After forever: Pre-colonial states and civil conflict

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Abstract

This paper examines the relationship between the degree of pre-colonial state presence and post cold war civil conflict. While there appears to be a significant overall conflict inducing effect to pre-colonial states, this paper find that such effects are in large part conditional on the distance to capital. I that higher levels of pre-colonial state presence are conflict reducing in areas surrounding modern capital cities. I argue this is due to greater continuity of traditions and institutions associated with statehood that are inherently conflict reducing. While in areas further away form current capital high levels of pre-colonial statehood represent powerful symbols of independence useful for mobilization, and regional elite networks (formal or informal) with the potential to violently resist state expansion into their sphere of influence. Additionally, the paper introduces the Geo-ISD data set, which dynamically maps the borders of 82 independent states in Africa in the 1800-1914 period.

Keywords— Conflict, civil war, pre-colonial states, GIS, ZINB, historical state entities

1 Introduction

Something that tends to be overlooked in the discussion of the European colonization of Africa, is that for the most part what the Europeans conquered were pre-existing states[1], with their own armies, dynasties and sometimes hundreds of years of history. Likewise, numerous studies have examined how colonial experiences have shaped post independence levels of conflict (Achankeng, 2013; Blanton et al., 2001; Carton, 2000; Cohen, 2014; Nunn, 2008; Wucherpfennig et al., 2016). Nevertheless, only a handful of recent studies have looked at how independent pre-colonial African polities have shaped post independence conflict, despite their simultaneous or immediately preceding existence. Within this emerging literature, the effect of pre-colonial states on civil conflict appears contradictory. While some find a conflict inducing effect due to differences between ethnic groups with and without histories of statehood (Englebert et al., 2002; Paine, 2019), others find a conflict reducing effect from institutions inherited from these states (Depetris-Chauvin, 2016; Wig, 2016).

This paper addresses this puzzle by arguing that the effect of pre-colonial states is determined by whether or not the given pre-colonial state forms the basis of the post-independence state. In many countries in Africa there is at least some continuity of rule and institutions running from a pre-colonial state, through colonial administration, to the post-colonial state. In these cases the state is able to draw upon old institutions and governance capacity. On the other hand, there are areas with long histories of independent statehood that find themselves ruled from far away capitals, whose populations prior to the colonial era had little to no contact. In these cases, local elite networks with the capacity to mobilize for conflict often find their interests at odds with the central state's.

To test this theory I introduce new and innovative data on pre-colonial statehood in Africa, which leverages variations in contemporaneous sources to provide a measure of historical statehood with fuzzy borders and gradually dissipating state presence outside core areas. The data covers far more states than comparative data sets, without compromising on the inclusion criteria for statehood. Crucially, it geocodes individual pre-colonial states, as opposed to aggregations to current administrative levels or ties to settlement patterns of related ethnic groups. Nor does the data take (currently politically relevant) ethnic groups as a starting point for inclusion.

I find evidence that there is an significant overall conflict inducing effect of pre-colonial states. However, this effect is conditioned on the distance to current capitals. I argue that close to capitals, high levels of pre-colonial state presence reflects some degree of continuation of rule, providing legitimacy and institutions that are inherently peace inducing. On the other hand, low levels of state presence reflect a lack of foundation for the modern state, and is often an indication of capitals created by and for colonial administration. I find a substantial conflict reducing effect at moderate levels of pre-colonial statehood near capitals, form an initially high level of conflict in

[1] An extended discussion of what kind of statehood existed in pre-colonial Africa will follow below.

cases without any, or very low levels of statehood. Outside capital areas the story is reversed. I find that low levels of state presence are conflict reducing, while high levels of state presence are conflict inducing. I argue that this is because pre-colonial states leave behind powerful symbols of independence useful for mobilization, as well as regional elite networks (formal or informal) with the potential to violently resist state expansion into their sphere of influence.

2 Literature review

Despite the emerging literature on the impacts of traditional and pre-colonial states and institutions, the nature of the relationship between such historical roots and conflict remains disputed. From a game theoretical perspective like that of Fearon (1995), one would expect pre-colonial institutions to be conflict reducing. Groups who interact with the (modern) state through (traditional or otherwise) institutions reduce the uncertainty of future behaviour relative to groups who bargain through individuals, who are inherently more unpredictable and more prone to spoilers (Wig, 2016). Additionally, institutions are able to make credible commitments by putting restraints on their leaders through imposing violation costs. If a leader reneges on a commitment ratified by an institution, it reduces the legitimacy of the institutions and thus other laws passed by it. Pre-colonial or traditional institutions could also be conflict reducing by improving local state capacity, which could have a direct effect on the states ability to impose and preserve order as well as an indirect effect through economic development (Depetris-Chauvin, 2016). In support of this latter argument, Depetris-Chauvin (2016) finds that areas with more 'state history' have higher levels of trust in various political leaders.

On the other hand, emphasizing the how the state as a whole is affected by multiple pre-colonial state, rather than just considering a dyadic relationship with the state, another branch of the literature has argued for potential conflict inducing effects of pre-colonial states.

