ethnic state e from the survey data as described in Section 4.2. $Cent_e$ is the precolonial centralization indicator and $S.Mus_e$, which allows us to measure pre-independence hegemonization, is the supermajority Muslim indicator described in Section 4.1. $\mathbf{X}$ is an extensive vector of controls including population density [51], geographical controls like distance to the capital, mean elevation in km, distance to the nearest major river[52], a seacoast indicator[53], land suitability for agriculture [54], ruggedness [55], indicators for the prevalence of slavery [56] and petrol[58], following the research on the longterm impacts of the slave trade on modern development outcomes (Nunn, 2008) and to control for the effect of the country's resource wealth on public service provision. In alternate specifications, an indicator for mineral locality or the presence of an identified mineral locale from the 1957 (colonial era) geological survey is included[59]. Disease controls are included for malaria using climatic suitability for malaria transmission from Adjuik et al. (1998) to address the various hypotheses in the literature on the negative impacts on malaria on African development outcomes (Gallup and Sachs, 2001) and tse tse fly suitability following Alsan (2015)[60]. Robust standard errors clustered by Murdock ethnicity and state, in

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[51]Population density in 2006 (and earlier in 1990 for available LGAs in alternate specifications with results unchanged)- by LGA from the Nigerian National Bureau of Statistics: Since public infrastructure provision planning decisions are often made taking maximum coverage by population into consideration. Population density is indeed significant in most specifications and is controlled for in all specifications.

[52]Distance from polygon centroids to the nearest major river.

[53]Equal to 1 for ethnic states bordering the seacoast. Distance to the seacoast is not used here due to collinearity with the petrol indicator.

[54]Ecological feature to test that centralization of groups was driven by their location in more favorable areas for crops and pasture. Data from the FAO.

[55]Following Fenske (2014) and Nunn and Puga (2012) control for ruggedness of the terrain which was related to the cost of capturing slaves using data sourced from (Fenske, 2014).

[56]An indicator for the prevalence of slavery, based on the V70 variable from the Murdock (1967) Ethnographic atlas, following Michalopoulos (2012) specification. In alternate specifications, Nunn and Wantchekon (2011)'s total number of exported slaves in the trans Atlantic and Indian ocean slave trades from 1400-1900 is used and the main results remain unchanged[57]. The indicator is used here consistent with previous work by Gennaioli and Rainer (2007).

[58]Based on data from "The Petroleum Dataset", PRIO.

[59]Mining and Mineral Resources in Nigeria (1957).

[60]Tse tse fly suitability index (TSI) included in alternate specifications with results unchanged, though including

alternate specifications, are used in the main results. In alternate specifications, satellite night-lights density data and distance to the railroad, a high federal state control service resulting from colonial investment, are included as dependent variables. In pre-specifications, the non-interacted version of Equation 1 is estimated [61].

To test the hypothesis that the effect of precolonial centralization is mitigated by military president origin and that punishment is worse in non-favored (non-military president origin) areas, Equation 2 is estimated with a "no military president" (denoted as NoMil) interaction as follows[62]
:

$$Y_{le} = \beta_0 + \beta_1 Cent_e + \beta_2 S.Mus_e + \beta_3 NoMil_e + \beta_{12} Cent_e * S.Mus_e + \beta_{13} Cent_e * NoMil_e + \mathbf{X}'_{le}\gamma + \epsilon_{le}$$
$$(2)$$

Finally, to test the hypothesis on trust in police, or representatives of federal institutions, over traditional leaders being lower in hegemonized (centralized and supermajority Muslim, non-compliant and punished) states, since most of the respondents were from previously centralized states[63], I analyze the split sample within centralized states and examine the responses of super-majority to non-supermajority Muslim state respondents using first a chi-square test and then an OLS specification. The hypothesis on relatively lower trust in federal vs local institutions in punished areas is tested with other measures of trust from the Afrobarometer sample, including directly reported trust in local governing councils and directly reported trust in police and the army. Inferences here are correlations, and given the small sample, the results should be interpreted with caution. The OLS model is specified as follows:

$$Y_{le} = \beta_0 + \beta_{21} S.Mus_e|(Cent_e = 1) + \mathbf{X}'_{le}\gamma + \epsilon_{le} \qquad (3)$$

the TSI drops a number of observations from the regression due to incompleteness of the TSI dataset. See Appendix for tables.

[61] Results presented in Table 5.

[62] Note, I interact the $NoMil_e$ with $Cent_e$ variable rather than $S.Mus_e$ to capture the effect for all centralized states, given that the smaller sample size does not allow for enough power for a triple interaction effect. This specification allows some agnosticism about the nature of the effect of having a military president and also allows for direct variation with the main variable of interest, centralization.

[63] 95% of the Afrobarometer sample.

4.4 Instrumental Variables (IV) and Ecological Diversity Index

Potential endogeneity of the precolonial centralization variable from omitted variables measuring some cultural aspect associated with precolonial centralization not captured in the OLS specification may be a concern. To address this concern, I adapt a Herfindahl/ecological diversity index from Fenske (2014) as an instrument for precolonial centralization[64]. The index calculates the share s_g^e of each ethnic state e's area that is occupied by each major ecological type g (with 7 of the 18 total in Africa found in Nigeria) and is constructed as follows:

$$Ecological \quad Diversity_e = 1 - \sum_{g=1}^{7} (s_g^e)^2 \qquad (4)$$

The index measures the probability that two or more different ecological zones are contained within a particular ethnic state area. The use of the instrument follows from Fenske (2014) and Bates (1983) that states on ecological boundaries were able to benefit from specialization and gains from trade across ecological boundaries which then fueled higher levels of precolonial centralization. This study exploits this correlation within the Nigeria region, made up of seven different vegetation zones or major vegetation types[65] as shown in Figure 9b [66]. The ecological diversity index instrument, shown in Figure 9c, is strongly positively correlated with precolonial centralization with mean ecological diversity higher in centralized areas (.28 vs .15, $p < .001$).

Following Cameron and Miller (2010), I address spatial autocorrelation and group-based correlations by clustering robust standard errors by ethnicity and by state [67]. Results with clus-

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[64]Note, unlike the other outcomes the exclusion restriction is unlikely to hold in the health immunization case since studies have documented an inverse relationship between disease risk and ecological (particularly species) diversity and it appears there is higher availability of immunization in areas that are less ecologically diverse and presumably have higher disease risk (Keesing, Holt, and Ostfeld, 2006). For other relevant dependent variables, the instrument remains valid and results from those specifications are presented here.

[65]From White's 1983 historically reconstructed map (White, 1983) including forest, woodland, bushland and thicket, azonal vegetation and anthropic landscapes. The full list of major types include forest, forest transitions and mosaics, woodland, woodland mosaics and transitions, bushland and thicket, azonal vegetation and anthropic landscapes. There are 15 sub-classified minor types including swamp forest, lowland rain forest, mangrove and the Jos Plateau mosaic.

[66]See Fenske (2014) for further discussion

[67]Alternate specifications of a spatial error model with different spatial weight matrices and Conley standard errors were also tested with largely unchanged results (Conley and Molinari, 2007) (tables available upon request).

tered errors are presented in this paper. A test of the split sample to verify the confidence intervals for the negative coefficient on the interaction terms confirms that findings of a negative effect of precolonial centralization on the public service outcome variables in the hegemonized/non-compliant/supermajority Muslim subsample. Effects are significant and negative at the 90% confidence interval.[68]

5 Results

5.1 Precolonial Centralization, Compliance, Punishment and Public Services

The results of Equation 1 show that the effect of precolonial centralization on access to high federal state control services is negative for hegemonized (centralized and supermajority Muslim and predicted non-compliant) states. Results of Equation 2 show that this effect is more negative for hegemonized, non-compliant ethnic states not favored by the military. Table 4 gives OLS results for high federal state control goods, grid based electricity and flush toilet access, where hegemonization and predicted non-compliance typified by the supermajority Muslim interaction, reduces access to the grid by a statistically significant, -.01 or 1% (shown in column (2)) and access to flush toilets by a significant negative -.02 points or 2%. When the effect of being a "non-favored by the military" state, in the form of no military president originating from your state, is accounted for, the effect of precolonial centralization on grid access and flush toilet access becomes even more negative, reducing grid access by about -.04 or 4% and flush toilet access by approximately 3%. Robustness checks on the split sample indicate that the coefficients are significantly negative at the 90% confidence level in the sample. The results are significant particularly given the fact that mean access to grid based electricity and flush toilets is only 13% and 12% respectively in the public schools based survey sample as shown in Table 1.

This significant negative effect of centralization on public service provision supports the historiography documenting the existence of a punishment regime enacted by the military government during the 1976-1999 period of military rule as discussed in Section 2. The result also contradicts

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[68]To account for concerns about normally distributed residuals, skew in the power access variables is corrected with box-cox, yeo-johnson transformed versions of the variables with the results remaining unchanged.

previous notions of precolonial ethnic state centralization always having a positive effect on public service provision. When precolonial centralization is allowed to vary with hegemonization in the pre-independence eras, the relationship between precolonial centralization and modern development outcomes in the form of public service provision is not always positive. Results for the interaction are largely insignificant or nonnegative for low and medium state control services as shown in Table 6, suggesting that punishment operated through the distribution of goods and services whose allocation federal autocrats could tightly control, similar to the account of punishment by autocratic regimes provided in Magaloni (2006)[69].

Being a centralized, non-hegemonized (compliant, centralized and non-supermajority Muslim) state on the other hand is strongly associated with a 6% - 13% increase in access to grid based electricity and a 2.4% to almost 7% increase in access to flush toilets depending on favored status as shown in Table 4.

Results from the non-interacted, misspecified, model are shown in Table 5 where, in line with the previous literature, precolonial centralization increases access to federally administered public services[70]. In robustness checks on the results from the OLS model in Equation 1, a multilevel, random slopes specification is employed, allowing the coefficient on precolonial centralization to

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[69]For locally administered, low federal state control services, including pit latrine and water access, there is no direct effect of centralization on access to these services. Given that the mechanism through which centralization affects public services is, as posited in this paper, compliance and reward relationships between centralized ethnic state leaders and federal governments, the null effect for local government administered goods is not surprising, since one interpretation is that the actors (the elected LGA officials) have no involvement in the compliant relationship with the federal government described previously. Another interpretation is that given the positive, significant sign on the interaction term for at least 2 services- pit latrine and tubewell access in Table 6- it is possible that for punished areas (centralized, supermajority Muslim areas), local government provides better services due to improved local government quality harnessing both social capital and having been largely underserved by federal sources. Table 9 provides some evidence supporting this interpretation, with individuals from punished areas reporting higher trust in local government councils, with no effect for trust in police and army ,though results should be interpreted with caution due to paucity of data in the Afrobarometer sample.

[70]Results from this paper show that precolonial centralization is significantly associated with a 4% increase in grid-based power access in the non-interacted model, an about 50% increase in health professional density, and a 7 % and 6% increase in yellow fever immunization and meningitis immunization respectively. Note, while Michalopoulos and Papaioannou (2013) and Gennaioli and Rainer (2007) do not distinguish between the effects on federally administered or locally administered public services, this result is in contrast with Bandyopadhyay and Green (2016) whose study does not find a relationship between centralization and "public goods" in their Uganda sample.

vary spatially by administrative states s as follows:

$$Y_{le} = \beta_0 + \sum_{s=1}^{37} \beta_1 sCent_e + \mathbf{X}'_{le}\gamma + \epsilon_{le} \tag{5}$$

The spatially varying coefficient model also allows precise identification of administrative states where the coefficient turns negative or where the punishment regime appears to have had the most effect on access to high federal state control goods [71].

5.2 IV and Threats to Validity

One concern regarding the OLS results is that the precolonial centralization measure is capturing some latent effect on public services through a variable, like culture, unobserved in the model. One way to remedy this is through the use of an instrument satisfying validity and relevance requirements, in a 2SLS equation. The IV results qualitatively support the OLS results with Table 7 showing the first stage results and providing support for the validity of ecological diversity as an instrument for precolonial centralization (Fenske, 2014).[72] Second stage IV results are shown in Table 8[73] and and again reinforce the OLS results on compliance and punishment as described in Section 5. The difference in magnitude between the OLS and IV second stage coefficients suggest cautious interpretation of the effect sizes in the IV specification. The difference in magnitude of the IV estimates could suggest measurement error in the precolonial centralization indicator, where the precolonial centralization indicator is an imperfect proxy for political complexity.[74].

Instrument exogeneity is satisfied for the grid based electricity and flush toilet dependent variables, though the exclusion restriction might fail in the case of the health and immunization variables since studies have documented an inverse relationship between disease risk and ecolog-

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[71]The negative coefficient in supermajority states can be confirmed visually and is mapped in Figure 16 in the Appendix. Interpret coefficients with caution due to low power from small within state sample sizes for some administrative states. Grid access and flush toilet access here, as specified previously.

[72]The index performs well in the non-interacted model and slightly weaker ($F < 10$) in one specification of the full model interaction case (column (3) in Table 7), though it passes in alternate specifications of the interacted model (columns (4) and (5) in Table 7).

[73]IV results for other variables available on request from author.

[74]In alternate specifications of the full interacted model, ecological diversity performs adequately as a valid instrument as shown in columns (4) and (5) in Table 7 and efficiency gains in model fitting as measured by the adjusted R^2 are minuscule between models (3), (4) and (5) as shown in Table 7.

ical (particularly species) diversity and it appears there is higher availability of immunization in areas that are less ecologically diverse and presumably have higher disease risk (Keesing, Holt, and Ostfeld, 2006). Conversely, there is no clear direct relationship between access to grid based electricity[75] or flush toilets access at the public school level and ecological diversity, so the exclusion restriction and instrument exogeneity appears satisfied for those variables. Results for both variables are presented in Table 8. In robustness checks, the ecological diversity index appears to have stronger predictive power for precolonial centralization in the southern geopolitical zone versus the northern geopolitical zone in the country, weakening the predictive power of the index in the interacted model [76]. Multiple instruments as a solution to this, including both zonal fixed effects and a zonal interaction with ecological diversity as instruments runs into issues concerning instrument exogeneity in the interacted model due to high collinearities between the supermajority Muslim interaction, supermajority Muslim indicator and the zonal dummies. The relatively high F statistic in the non-interacted model, the non-interacted model including zonal fixed effects and the zonal interaction as additional instruments, and alternate specifications of the interacted model lends support to ecological diversity index as a predictor of precolonial centralization as discussed in Fenske (2014). Due to the upward bias in magnitude in the second stage IV results, the main results from the OLS specifications are interpreted in this paper.

5.3 Compliance, Punishment and Trust in Nigeria

To illustrate the long-term effects of a punishment regime on social capital between the federal government and groups from punished areas[77], a simple Chi-square test on proportions shows that in the sample of centralized ethnic states, respondents to the 2012 Afrobarometer question of "Who would you go to first for help if you were the victim of a crime?" from hegemonized (centralized and supermajority Muslim) states are less likely to go to police over their traditional leaders (58%) versus respondents from non-hegemonized (centralized and non-supermajority Muslim) states (73%)[78]

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[75]Grid based electricity is primarily gas sourced in Nigeria.

[76]see Figure 15 in the Appendix

[77]Contributing to the literature on the determinants of social capital among groups in Africa including Nunn and Wantchekon's work on the impact of the slave trade on trust (Nunn and Wantchekon, 2011).

[78]As shown in Figure 17 in the Appendix.

($p < .1$). Results from the OLS specification are shown in Table 10. Given the small number of independent samples in the split sample approach, significance of the supermajority Muslim indicator in the centralized state sample is unstable, though the coefficient is negative (sometimes significantly negative) with membership in hegemonized (centralized and supermajority Muslim) states seeming to reduce the "likelihood" of going to the police over traditional leaders by a magnitude of about -.17 to -.25 in all specifications. This relatively lower trust in federal institutions like police over traditional leaders in punished areas (hegemonized/centralized and supermajority Muslim) versus non-punished areas (non-hegemonized/ centralized and non supermajority Muslim) suggests evidence of the persistent impacts of the punishment regime on social capital between punished areas and the federal government.

As further suggestive evidence for the effects of a federally imposed punishment regime on social capital, residents from hegemonized (centralized and supermajority Muslim) states report more trust in their local governing councils with no effect on directly reported trust in federal institutions of police and the army as shown in Table 9. Effect sizes for trust local governing councils are positive, significant and stable, with a magnitude of about .4 in all specifications. Another potential implication of the trust result is that given the positive, significant sign on the interaction term for at least 2 services[79] in Table 6, it is possible that for punished areas (centralized, supermajority Muslim areas), local government provides better services due to improved local government quality harnessing social capital to encourage investment in locally controlled public services, due to being largely underserved by federal sources. Given the small sample sizes in the split sample approach, the results are significant correlations and the effect sizes should be interpreted with caution here [80].

6 Evaluation of Alternative Hypotheses

Given the sparseness of comprehensive micro-level data on federal government public spending and investment and riots/direct measures of rebellion/non-compliance from the colonial and military

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[79]Pit latrine and tubewell access.

[80]Additional evidence from the Nigerian historiography is provided in the Appendix.

eras, in order to make the case for a compliance/reward, non-compliance/punishment mechanism through which precolonial centralization affects current development outcomes in the country, four connections have been made here. First, the empirical results showing a nonlinear relationship between precolonial centralization and current public infrastructure service provision outcomes using the supermajority Muslim indicator here match the extensive historiography on heterogeneous relationships between precolonial ethnic states in the largely Muslim north and the south of the country. It is difficult to confirm reasons other than within the framework presented here for why these areas would have such different outcomes than their non-Muslim north, centralized counterparts, particularly given the extensive set of controls used here. Also, to test that the precolonial centralization effect is not driven by being a Muslim state, I test the results in the non-supermajority Muslim split sample, and find the effect of precolonial centralization remains largely significant for the aforementioned federally administered services[81]. Second, the conceptual framework and simple model of expropriation through fiscal and legal policy as related to the risk of non-compliance or rebellion, matches accounts of the timing of outbreaks of riots in the historiographic literature[82]. Third, the evidence showing that military president state origin mitigates the effect of precolonial centralization on access to federally controlled public services is in line with much of the ethnic favoritism literature and highlights punishment as the flip side of favoritism. Fourth, the evidence on lower trust in federal institutions over local ones in the identified punished areas is also suggestive of a longterm nonpositive relationship between individuals in these areas and the federal regime, particularly given the evidence of non significant migration of groups in the country, mentioned in the previous sections. The subsection below addresses other alternative hypotheses[83].

6.1 Alternative Hypotheses: Differing Socioeconomic and Environmental Conditions, Culture and Politics

Other hypotheses that might explain the nonlinear relationship between precolonial centralization and access to federally controlled public infrastructure services might relate to existing differences in

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[81]Results shown in Table 16 in the Appendix.

[82]Figure 13 in the Appendix presents a simple frequency distribution timeline of riots mentions in written literature as well that corroborate the historiographical accounts and framework described here.

[83]Partially following the account presented in Gennaioli and Rainer (2007).

socioeconomic and environmental conditions between these areas and the rest of the country so that some areas are able to attain better or worse access than others due to these differences. Included among some relevant socioeconomic and environmental factors are differences in urbanization and population density, ease of transportation, prevalence of slavery, elevation and ruggedness of the terrain, disease suitability and distance from the capital (Gennaioli and Rainer, 2007).

The empirical specifications include extensive controls for population density and urbanization with the results robust to these controls. Addressing concerns of differences in transportation costs leading to different political institutions by, for instance, creating regions more favorable to trade in areas with better access to waterways, regressions include controls for distance to nearest major rivers and seacoast indicators in the country. A related concern regarding transportation and whether more or less elevated/rugged terrain is conducive to better access to these public infrastructure is also addressed by adding controls for elevation and ruggedness in all specifications. Controls for malaria and tse tse fly suitability address concerns that areas in the country with higher disease burdens will have lower development outcomes including poorer access to these public services (Gallup and Sachs, 2001; Alsan, 2015). Whether proximity to the capital enables areas closer to it to benefit from spillovers from greater investment at the capital is tested with a control for distance to the capital included in all specifications as well[84].

A resource abundance argument for differential access to public services is tested by including controls for Nigeria's most significant natural resource accounting for some 80% of government revenue, petroleum. Controls for mineral locality and for land suitability for agriculture are included as well. Finally, given the extensive literature on the impact of slavery and the slave trade on current development outcomes (Nunn, 2008; Nunn and Wantchekon, 2011), controls for both slave prevalence in the precolonial era using Murdock's variable and the number of slave exports between 1400-1900 in the trans Atlantic and Indian Ocean slave trades are included in the empirical specifications. Table 4 shows the results including all these controls, with coefficients robust to the

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[84]Distance to the capital as of 1991, Abuja, is used. Construction of the capital Abuja began in 1980 with plans to change the capital from Lagos to Abuja starting in 1975. To verify that the former capital, Lagos, is not driving the results, in alternate specifications, Lagos state is dropped from the sample and a dummy included for Lagos with the results unchanged. Tables available upon request.

inclusion of controls.

Another set of hypotheses that might explain the nonlinear relationship between precolonial centralization and access to federally controlled public infrastructure services regards the mechanism proposed in this paper. Other mechanisms exploring political and cultural factors might explain the heterogeneity in outcomes identified here. For political factors, Gennaioli and Rainer (2007) suggest that precolonial centralization "improved public goods provision by increasing accountability of local chiefs". The results presented here show that precolonial centralization did not always improve public goods provision. Also, under the local accountability hypothesis, it is unclear why precolonial centralization would have no effect on locally administered services like access to certain sanitation and water infrastructure[85] identified here. In contrast, the non-compliance/punishment argument presented here rests on the ability of the autocrat to directly control allocation of public services and better explains the results presented in this paper. As a falsification test, since the supermajority Muslim interaction should only predict noncompliance with the military, not the British autocrats, as described in preceding sections, there should be no effect of the supermajority Muslim interaction on access to the railroad, a purely colonial infrastructure investment. But we should see centralized states[86] having better access to this federally administered service following the accounts and predictions presented in Section 2 and 3. The results presented in Table 11 support this hypothesis with centralized states located, on average, 64km closer to the railroad.

Another hypothesis questions the exact role of the British autocrats in the mechanism presented here, and the paper draws on an extensive historiography on indirect rule and the differential relationships within colonies produced from it to make the case for the mechanism along with historical data on patterns of taxation and investment in schools. On the subject of the exact role of the British autocrats and taxation, Berger (2009) suggests that "different colonial tax institutions within Nigeria implemented by the British for reasons exogenous to local conditions led to different present day quality of governance" which might explain the nonlinear relationship presented here. While this paper rests on the hypothesis of differential institutions established by the British in the

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[85]For sanitation, improved pit latrines and for water, access to tube well and piped water.

[86]Who as discussed in Sections 2 were largely compliant with the British following the accounts presented in Section 2.

north vs south of the country, Berger's hypothesis does not explain the heterogeneous relationship between precolonial centralization and access to public infrastructure services north of his identified 7°10' line. The hypothesis of some cultural particularity of the supermajority Muslim areas driving the nonlinear results does not hold in light of the "dog that didn't bark" cases of the centralized, supermajority Muslim areas that appear to do somewhat better than other punished counterparts (though still worse than their non-punished centralized counterparts) on access to the high state control public services seemingly due to being a "favored" area or homeland of a military president.

Finally, an alternate hypothesis presents an explanation of the nonlinear results as reflecting the longterm impacts of the Nigerian Civil War or the Biafran war from 1967-1970. To test this hypothesis, I drop the southeast region where most of the casualties were concentrated[87] in alternate specifications with the results unchanged[88].

In summary, the evidence presented citing the nonlinear effect of precolonial centralization on access to federally controlled public services appears to most strongly support the hypothesis that relationships of compliance/reward and non-compliance/punishment between federal autocratic regimes and centralized ethnic state leaders drove the public service provision outcomes documented here and in previous scholarship.

7 Concluding Remarks

The results indicate that the heterogeneity in development outcomes for centralized ethnic states reflected in differential public service provision in much of colonized Africa can be explained within the context of compliance/reward and non-compliance/punishment relationships in sequential games between ethnic state leaders and colonial and postcolonial federal autocratic regimes. When compliance was the equilibrium outcome in the bilateral bargaining game between centralized precolonial ethnic state leaders and autocratic federal leaders, then public services were provided in centralized ethnic states. When compliance failed between parties, then ethnic state leaders were punished through underinvestment in goods and services whose allocation autocratic federal governments

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[87] See Akresh et al., (2012) for further discussion on the geographical concentration of casualties from the Nigerian civil war.

[88] See Appendix for Tables. Results presented in Table 17.

could control. This study finds evidence for a negative relationship between precolonial centralization and public service provision as a development outcome under certain conditions unexamined in the previous literature. The paper also adds to the understanding of the role of historical institutions in determining persistent within country group based inequality. The conceptual framework presented here contributes important insights into the logic of public service provision under authoritarian regimes, with general application for states outside of Africa as well.

A key contribution to the literature is to show precolonial centralization as a dynamic process with two distinct but related periods, namely precolonial centralization and subsequent hegemonization for centralized states in the colonial and postcolonial eras. A further contribution of this paper is to offer a structured approach, with rigorous application of the historiography to understand the mechanisms underlying the persistent effects of precolonial institutions on current development outcomes in African states. Further research should be done on the "reversal of fortunes" result here- exploring why some centralized ethnic states mentioned previously, including the Hausa and Bolewa precolonial ethnic states in present day Bauchi, the Kanuri in present day Borno, the Bolewa in present day Gombe, the Hausa and Reshe in present day Kebbi and the Hausa in present day Kaduna, have some of the worst development outcomes today and the relationship with persistent group based inequality within countries.

Further research should also be done to understand the origins and drivers of precolonial centralization[89]. Given the sparseness of micro-data on public investments and expenditure by the colonial and military regimes, future work should focus on research to reconstruct datasets of public spending by these regimes to study the effects of the punishment more directly as well.

On the policy implications, this study also addresses the important roles of current non-state actors like traditional leaders (former ethnic state leaders) in facilitating public service expansion by capitalizing on historic social capital in formerly centralized ethnic states[90]. Finally, particularly

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[89]One study has suggested examining the impact of interstate warfare (following Tilly's "war makes states, states make war" hypothesis (Tilly et al., 1985)) on precolonial centralization by examining the use of plants for poisons and medicines in so-called "biological warfare" (Akiwunmi and Filaba, 2012) to strengthen state sovereignty; there is potential for using ethnobotanic records and environmental historical modeling of plant distribution to gain more insight into the role of environmentally backed interstate warfare in precolonial state centralization.

[90]Reflected in attitudes like the ones presented in the 2008 Afrobarometer Nigeria survey where almost 60% of

in view of the recent outbreaks of violence and social upheaval in those areas[91], there might be some role for an affirmative action or broadly Rawlsian policy aimed at improving development outcomes for areas that suffered from underinvestment under these punishment regimes and are currently among the least advantaged areas in the country. Further work is needed to understand the full extent of this throughout the country, along with a more structured theoretical framework of the mechanism of compliance and punishment that operated between ethnic state leaders and federal autocratic regimes.

respondents felt that traditional leader influence in local government should increase.

[91] The recent Boko Haram attacks being the most prominent.
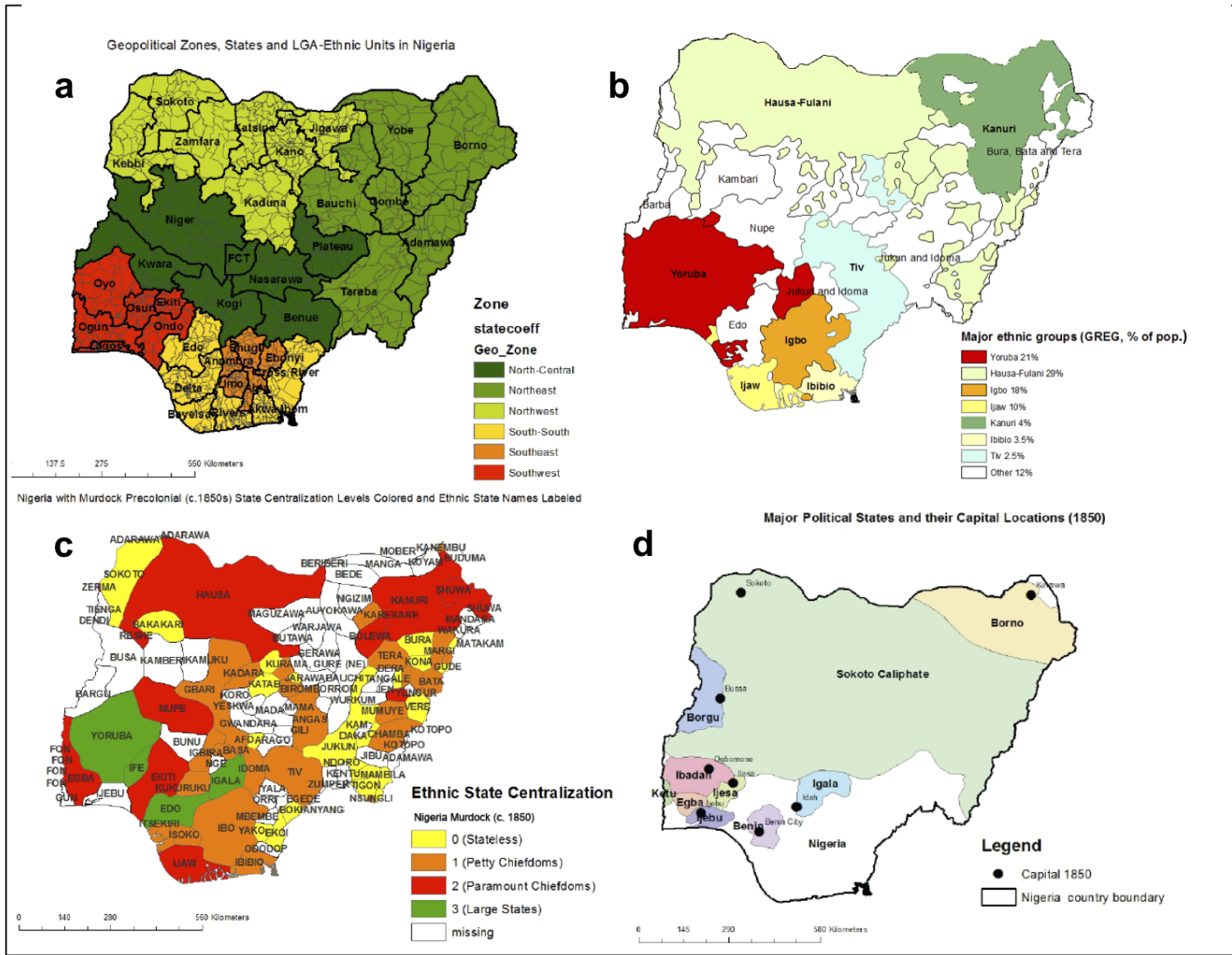
Figure 1: Nigeria: the actors 1850-Present
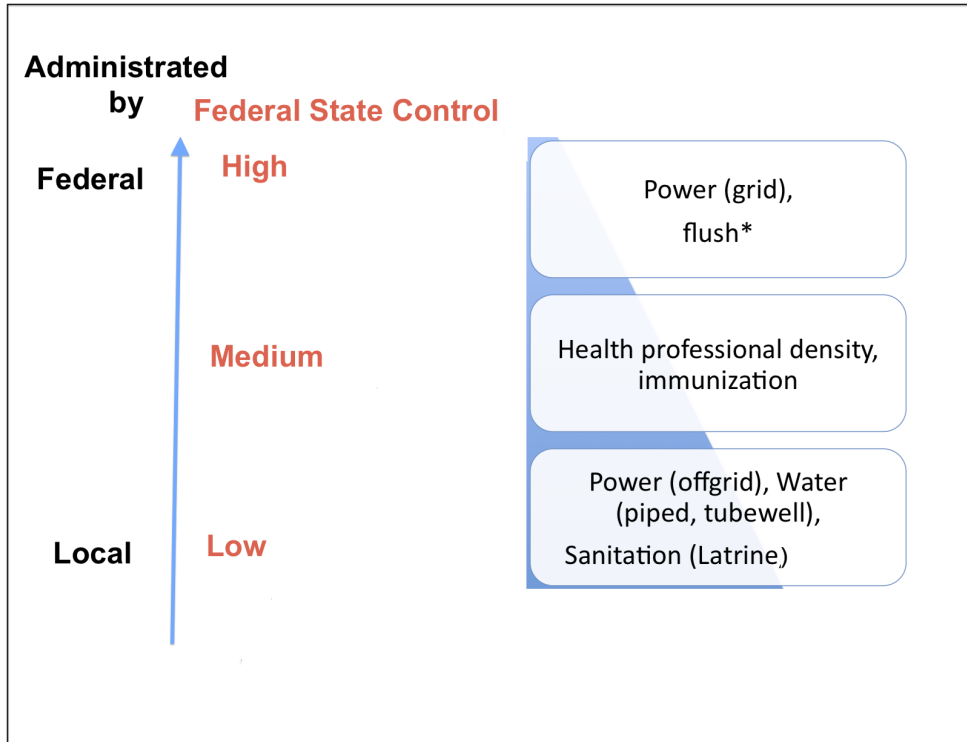
Figure 2: Schematic of the administration and extent of state control of public services mentioned in the paper reflecting policy choices made by the federal government not technological capacity for provision of the public service at the local or federal levels
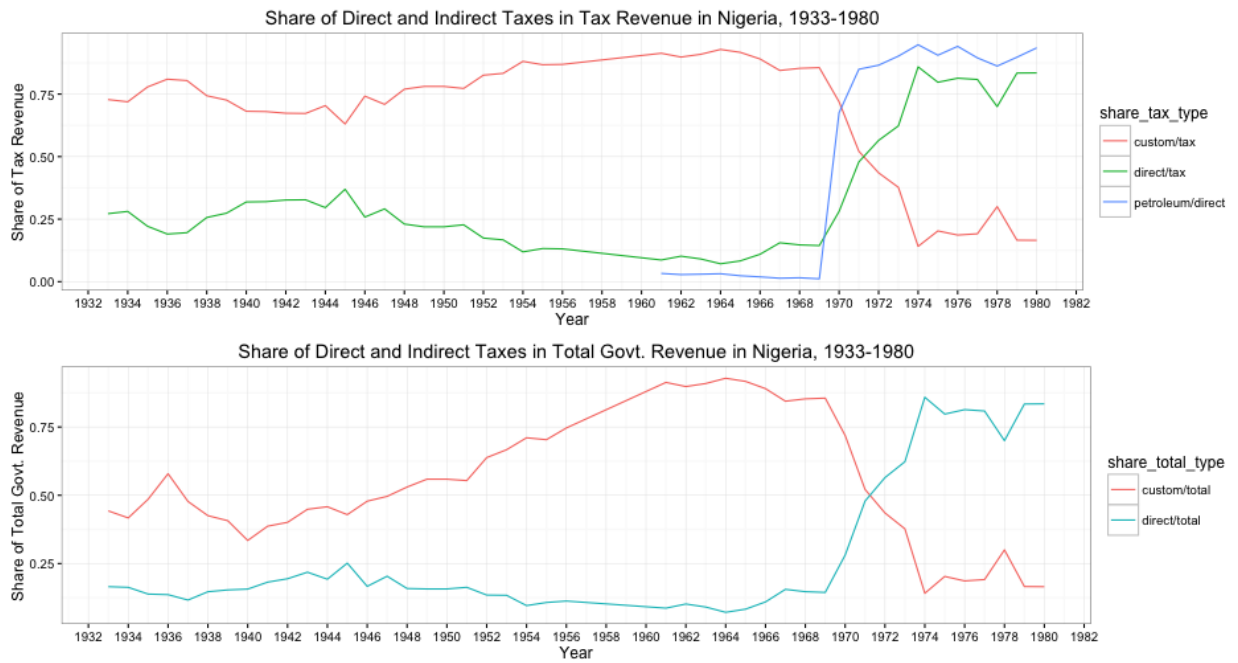
Figure 3: Share of direct and indirect taxes in tax and government revenue, 1933-1980. Source: Data from Nigeria Digest of Statistics, multiple; Hicks and Phillipson (1951)
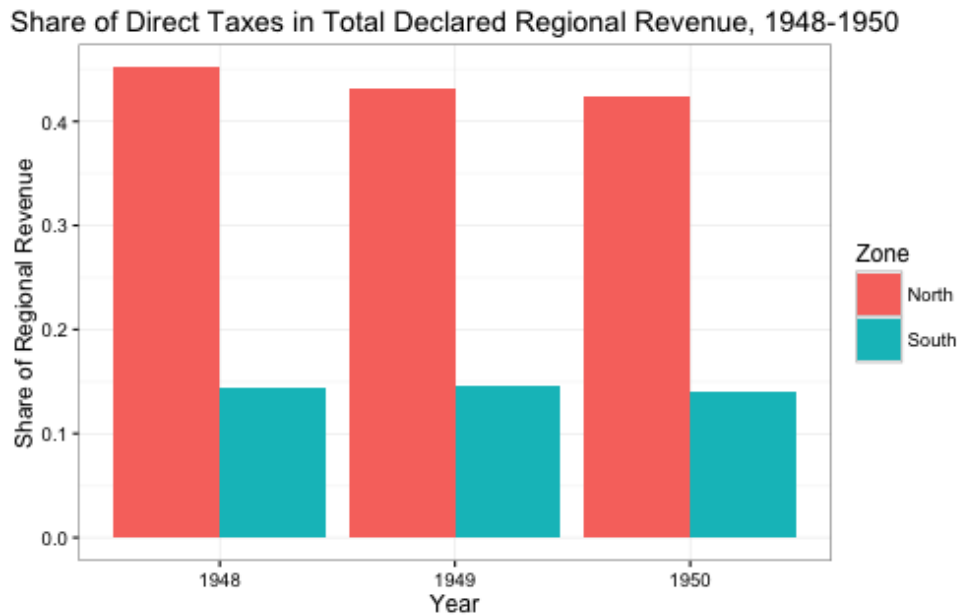
Figure 4: Share of direct tax in total declared regional revenue, 1948-1950, Source: Data from Hicks and Phillipson (1951)

Nature (e.g.*Ecological Diversity*)

$I_1 = Centralized$ (*Incl. S.Mus and ¬S.Mus*)

$II_1 = Non - Centralized$ (*Incl. S.Mus and ¬S.Mus*)

British

(0,0)

Tax

No Tax

Ethnic State Leader

(A_{11}, B_{11})

Comply

Not Comply

(A_{12}, B_{12})

(A_{13}, B_{13})
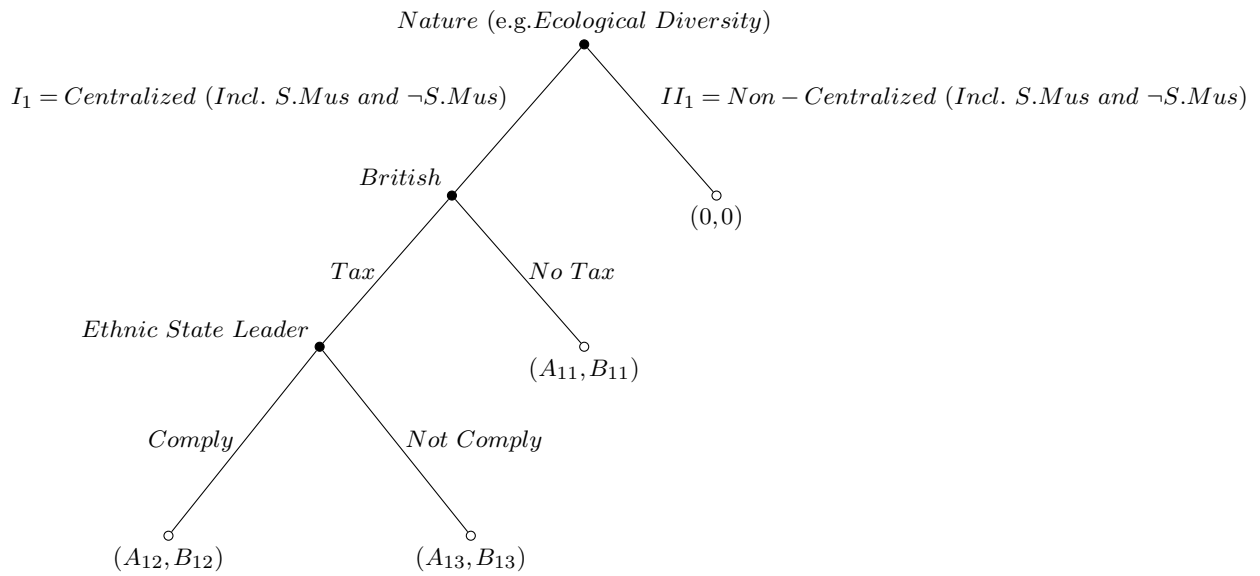
Figure 5: Conceptual Framework: In Game 1, $(I_1(Centralized), Tax, Comply)$ is an equilibrium outcome

British Policy (*Muslimnorth vs south*)

$I_2|I_1 = Hegemonized$ (*Cent* and *S.Mus*)

$II_2|I_1 = Non - Hegemonized$ (*Cent* and *¬S.Mus*)

Military

(A_{21}, B_{21})

LGA Policy

No LGA Policy

Ethnic State Leader

(A_{22}, B_{22})

Comply

Not Comply

(A_{23}, B_{23})

(A_{24}, B_{24})
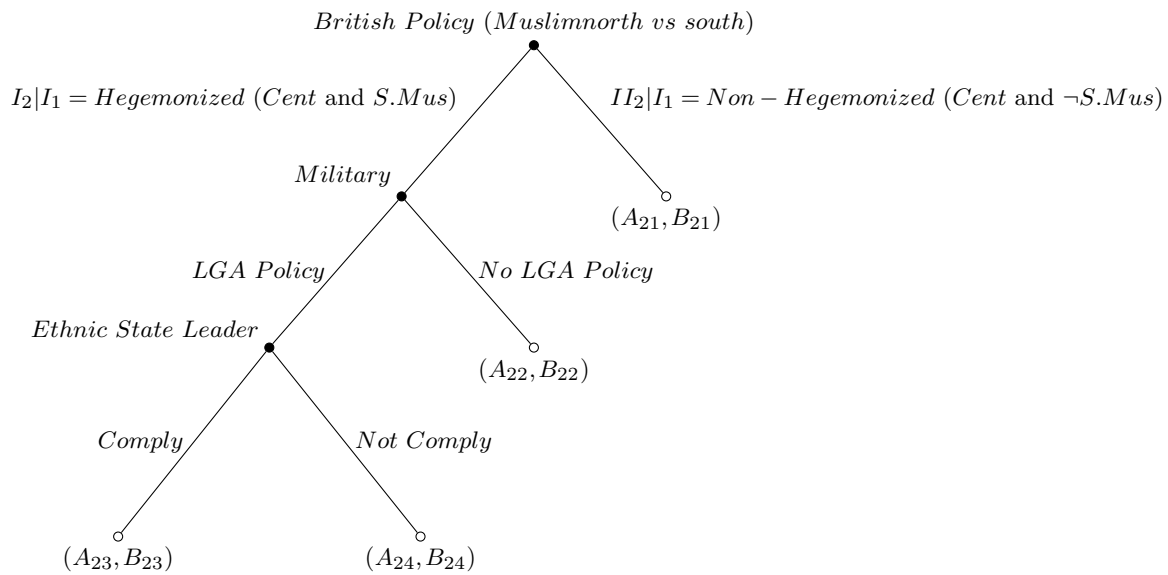
Figure 6: Conceptual Framework: In Game 2, $(I_2|I_1(Hegemonized), LGA Policy, Not Comply)$ is an equilibrium outcome
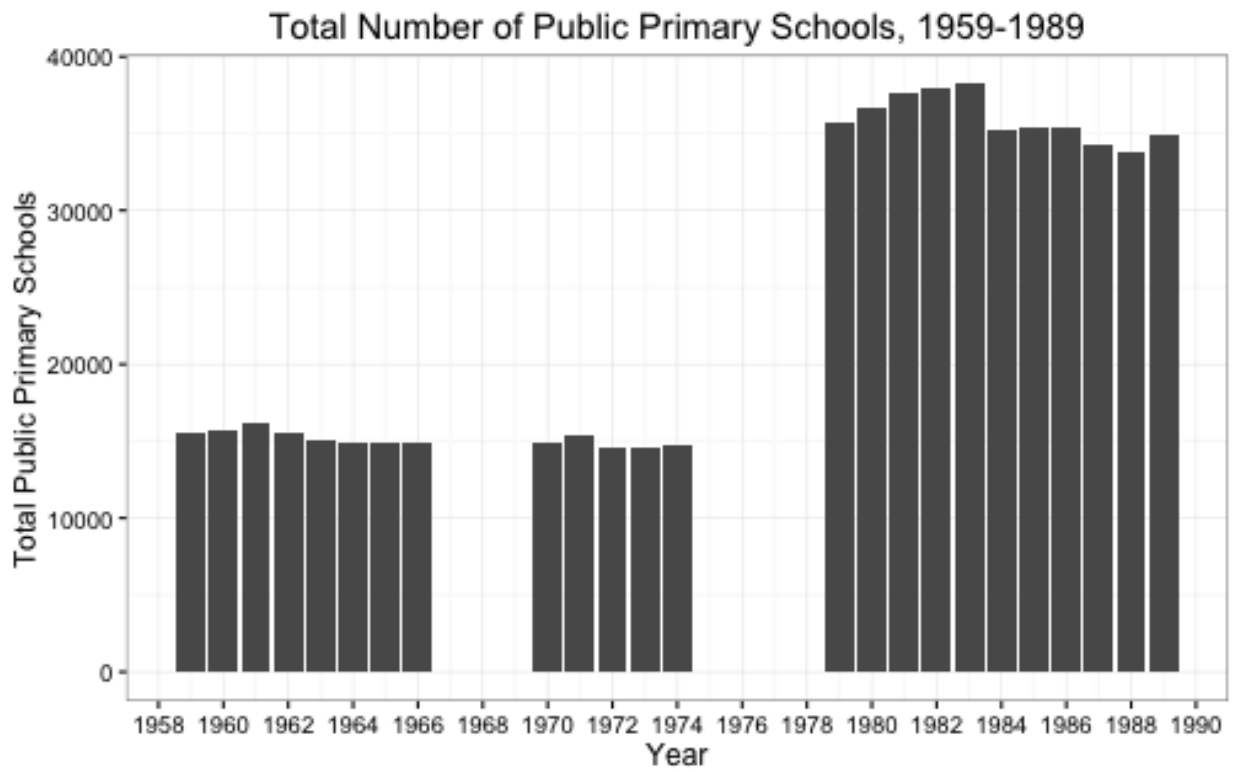
Figure 7: Total number of public primary schools, 1959-1989, Source: Data from the Nigeria Statistics of Education, multiple
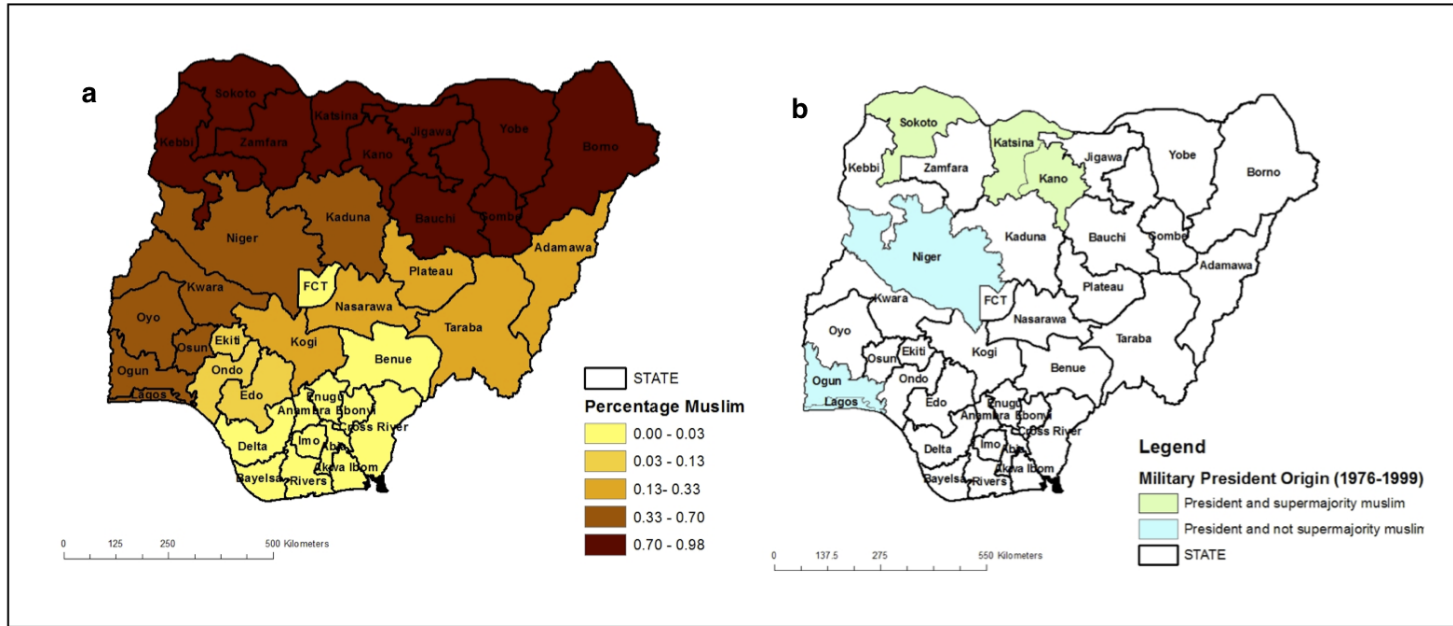
Figure 8: Percent Muslim by State in 1952 (a) and States of Military[92]President Origin from 1976-1999 Labeled in (b)

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[92]Note, including President Ernest Shonekan from Lagos state, who was technically not a military official himself though he was chosen by the previous military president as an interim head of state in light of contentious 1993 elections (see Akinrinade, 2006 for details). Lagos is included in the sample for completeness though the results remain unchanged when Lagos is excluded from the military president origin variable. See Appendix for tables.
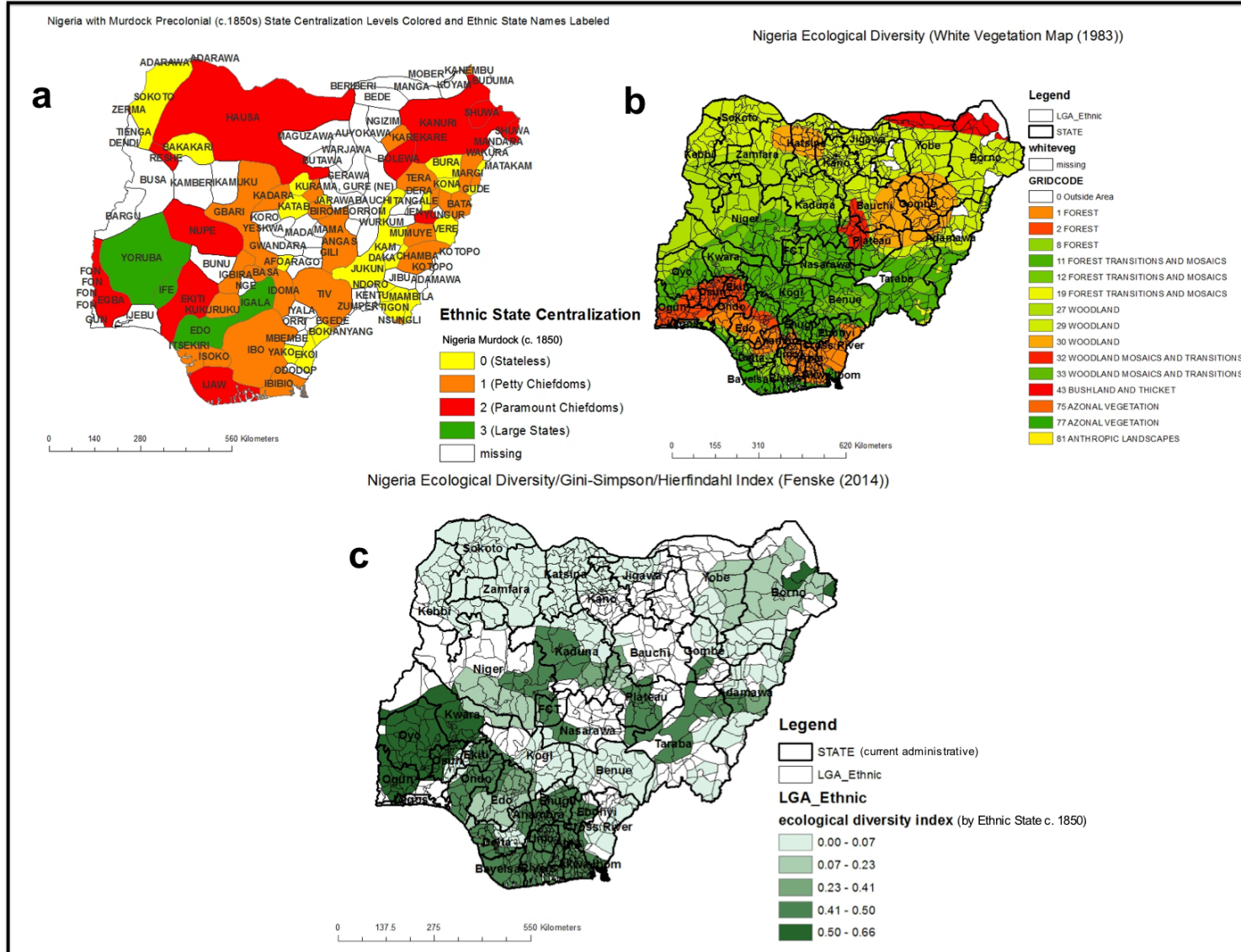
Figure 9: Nigeria Ecological Diversity Index (disaggregated in (b) and aggregated by ethnic state level in (c) with Murdock Ethnic States in (a)

Table 1: Outcomes (Infrastructure and Health Access, Light and Trust) Summary Statistics (Observations are LGA-Ethnic states)

Statistic	N	Mean	St. Dev.	Min	Max
Power	945	0.19	0.20	0.00	1.00
Grid	945	0.13	0.16	0.00	1.00
Offgrid	945	0.10	0.14	0.00	1.00
Sanitation	945	0.41	0.24	0.00	1.00
Flush	945	0.12	0.16	0.00	1.00
Latrine	945	0.27	0.20	0.00	1.00
Water	945	0.29	0.20	0.00	1.00
Piped Water	945	0.04	0.09	0.00	1.00
Tubewell	945	0.22	0.18	0.00	1.00
Yellow Fever Immunization	900	0.56	0.24	0.00	1.00
Meningitis Immunization	900	0.18	0.19	0.00	1.00
Health Professionals Density	900	1.99	2.54	0.00	44.79
Log Night Light Density	943	1.76	0.63	1.13	4.14
Police Over Traditional Trust	226	0.34	0.37	−0.88	1.00
Police Trust (Crime)	226	0.49	0.24	0.00	1.00
Traditional Leader Trust (Crime)	226	0.15	0.18	0.00	0.88
Local Governing Council Trust	199	0.99	0.36	0.00	1.88
Army Trust	206	1.48	0.42	0.38	2.38
Police Trust (Reported)	221	0.68	0.35	0.00	1.88
Distance to Railroad	945	78.07	64.80	0.001	340.42

Notes: See text for more details. Distance to Railroad in km. Police Trust (Crime) and Traditional Leader Trust (Crime) are 2012 Afrobarometer responses to Q12. Local Governing Council Trust, Army Trust and Police Trust (Reported) are responses to Q59E, Q59I and Q59H respectively. Under directly reported trust in Q59E, I and H, values of 0= 'No trust at all' , 1= 'Just a Little', 2= 'Somewhat' and 3= 'A Lot'. Power, Sanitation and Water were constructed from responses to 'or' questions, e.g. for Power access, 'do you have power from the grid or an offgrid source?' at schools. So Power is in effect a union of Grid and Offgrid access but note since the overall Power access numeral takes only unique responses, the estimate for Power is lower than the actual sum of Grid and Offgrid for Power displayed in the above table. Calculations were executed in ArcGIS so Sanitation and Water access estimates are slightly inflated since points falling on the borders of LGA-Ethnic polygons were counted twice, the measured error is minute and inconsequential when adjusted for in later analysis.

Table 2: Controls Summary Statistics (Observations are LGA-Ethnic states)

Statistic	N	Mean	St. Dev.	Min	Max
Centralization (bin)	945	0.89	0.32	0	1
Centralization (full)	945	1.51	0.88	0	3
Supermajority Muslim	945	0.25	0.43	0	1
No Military President	945	0.82	0.38	0	1
No Police	226	0.06	0.09	0.00	0.50
Population Density	945	690.19	2,352.28	6.90	41,012.70
Mean Elevation	859	286.96	251.69	−0.25	1,829.00
Ruggedness	945	0.28	0.25	0.03	2.28
Distance to Capital	945	410.61	169.29	13.29	825.47
Petrol	945	0.25	0.43	0	1
Mineral Locality	945	0.04	0.19	0	1
Mean Agricultural Suitability	925	4.73	0.79	0.00	6.00
Slavery (Prevalence)	921	0.99	0.07	0	1
Slavery (Exports)	945	133,101.90	208,730.70	0	854,958
Malaria	945	0.99	0.03	0.72	1.00
Distance to Rivers	945	64.47	47.12	0.18	236.24
Sea Coast	945	0.19	0.39	0	1
Tse Tse Suitability	771	0.772	0.528	-1.006	1.449
Ecological Diversity*	945	0.26	0.24	0.00	0.66

Notes: See text for details. *Ecological diversity is used in the IV specification only. Models are tested with the binary and full centralization index. Results from the binary centralization variable are reported in this paper. Distance in km. Slave exports from 1400-1900 as a measure of intensity of slave trade are used in alternate specifications with main results unchanged.

Table 3: Night Light Density and Infrastructure Access Correlations (Among aggregate infrastructure measures, night light density has highest correlation with Power (.6) over Sanitation (.4) and Water (.4))

Correlations	Night Lights
Power	0.594***
Grid	0.616***
Offgrid	0.424***
Sanitation	0.431***
Flush	0.689***
Latrine	−0.055*
Water	0.397***
Piped	0.329***
Tubewell	0.393***

Notes: Correlations with log mean night light density in 2012 from the NOAA DMSP database. Observations calculated at the LGA-Ethnic level. ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level. Highest correlations between night light density and functional grid based power (.62) and also between night light density and working flush toilets (.69). Overall for the aggregate infrastructure indicators, night light density has highest correlation with functional Power ($\approx$ .6) over Sanitation ($\approx$ .4) and Water($\approx$ .4) in the country suggesting that the Power and Grid variables from school level surveys accurately proxy mean distribution of available functional electricity for the country.
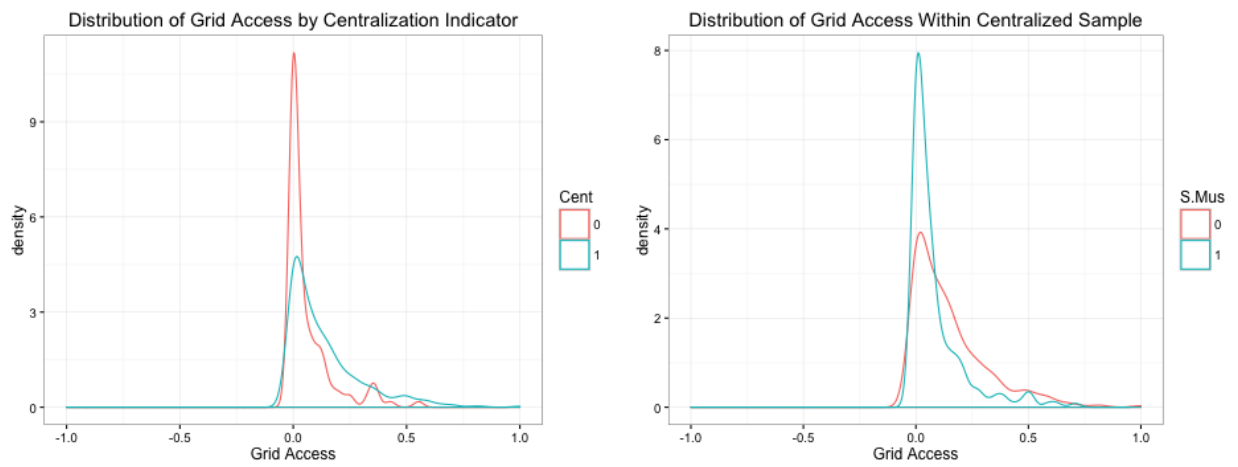
Figure 10: Stochastic dominance: precolonial centralization has a positive effect on grid access (left), for compliant ethnic states (right)

Table 4: Reduced form estimates showing heterogenous effects of precolonial centralization on access to high federal state control infrastructure services

	Grid			Flush		
	(1)	(2)	(3)	(4)	(5)	(6)
Centralization	0.039*	0.059**	0.125***	0.009	0.024*	0.065***
	(0.024)	(0.023)	(0.037)	(0.014)	(0.014)	(0.023)
Supermajority Muslim		0.021	0.023		−0.026	−0.018
		(0.031)	(0.034)		(0.021)	(0.024)
Cent x S.Mus		−0.070*	−0.096**		−0.044**	−0.050**
		(0.036)	(0.041)		(0.017)	(0.022)
No Military President			0.029			0.050***
			(0.022)			(0.019)
Cent x No Military			−0.070**			−0.044*
			(0.032)			(0.025)
Slavery	0.030	−0.001	0.003	−0.044	−0.052	−0.052
	(0.068)	(0.063)	(0.061)	(0.040)	(0.039)	(0.039)
Petrol	0.071***	0.049**	0.055***	0.109***	0.096***	0.095***
	(0.022)	(0.021)	(0.021)	(0.019)	(0.017)	(0.017)
Constant	−0.456	−0.345	−0.342	0.234	0.205	0.139
	(0.408)	(0.346)	(0.327)	(0.255)	(0.229)	(0.228)
Population Density	Yes	Yes	Yes	Yes	Yes	Yes
Disease controls	Yes	Yes	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes	Yes	Yes
N	821	821	821	821	821	821
R^2	0.151	0.193	0.200	0.336	0.355	0.357
Adjusted R^2	0.140	0.180	0.185	0.327	0.345	0.345

Notes: Regressions estimated by OLS. Robust standard errors in parentheses clustered by ethnicity. Errors clustered by state in alternate specifications with results unchanged. Dependent variable measures Grid access in (1) -(3) and Flush toilet access in (4)-(6). Disease controls include malaria and tse tse suitability in alternate specifications. Geographic controls include ruggedness, mean elevation, agricultural land suitability, distance to capital, distance to rivers, and seacoast. Population density and controls for slavery (prevalence and exports in alternate specifications) are included in all specifications in the full model. Former capital, Lagos dummies are included and Lagos excluded in alternate specifications with results unchanged. Site of the Nigerian civil war, the Southeast zone is excluded in alternate specifications with results largely unchanged (see Appendix). Results remain significant in some specifications when the full centralization index is used. ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level.

Table 5: Reduced form estimates of the relationship between precolonial centralization and access to federally administered services

	Grid	Night Lights	Flush	Health Prof.	Yellow Fever Imm.	Meningitis Imm.
	(1)	(2)	(3)	(4)	(5)	(6)
Centralization	0.039*	0.087*	0.009	0.481*	0.069**	0.055**
	(0.024)	(0.050)	(0.014)	(0.282)	(0.035)	(0.026)
Slavery	0.030	−0.032	−0.044	−0.969*	−0.072	0.090
	(0.068)	(0.155)	(0.040)	(0.567)	(0.143)	(0.078)
Petrol	0.071***	0.529***	0.109***	1.253***	−0.009	−0.034*
	(0.022)	(0.079)	(0.019)	(0.261)	(0.023)	(0.018)
Constant	−0.456	2.481**	0.234	14.751**	−0.215	−0.420
	(0.408)	(1.042)	(0.255)	(6.005)	(0.657)	(0.557)
Population Density	Yes	Yes	Yes	Yes	Yes	Yes
Disease controls	Yes	Yes	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes	Yes	Yes
N	821	821	821	799	799	799
R^2	0.151	0.420	0.336	0.189	0.042	0.091
Adjusted R^2	0.140	0.413	0.327	0.178	0.028	0.079

Notes: Regressions estimated by OLS. Robust standard errors in parentheses clustered by ethnicity. Errors clustered by state in alternate specifications with results unchanged. Disease controls includes malaria and tse tse fly suitability in alternate specifications. Geographic controls include ruggedness, mean elevation, agricultural land suitability and distance to capital and rivers and sea coast. Population density and controls for slavery (prevalence and exports in alternate specifications) are included in all specifications in the full model. Former capital, Lagos dummies are included and Lagos excluded in alternate specifications with results unchanged. Site of the Nigerian civil war, the Southeast zone is excluded in alternate specifications with results unchanged (see Appendix). Results remain significant in some specifications when the full Centralization index is used. Except for (1) and (3), interaction is not significant in all models except (6), where the effect is positive, but main effects are not significant and effect on Centralization is insignificantly different from 0. ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level.

Table 6: Reduced form estimates of the relationship between precolonial centralization and access to locally administered infrastructure services

	Offgrid		Latrine		Piped		Tubewell	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Centralization	0.009	0.010	0.029	−0.010	0.002	−0.004	0.019	−0.015
	(0.013)	(0.018)	(0.035)	(0.027)	(0.007)	(0.008)	(0.022)	(0.023)
Supermajority Muslim		−0.047**		0.022		0.016		−0.026
		(0.022)		(0.044)		(0.012)		(0.036)
Cent x S.Mus		−0.014		0.107**		0.018		0.082**
		(0.024)		(0.044)		(0.014)		(0.041)
Slavery	0.044	0.045	−0.053	−0.029	0.030	0.033	0.115*	0.137**
	(0.070)	(0.065)	(0.092)	(0.095)	(0.025)	(0.025)	(0.067)	(0.063)
Petrol	0.033*	0.022	0.0003	0.023	0.012	0.019***	0.052***	0.062***
	(0.018)	(0.014)	(0.035)	(0.036)	(0.008)	(0.007)	(0.019)	(0.020)
Constant	−0.401	−0.448	−0.458	−0.430	−0.191*	−0.174*	−0.524	−0.543
	(0.381)	(0.362)	(0.687)	(0.609)	(0.115)	(0.105)	(0.460)	(0.464)
Population Density	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Disease controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	821	821	821	821	821	821	821	821
R^2	0.136	0.157	0.062	0.104	0.061	0.076	0.081	0.094
Adjusted R^2	0.124	0.143	0.049	0.090	0.048	0.062	0.068	0.079

Notes: Regressions estimated by OLS. Robust standard errors in parentheses clustered by ethnicity. Errors clustered by state in alternate specifications with results unchanged. Disease controls include malaria and tse tse suitability in alternate specifications. Geographic controls include ruggedness, mean elevation, agricultural land suitability, distance to capital, distance to rivers, and seacoast. Population density and controls for slavery (prevalence and exports in alternate specifications) are included in all specifications in the full model. Former capital, Lagos dummies are included and Lagos excluded in alternate specifications with results unchanged. Site of the Nigerian civil war, the Southeast zone is excluded in alternate specifications with results largely unchanged (see Appendix). Results remain insignificant when the full centralization index is used. ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level.

Table 7: First stage results: Ecological diversity predicts precolonial centralization

	Precolonial State Centralization				
	(1)	(2)	(3)	(4)	(5)
Ecological Diversity	0.186***	0.192***	0.148***	0.172***	0.170***
	(0.048)	(0.048)	(0.050)	(0.049)	(0.049)
Constant	−2.114**	−2.117**	−1.962**	−2.357***	−2.352***
	(0.855)	(0.854)	(0.816)	(0.809)	(0.809)
Population Density	Yes	No	Yes	No	Yes
Disease controls	Yes	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes*	Yes*
Other controls	Yes	Yes	Yes	Yes	Yes
Supermajority Interaction	No	No	Yes	Yes	Yes
N	821	821	821	821	821
Adjusted R^2	0.113	0.112	0.536	0.534	0.533
F Statistic	14.93	15.98	8.75	12.30	11.92

Notes: IV 2SLS regression first stage OLS estimates. Robust standard errors in parentheses. Disease controls include malaria and tse tse suitability in alternate specifications. Geographic controls include ruggedness, mean elevation, agricultural land suitability and distance to capital and rivers in (1)-(3). Ruggedness excluded from geographic controls in (4) and (5). Other controls include slavery and petrol. Results remain significant in most specifications when the full centralization index is used. Results remain significant when the supermajority muslim interaction is included. Results in (3), (4) and (5) interaction case should be interpreted with caution due to collinearity between the centralization indicator and supermajority muslim interaction on the RHS and, in the case of (3), an F-statistic < 10. Population density is included in all specifications in the full model. ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level.

Table 8: OLS and IV results: Heterogenous effects of precolonial centralization on access to high federal state control infrastructure services

	Grid (OLS)		Grid (IV)		Flush (OLS)		Flush (IV)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Centralization	0.039*	0.059**	0.454**	0.367*	0.009	0.024*	0.545***	0.405*
	(0.024)	(0.023)	(0.213)	(0.204)	(0.014)	(0.014)	(0.176)	(0.236)
Supermajority Muslim		0.021		0.295		−0.026		0.321
		(0.031)		(0.180)		(0.021)		(0.212)
Cent x S.Mus		−0.070*		−0.382*		−0.044**		−0.431*
		(0.036)		(0.208)		(0.017)		(0.241)
Constant	−0.456	−0.345	0.365	0.247	0.234	0.205	1.202***	0.905*
	(0.408)	(0.346)	(0.601)	(0.607)	(0.255)	(0.229)	(0.413)	(0.546)
Population Density	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Disease controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	821	821	821	821	821	821	821	821
R^2	0.151	0.193	0.160	0.162	0.336	0.355	0.337	0.343
Adjusted R^2	0.140	0.180	0.150	0.151	0.327	0.345	0.329	0.335

Notes: Robust standard errors in parentheses clustered by ethnicity in OLS specifications and state in IV interactions. Errors clustered by state in alternate specifications with results unchanged. Dependent variable measures Grid access in (1)-(4), Flush toilet access in (5) -(8). Disease controls include malaria and tse tse suitability in alternate specifications. Geographic controls include ruggedness, mean elevation, agricultural land suitability and distance to capital and rivers and seacoast in OLS specifications. Other controls include slavery and petrol. Results remain significant in some specifications when the full centralization index is used. Population density is included in all specifications in the full model. ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level.

Table 9: Reduced form estimates of the relationship between 'punished' (Cent=1 and S. Mus=1) areas and trust in local governing councils, police and army (Cent=1 split sample observations)

	Local Governing Council			Police	Army	
	(1)	(2)	(3)	(4)	(5)	(6)
Supermajority Muslim	0.382***	0.358***	0.430***	0.058	0.072	−0.029
	(0.076)	(0.104)	(0.095)	(0.130)	(0.132)	(0.140)
No Police		0.757***	0.764**	0.352	0.462	0.364
		(0.288)	(0.297)	(0.321)	(0.399)	(0.372)
Petrol		−0.131	−0.119	−0.092		−0.157
		(0.114)	(0.105)	(0.093)		(0.111)
Constant	0.896***	1.310***	1.906***	1.185	1.410***	−1.054
	(0.054)	(0.263)	(0.685)	(1.088)	(0.071)	(1.200)
Population Density	Yes	Yes	Yes	Yes	Yes	Yes
Disease controls	No	No	Yes	Yes	No	Yes
Geographic controls	No	Yes	Yes	Yes	No	Yes
N	187	160	160	172	193	159
R^2	0.221	0.363	0.386	0.144	0.031	0.107
Adjusted R^2	0.213	0.321	0.336	0.079	0.016	0.033

Notes: Regressions estimated by OLS. Robust standard errors in parentheses clustered by state. Dependent variables are from the 2012 Afrobarometer survey and are reported trust in local governing councils, police trust (reported) and trust in the army. Disease controls includes malaria and tse tse fly suitability in alternate specifications. Geographic controls include ruggedness, mean elevation, agricultural land suitability and distance to capital and rivers and sea coast. Population density and controls for slavery are included in all specifications in the full model. ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level.

Table 10: Reduced form estimates of the relationship between 'punished' (Cent=1 and S.Mus=1) areas and trust in federal institutions (police) over traditional leaders (Cent=1 split sample observations)

	'Trust' in Police Over Traditional Leaders				
	(1)	(2)	(3)	(4)	(5)
Supermajority Muslim	−0.176	−0.197*	−0.185	−0.205*	−0.256*
	(0.115)	(0.115)	(0.117)	(0.117)	(0.133)
Petrol	−0.141	−0.148	−0.169*	−0.195**	−0.129
	(0.103)	(0.098)	(0.097)	(0.098)	(0.084)
No Police			−0.828**	−0.756**	−0.709*
			(0.323)	(0.318)	(0.367)
Constant	0.407***	0.448***	0.502***	0.573***	0.536*
	(0.051)	(0.061)	(0.064)	(0.106)	(0.304)
Population Density	Yes	Yes	Yes	Yes	Yes
Slavery	No	Yes	Yes	Yes	Yes
Geographic controls	No	No	No	Yes*	Yes
N	212	212	212	212	175
R^2	0.078	0.096	0.131	0.140	0.157
Adjusted R^2	0.064	0.078	0.110	0.115	0.117

Notes: Regressions estimated by OLS. Standard errors in parentheses clustered by state. Dependent variable measures choice of police over traditional leaders as first resort for help when the respondent has been victim of a crime (calculated from the 2012 Afrobarometer survey). Slavery is slave exports and is included in most specifications. Geographic controls include ruggedness, mean elevation and agricultural land suitability, include ruggedness alone in column (4). Population density is included in all specifications. ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level.

Table 11: Falsification Test: Reduced form estimates of the relationship between precolonial centralization and distance to railroad

| | Distance to Railroad | |
	(1)	(2)
Centralization	−64.063**	−37.953*
	(27.044)	(20.583)
Supermajority Muslim		63.122
		(47.412)
Cent x S.Mus		−51.559
		(47.103)
Mineral Locality	−12.311	−14.421*
	(8.197)	(7.657)
Constant	230.511	288.812
	(324.515)	(332.805)
Population Density	Yes	Yes
Disease controls	Yes	Yes
Geographic controls	Yes	Yes
N	821	821
R^2	0.316	0.339
Adjusted R^2	0.306	0.327

Notes: Regressions estimated by OLS. Robust standard errors in parentheses clustered by ethnicity. Errors clustered by state in alternate specifications with results unchanged. Disease controls include malaria and tse tse suitability in alternate specifications. Geographic controls include ruggedness, mean elevation, agricultural land suitability, distance to capital, distance to rivers, and seacoast. Population density, petrol and controls for slavery (prevalence and exports in alternate specifications) are included in all specifications in the full model. ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level.

Table 12: Falsification Test: Effect of supermajority Muslim and grid access in non-centralized vs centralized sample

	Dependent Variable: Grid	
	Cent=0	Cent=1
	(1)	(2)
Supermajority Muslim	0.029	−0.070***
	(0.020)	(0.026)
Constant	0.270	−0.340
	(0.208)	(0.279)
Population Density	Yes	Yes
Disease controls	Yes	Yes
Geographic controls	Yes	Yes
N	100	742
R^2	0.236	0.165
Adjusted R^2	0.160	0.155

Notes: Regressions estimated by OLS. Robust standard errors in parentheses clustered by ethnicity. Errors clustered by state in alternate specifications with results unchanged. Sample is non-centralized ($Cent = 0$) in column 1, and centralized ($Cent = 1$) in column 2. Disease controls include malaria and tse tse suitability in alternate specifications. Geographic controls include ruggedness, mean elevation, agricultural land suitability, distance to capital, distance to rivers. Population density and petrol are included in all specifications in the full model. ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level.

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A   Appendix: For Online Publication Only

A.1   Simple Theoretical Model: Sketch

The sections below outline a simple, stylized model driving the empirical specifications and results in this paper. The relationship between ethnic state leaders and the federal autocratic regimes can be conceptualized as 2 distinct but related sequential move games: Game 1 and Game 2. Game 1 outlines the average payoffs of a game between the ethnic state leaders and the British colonial autocrats spanning years 1885-1960. Game 2 continues from the close of Game 1 and outlines the average payoffs of a game between the ethnic state leaders and the Military postcolonial autocrats spanning years 1966-1999. Overall payoffs to ethnic state leaders and corresponding ethnic states is the sum of payoffs over these 2 games.

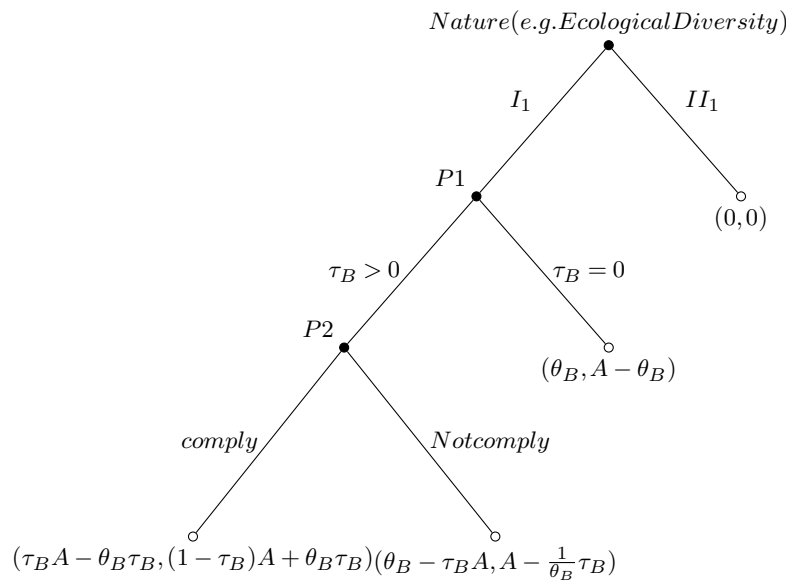## A.2   Game 1: Sequential-Move Game Between the Ethnic State Leaders (P2) and the British Colonial Autocrats (P1)

$$Nature(e.g.EcologicalDiversity)$$

$$I_1 \qquad II_1$$

$$P1$$

$$(0,0)$$

$$\tau_B > 0 \qquad \tau_B = 0$$

$$P2$$

$$(\theta_B, A - \theta_B)$$

$$comply \qquad Notcomply$$

$$(\tau_B A - \theta_B \tau_B, (1 - \tau_B)A + \theta_B \tau_B)(\theta_B - \tau_B A, A - \frac{1}{\theta_B}\tau_B)$$

Figure 11: Sequential Move Game: (I_1, $\tau_B > 0$, comply) is a Nash equilibrium outcome

The game tree in Figure 11 depicts the average payoffs of a sequential move game (Game 1) between the British colonial autocrats (Player 1 denoted as P1 above) and a "continuum" of ethnic

state leaders (Player 2 denoted as P2) lasting from 1885-1960 (Nunn, 2007). P2 can be from two types of ethnic states defined as below:

- I_1 = centralized ethnic state in Game 1 (denoted as the $Cent_e = 1$ in the empirical specification)

- II_1 = non-centralized ethnic state in Game 1 (denoted as $Cent_e = 0$ in the empirical specification)

"Nature" (or ecological diversity used in this paper) determines P2's type. If P2 is of type II_1, the game ends with null payoffs, since bilateral bargaining under a strict form of indirect rule is impossible without an identified sovereign. If P2 is of type I_1, the game proceeds as depicted in Figure 11 with P1 as the initial mover in the first stage. The payoffs of the game are determined by a bilateral bargaining and reward/punishment scheme between the British colonial autocrats and the centralized ethnic state leaders. When the centralized ethnic state leaders were compliant with British colonial autocrats, they were rewarded with some proportion of federal benefits θ_B $\in (0,1)$ (e.g. in terms of public service provision like railroad construction (Gardner, 2012) and increased political autonomy in their region (Ogbomo, 2005; Otoide, 2005)). When the centralized ethnic state leaders were not compliant with the British colonial autocrats, they were punished by a withdrawal of these benefits (e.g. forfeited autonomy through bloody depositions and exiles (Ogbomo, 2005; Otoide, 2005)). The ethnic state leader's centralized status allows the British autocrats to monitor and target punishment in a so-called punishment regime (Magaloni, 2006). compliance in Game 1 with the British colonial autocrats entailed adherence to the fiscal policy instrument described below.

In the first stage of Game 1, the British colonizer (P1) moves, choosing a fiscal policy instrument τ_B. The instrument, $\tau_B \in (0,1)$ is a fiscal transfer or a "rate of extraction" that defines the proportion of the initial wealth of the ethnic state A (with $A \in [0,1]$) (measured in amounts of agricultural commodities produced- most notably cash crops like cocoa, groundnuts and palm kernel) that is expropriated by the British colonial regime (Nunn, 2007). The policy instrument τ_B can be taxes collected by the British federal autocratic regime, levies or any fiscal transfers to the federal autocratic regime from the centralized ethnic state leader P2 of type II_1.

If the British colonizer chooses the no tax regime ($\tau_B = 0$), then the game ends and the expected payoff to the colonizer is θ_B, the benefit that would have been transferred to the ethnic state leader. The expected payoff to the centralized ethnic state leader is $A - \theta_B$, their initial wealth minus the foregone benefits from the tax instrument.

If the British colonizer chooses the positive tax regime ($\tau_B > 0$), then the centralized ethnic state leader, in the second stage of the game, can choose to "comply" and hand over collected tax revenue or "Not comply" and do the opposite. When the centralized ethnic state leader chooses to comply, the expected payoff to the British colonial autocrats is $\tau_B A - \theta_B \tau_B$ or the proportion of the initial wealth expropriated minus the amount of the benefit given to the ethnic state leader, scaled by the amount of the tax. The expected payoff the centralized ethnic state leader from compliance is $(1 - \tau_B)A + \theta_B \tau_B$ or the proportion of the initial wealth transferred to the British colonial autocrats plus the corresponding benefit.

When the centralized ethnic state leader chooses not to comply under the positive tax regime, the expected payoff to the British colonial autocrat is $\theta_B - \tau_B A$, the withheld benefit. The expected payoff to the centralized ethnic state leader from non-compliance under the positive tax regime is $A - \frac{1}{\theta_B}\tau_B$, the full value of the initial wealth minus the foregone benefit or punishment scaled as the inverse of θ_B times the tax. A weak restriction on the parameters is placed as follows: $\theta_B \leq \tau_B \leq A$.

Proposition A.1. *For values of $A \gg (\tau_B, \theta_B)$ and $\tau_B - \theta_B = \epsilon \to 0$, the second stage subgame has a Nash equilibrium in which $(I_1, \tau_B > 0, comply)$ is an equilibrium outcome.*

A.3 Game 2: Sequential-Move Game Between the Ethnic State Leaders (P2) and the Military Postcolonial Autocrats (P1)

The game tree in Figure 12 depicts the average payoffs of a sequential move game (Game 2) between the Military postcolonial autocrats (Player 1 denoted as P1 above) and a continuum of ethnic state leaders (Player 2 denoted as P2) lasting from 1966-1999. Continuing from Game 1 and following differential British policy between the Muslim north and the south of the country, P2 can be from two types defined as below:
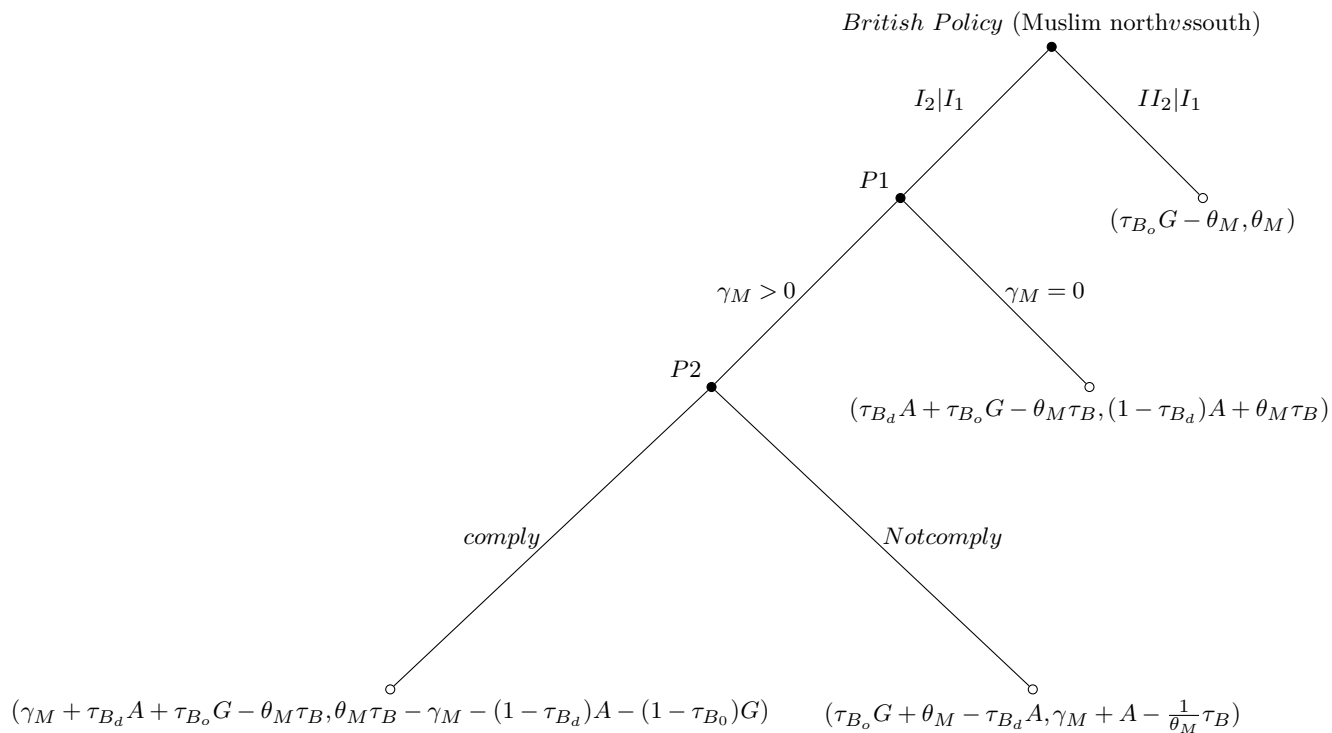
$British\ Policy$ (Muslim north vs south)

$I_2|I_1$ $\qquad$ $II_2|I_1$

$P1$

$(\tau_{B_o}G - \theta_M, \theta_M)$

$\gamma_M > 0$ $\qquad$ $\gamma_M = 0$

$P2$

$(\tau_{B_d}A + \tau_{B_o}G - \theta_M\tau_B, (1 - \tau_{B_d})A + \theta_M\tau_B)$

$comply$ $\qquad$ $Not comply$

$(\gamma_M + \tau_{B_d}A + \tau_{B_o}G - \theta_M\tau_B, \theta_M\tau_B - \gamma_M - (1 - \tau_{B_d})A - (1 - \tau_{B_0})G)$ $\qquad$ $(\tau_{B_o}G + \theta_M - \tau_{B_d}A, \gamma_M + A - \frac{1}{\theta_M}\tau_B)$

Figure 12: Sequential Move Game: $(I_2|I_1, \gamma_M > 0,$ Not comply) is a Nash equilibrium outcome

- $I_2|I_1 =$ hegemonized ethnic state in Game 2 given was centralized in Game 1 (denoted as the $S.Muslim_e = 1$ and $Cent_e = 1$ in the empirical specification)

- $II_2|I_1 =$ non-hegemonized ethnic state in Game 2 given was centralized in Game 1 (denoted as the $S.Muslim_e = 0$ and $Cent_e = 1$ in the empirical specification)

Differential British policy between the Muslim north and the south of Nigeria led to strengthening of sovereignty among centralized ethnic state leaders in the Muslim north of the country, a process termed pre-independence hegemonization here. It led to the weakening of sovereignty among centralized ethnic state leaders in the south of the country, a process termed pre-independence non-centralization here. centralized ethnic state leaders in the south (including the non 'super-Muslim' north) were eventually replaced by mostly democratically elected local officials, marking a gradual to near complete loss of sovereignty in their regions by the beginning of the military era with the reverse process occurring in the Muslim north as a result of differential British policy towards both regions (Mamdani, 1996; Dudley, 1968; Tonwe and Osemwota, 2013). It was the policy

that determined Player 2's type in Game 2. The early part Game 2, notably the 1970s marked a change in the composition of federal revenue with the share of oil revenue in government revenue rising to over 80% and the share of agricultural revenue falling dramatically in comparison. The change was driven by an oil boom and rising oil prices leading to huge windfalls for the regime in revenue from petroleum (Tonwe and Osemwota, 2013; Mustapha, 2006; Olasupo, 2001). Wealth from oil is denoted as $G \in [0,1]$ in Game 2. The tax instrument, modeled after the British system, is $\tau_B = \tau_{B_d} + \tau_{B_o}$, the sum of domestic taxes of primarily sourced from agricultural commodities initial wealth A, denoted as τ_{B_d} and corporate taxes of foreign oil companies sourced from oil wealth G, denoted as τ_{B_o}. As before, $\tau_B \in (0,1)$. Nationwide public service provision by the military autocrats in the 1970s-1980s, particularly regarding investments in grid based electricity and sanitation infrastructure like flush toilets, was funded, primarily, by the oil windfall (Tonwe and Osemwota, 2013; Uduku, 1994). These military funded federal benefits are denoted as $\theta_M \in (0,1)$ here. Rules of the game regarding bilateral bargaining and reward/punishment scheme are as in Game 1. When the hegemonized ethnic state leaders (P2 of type $II_2|I_1$) were compliant with military postcolonial autocrats, they were rewarded with some proportion of federal benefits θ_M (e.g. access to federal state controlled public services). When the hegemonized ethnic state leaders (P2 of type $II_2|I_1$) were not compliant with the military postcolonial autocrats, they were punished by a withdrawal of these benefits. As in Game 1, the ethnic state leader's hegemonized status allows the military autocrats to monitor and target punishment in a punishment regime (Magaloni, 2006). compliance in Game 2 with the military postcolonial autocrats entailed adherence to the legal policy instrument described below.

When P2 is of type $II_2|I_1$, the game ends trivially with an expected payoff to the military autocrat of the proportion of the taxed oil revenue less the national public service provision described above, and the expected payoff to non-hegemonized ethnic states of the public service provided $\theta_M \tau_B$ as depicted in Figure 12.

In the first stage of Game 2, the military autocrat (P1) moves, choosing a legal policy instrument γ_M. The instrument, $\gamma_M \in [0, \infty)$ is a legal transfer of political autonomy from ethnic state leaders to the federal military government through the landmark 1976 Local Government Reform

law. The 1976 law removed ethnic state leaders from their posts as official representatives of local government , and banned them from participation in democratically elected local governments propped up by the military party system. It relegated them to advisory roles only. It also allowed for an official grant for the local government leaders as a proportion of mostly oil fueled federal revenue. (Tonwe and Osemwota, 2013; Hickey, 1984; Mustapha, 2006; Blench et al., 2006).

If the military autocrat chooses the no legal policy regime ($\gamma_M = 0$), then the game ends and the expected payoff to the military autocrat, is similar to the equilibrium scenario in Game 1 (described in Proposition A.1), with the expected payoff to the military autocrat equal to $\tau_{B_d}A + \tau_{B_o}G - \theta_M\tau_B$, or the sum of the proportion of initial wealth and government revenue appropriated minus the proportion spent on public benefits or public service provision $\theta_M\tau_B$. The expected payoff to the hegemonized ethnic state leader is $(1 - \tau_{B_d})A + \theta_M\tau_B$ or the sum of the proportion of initial wealth retained and and public services provided by the federal regime.

If the military autocrat chooses the positive legal policy regime ($\gamma_M > 0$), then the hegemonized ethnic state leader, in the second stage of the game, can choose to "comply" and step down from their official post without inciting rebellion among their constituents or "Not comply" and refuse to step down, typified by refusal to abstain from local governance politics, withholding tax revenue and, notably from the historiography, inciting rebellion among their constituents (Hickey, 1984; Tonwe and Osemwota, 2013). When the hegemonized ethnic state leader chooses to comply, the expected payoff to the military autocrats is $\gamma_M + \tau_{B_d}A + \tau_{B_o}G - \theta_M\tau_B$ or the sum of the political autonomy transferred from the ethnic state leader to the military autocrat, some proportion of the initial wealth and government revenue minus the proportion spent on public benefits or public service provision. The expected payoff to the hegemonized ethnic state leader is $\theta_M\tau_B - \gamma_M - (1 - \tau_{B_d})A - (1 - \tau_{B_0})G$ or the public service provision issued from the military autocrat minus the political autonomy given up, along with the proportion of initial wealth and government revenue given up by the ethnic state leader with the relinquishing of their position as an official local government representative.

When the hegemonized ethnic state leader chooses not to comply under the positive legal

policy regime, the expected payoff to the military autocrat is $\tau_{B_o}G + \theta_M - \tau_{B_d}A$ or the proportion of oil wealth kept along with the share of public benefits θ_M minus the proportion of the initial wealth $\tau_{B_d}A$ withheld by the non-compliant ethnic state leader (note, there is no loss of political autonomy by the military autocrat here since the aim of the legal policy is a unilateral transfer of autonomy). The non-compliant hegemonized ethnic state leader receives an expected payoff of $\gamma_M + A - \frac{1}{\theta_M}\tau_B$ or the withheld political transfer γ_M and initial wealth minus the withheld public services (or plus a punishment) from the federal regime equal to the scaled inverse of θ_M. A weak restriction on the parameters is placed as follows: $G > A$ and $\tau_{B_o} \gg \tau_{B_d}$.

Proposition A.2. *For values of A, γ_M, θ_M and τ_B such that $(A, \gamma_M) > \theta_M$ and $\tau_B < \theta_M$ with $\tau_{B_d} \to 0$ (note in alternate, simplified versions of the model, τ_{B_d} can be normalized to 0 with no change in the results), the second stage subgame has a Nash equilibrium in which $(I_2|I_1, \gamma_M > 0,$ Not comply) is an equilibrium outcome. When $(A, \gamma_M) > \theta_M$ and $\tau_B < \theta_M$, "Not comply" is a dominant strategy for player 2 in Game 2.*
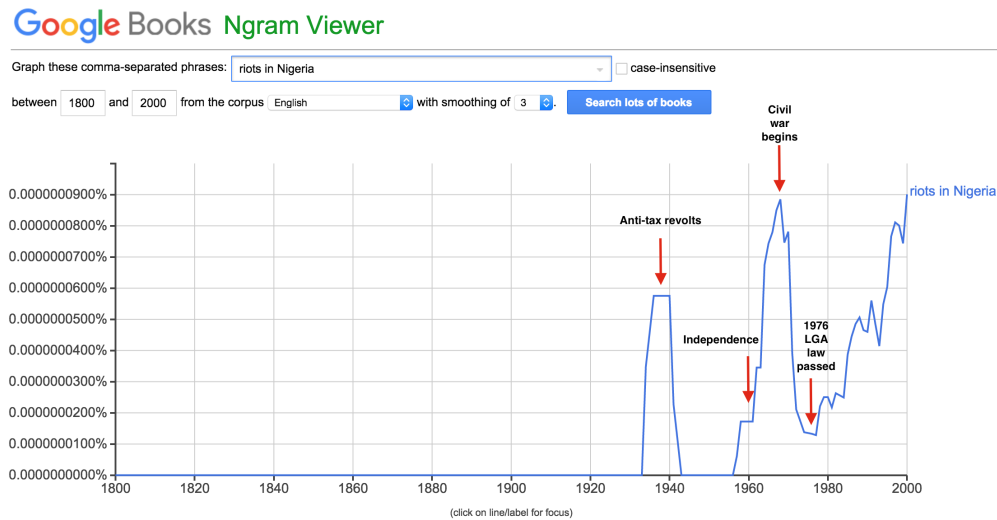
A.4 Riots in Nigeria: Google Ngram data

Figure 13: Frequency of 'Riots in Nigeria' mentions in database of google books over available time period
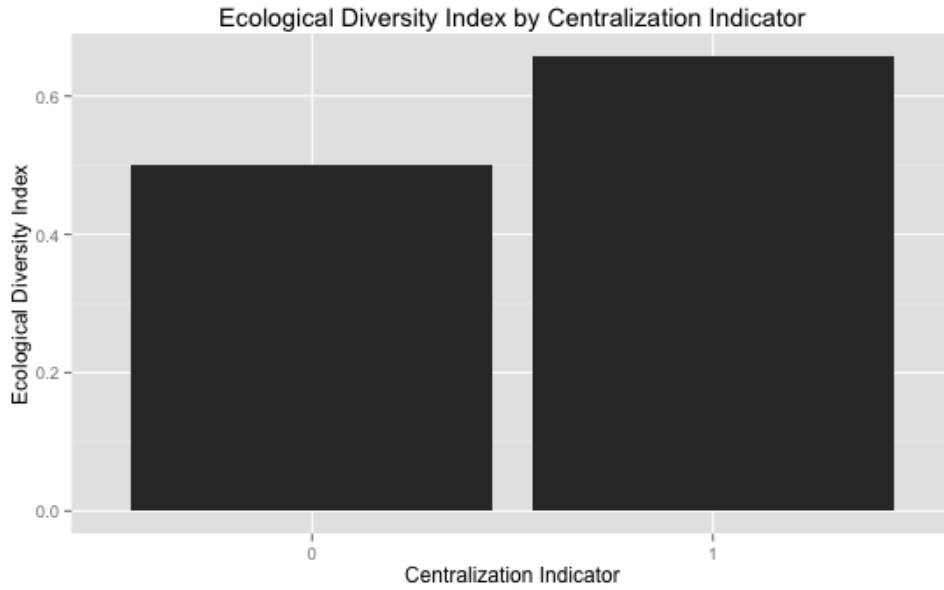
A.5 Robustness checks

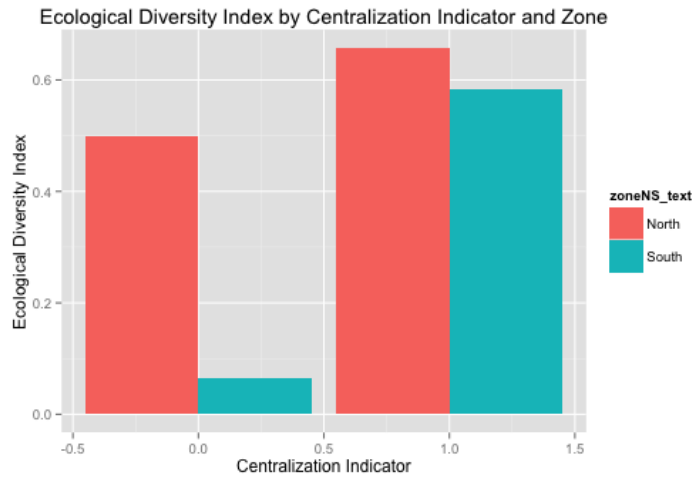Figure 14: Ecological Diversity Index Range by Centralization Indicator

Figure 15: Ecological Diversity Index by Centralization Indicator and Geopolitical Zone

Table 13: Cross-Correlation matrix between new dataset (OSSAP in 2011-2012) and DHS dataset (2013)

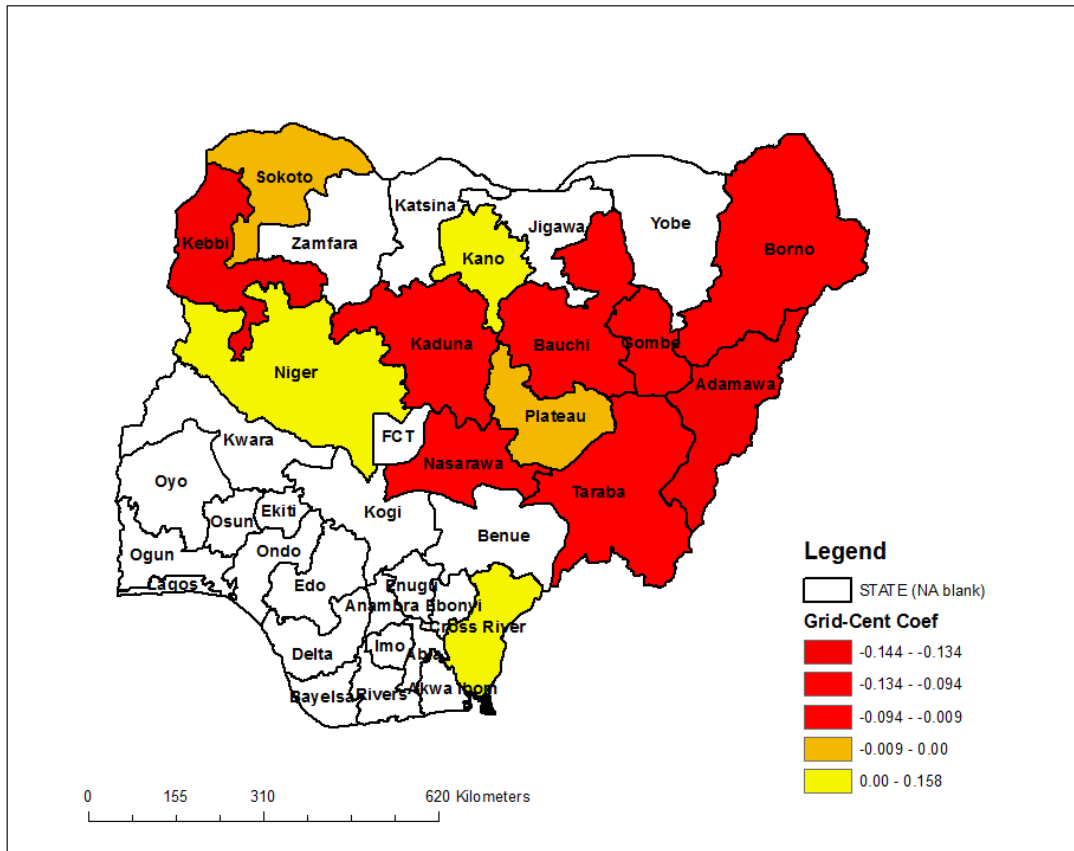| Correlations	Power (DHS 2013)	Flush (DHS 2013)	Latrine (DHS 2013)	Tubewell (DHS 2013)	Piped Water (DHS 2013)
Grid (OSSAP)	0.52***	0.5***	-0.06	0.2***	0.27***
Power (OSSAP)	0.51***	0.52***	-0.09*	0.24***	0.24***
Offgrid (OSSAP)	0.36***	0.44***	-0.09*	0.21***	0.14***
Flush (OSSAP)	0.47***	0.66***	-0.23***	0.21***	0.17***
Latrine (OSSAP)	0.02	-0.24***	0.46***	0.07	0.02
Tubewell (OSSAP)	0.23***	0.35***	-0.03	0.3***	0.07
Piped Water (OSSAP)	0.18***	0.13***	0.04	0.05	0.36***

Figure 16: Effects of precolonial centralization on grid access with varying slopes at current state-level (heterogeneity with multilevel model). In red, areas where coefficient turns noticeably negative.

Table 14: Cross-Correlation matrix between new dataset (OSSAP in 2011-2012) and DHS dataset average (avg. over 1990-2013)

Correlations	Power (DHS avg)	Flush (DHS avg)	Latrine (DHS avg)	Tubewell (DHS avg)	Piped Water (DHS avg)
Grid (OSSAP)	0.54***	0.54***	0	0.20***	0.36***
Power (OSSAP)	0.54***	0.56***	-0.02	0.22***	0.32***
Offgrid (OSSAP)	0.37***	0.46***	-0.05	0.19***	0.18***
Flush (OSSAP)	0.50***	0.72***	-0.17***	0.27***	0.23***
Latrine (OSSAP)	0.09	-0.18***	0.41***	0	0.05
Tubewell (OSSAP)	0.26***	0.42***	0	0.32***	0.18***
Piped Water (OSSAP)	0.22***	0.19***	0.03	-0.01	0.45***

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Table 15: Results from DHS dependent variables from 1990-2013: Precolonial Centralization predicts access to historically federally administered services (Power (grid) and Flush Toilets). Negative impacts under punishment regimes with high state control infrastructure- (grid based) Power and Flush toilets access lower in centralized, Supermajority Muslim ('punished') areas

	Power(Grid)		Flush	
	(1)	(2)	(3)	(4)
Centralization	0.095*	0.140*	0.039**	0.059**
	(0.053)	(0.081)	(0.019)	(0.026)
Supermajority Muslim		−0.002		−0.042
		(0.083)		(0.030)
CentXMus		−0.200**		−0.055*
		(0.086)		(0.029)
Petrol	0.087	0.035	0.098***	0.078***
	(0.067)	(0.050)	(0.022)	(0.019)
Constant	−1.155	−1.658**	0.674**	0.354
	(0.859)	(0.772)	(0.333)	(0.254)
Population Density	Yes	Yes	Yes	Yes
Disease controls	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes
N	631	631	631	631
R^2	0.126	0.177	0.191	0.213
Adjusted R^2	0.112	0.160	0.178	0.196

Notes: Regressions estimated by OLS. Robust standard errors in parentheses clustered by ethnicity. Errors clustered by state in alternate specifications with results unchanged. Dependent variables are averages over 1990-2013 DHS records. Disease controls includes malaria and tse tse fly suitability in alternate specifications. Geographic controls include ruggedness, mean elevation, agricultural land suitability and distance to capital and rivers and sea coast. Population density and controls for slavery are included in all specifications in the full model. Slavery not included in (1) only, (effect size is 0 for slavery), results for (1) remain significant in alternate specifications when slavery added as a control. Lagos dummies are included and Lagos excluded in alternate specifications with results unchanged. The Southeast zone is excluded in alternate specifications with results largely unchanged (tables available on request). Results remain significant in most specifications when the full Centralization index is used (tables available on request). Model tested in the split sample in non supermajority muslim states and effects for centralization remain significant. ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level.

Afrobarometer Distribution of 'Trust' in Leaders by Centralization and Supermajority Muslim Indicator

'Who do you go to first for help if victim of a crime?' responses (tan=cent, green=supermaj. mus.) (3=traditional leader)
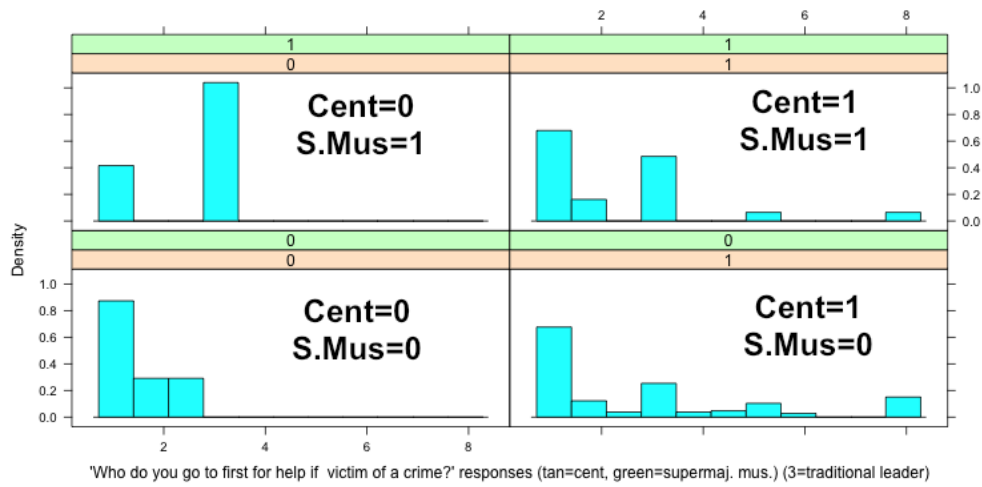
Figure 17: Respondents from centralized areas subjected to punishment regime (proxied by supermajority Muslim indicator) report less "trust in police over traditional leaders" than their centralized counterparts in non-punishment regime states: 1= police, 3=traditional leaders

Table 16: Impacts of precolonial centralization in the split sample where S.Mus=0: Results positive and significant for federally administered services (grid, flush, health professional density)

	Grid	Flush	Health Prof.	Latrine
	(1)	(2)	(3)	(4)
Centralization	0.059**	0.029*	0.355*	−0.016
	(0.024)	(0.017)	(0.201)	(0.026)
Slavery	0.004	−0.038	−0.607	0.009
	(0.068)	(0.046)	(0.519)	(0.082)
Petrol	0.043*	0.098***	1.071***	0.005
	(0.022)	(0.021)	(0.166)	(0.033)
Constant	−0.407	0.094	8.259**	−0.239
	(0.376)	(0.288)	(3.669)	(0.448)
Population Density	Yes	Yes	Yes	Yes
Disease controls	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes
N	606	606	593	606
R^2	0.164	0.263	0.250	0.083
Adjusted R^2	0.148	0.251	0.236	0.066

Notes: Regressions estimated by OLS. Robust standard errors in parentheses clustered by ethnicity. Errors clustered by state in alternate specifications with results unchanged. Disease controls includes malaria and tse tse fly suitability in alternate specifications. Geographic controls include ruggedness, mean elevation, agricultural land suitability and distance to capital and rivers and sea coast. Population density and controls for slavery (prevalence and exports in alternate specifications) are included in all specifications in the full model. ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level.

Table 17: Results remain unchanged with southeast zone dropped

	Grid)		Flush	Yellow Fever Imm.
	(1)	(2)	(3)	(4)
Centralization	0.041*	0.061**	0.025*	0.069**
	(0.025)	(0.024)	(0.014)	(0.034)
Supermajority Muslim		0.022	−0.011	
		(0.031)	(0.019)	
CentXMus		−0.072*	−0.046**	
		(0.037)	(0.018)	
Petrol	0.079***	0.047	0.117***	0.012
	(0.030)	(0.032)	(0.031)	(0.031)
Constant	−0.403	−0.325	−0.032	−0.198
	(0.412)	(0.354)	(0.195)	(0.654)
Population Density	Yes	Yes	Yes	Yes
Disease controls	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes
N	729	729	729	707
R^2	0.155	0.197	0.357	0.041
Adjusted R^2	0.143	0.182	0.346	0.026

Notes: Regressions estimated by OLS. Robust standard errors in parentheses clustered by ethnicity. Errors clustered by state in alternate specifications with results unchanged. Sample is observations excluding the site of the Nigerian civil war, the Southeast zone. Dependent variable measures Grid access in (1) -(2) and Flush toilet access in (3) and Yellow fever immunization in (4) . Disease controls include malaria and tse tse suitability in alternate specifications. Geographic controls include ruggedness, mean elevation, agricultural land suitability, distance to capital, distance to rivers, and seacoast. Population density and controls for slavery (prevalence and exports in alternate specifications) are included in all specifications in the full model. ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level.