Colonial boundaries that bundled together multiple ethnic groups with different historical experiences of political organization, led to a 'suffocation' effect (Englebert et al., 2002). In such an environment, post-independent states found it difficult to create a sense of nationality, cohesion or solidarity among its population, leading to higher levels of conflict (Englebert et al., 2002). This argument ties in to the larger literature on 'artificial states', which argues that many states, in Africa in particular, are artificial in the sense that their boundaries do not reflect the underlying topography of statehood (Alesina et al., 2011). This artificiality has been linked to lower levels of economic development, presumably working in part through increased ethnic tensions and conflict (Alesina et al., 2011). In this view, both having no pre-colonial states, as well as having more than one, could be considered artificial.[2]

[2]At least when these states were incorporated into the current boundaries by external force (such as colonizers), as opposed to 'indigenously' (as for example the 100+ states of Germany being unified by Prussia).

In cases where there are multiple groups with similar claims to pre-colonial independence, this can make conflict a rational option for the state [3] Choosing to accommodate one claims-making group in such an environment could lead to further claims by similar groups. This makes the option of punishing any group who makes demands relatively cheaper, and thus makes conflict a more likely outcome (Wishman and Butcher, ming).

Ethnic groups with a history of statecraft, are likely to be have an over sized share of power in government (Wucherpfennig et al., 2016). This can come about through indirect colonial rule, which preferred to leaving existing power structures intact, or by seizure from less politically experienced groups following independence (Paine, 2019). When faced with a trade off between including strong rivals[4] in government and risking coups, and excluding them and risking civil conflict, rulers generally avoid risk of coup (Paine, 2019; Powell, 2014; Roessler, 2011).[5] Paine (2019) predicts that pre-colonial state groups are more likely to be in such a situation due to commitment issues vis-a-vis other groups, and thus are more often engaged in civil conflicts. This also ties in with the substantial literature on the conflict inducing impact of horizontal inequalities (Cederman et al., 2011).

Apart from institutions, pre-colonial states potentially leave behind symbols of sovereignty and vertical elite networks (Wishman and Butcher, ming). Past independence has become an important ingredient in most struggles for national independence, and is used by conflict entrepreneurs to overcome collective action problems, as well as to provide a basis for ethnic claims making by referring to past violations of sovereignty (Ahram, 2019; Shelef, 2016). Vertical elite networks [6] are useful for mobilization, and the fact that they are elite networks means that they have expectations of being included in government, have substantial regional autonomy, or both (Wishman and Butcher, ming). Recent work by Ying (2020) indicates that civil conflict tends to occur when the state increases its presence in areas that it has hitherto not been present, i.e. when it challenges the autonomy of regional elites. For example, in Ethiopia, the Afar Liberation Front was originally formed by the sultan of the former pre-colonial state of Awsa, when the Dirge regime tried to depose the sultan (Shehim, 1985; Hanfare, 2011). In Libya the Cyraneica Liberation Army demonstrates both the symbolic mechanism as well as the elite networks, as its name refers to a short lived kingdom in Eastern Libya, and the group elected a descendent of the former king as their leader (Ahram, 2019).

Summarising the literature it is evident that pre-colonial states could have either conflict in-

[3] Conflict is otherwise assumed to be the outcome of miscalculations due to information problems in most game theory models.

[4] 'Strong rivals' refer to rival (ethnic) groups who would be capable of punishing the ruling group for exclusion.

[5] Note that in some cases the ruler is forced to include the rival group, for example in cases of split dominion, when the colonial power split the responsibility of the civil and military administration between different ethnic groups (Paine, 2019).

[6] The vertical orientation of these networks stem from the vertical power structures typical of states.

ducing or conflict reducing effects depending on which mechanisms are active.

3 The importance of pre-colonial roots for avoiding civil conflict

I argue that how pre-colonial states affect conflict, is determined by whether or not the pre-colonial state in a given area inherited the modern state. In other words, the local level of conflict is affected by the degree to which the current state has been build on top existing state structures, as opposed to colonial structures in most other instances.

As discussed previously, pre-colonial state groups were in a prime position to seize the state apparatus upon independence (Paine, 2019; Wucherpfennig et al., 2016). This could come about through more or less direct hand-over from colonial authorities, as in Libya, or by physical proximity to the levers of power, as in Ghana where the Ashanti reached a power sharing agreement with the state in Accra (less than 200km South of the Ashanti capital of Kumasi). In these cases I expect the institutions and experience of statecraft to work toward greater state capacity and political trust (Depetris-Chauvin, 2016). This should be especially true in the areas surrounding the capital (of the pre-colonial state), where the pre-colonial state would have deeper historical and institutional roots than in formerly more peripheral areas. In areas where the modern capital (more or less) overlaps with that of a pre-colonial state, this better reflects the existing underlying topgraphy of statehood , than cases where the post-colonial capital does not have any pre-colonial roots. In other words, these areas can be said to be relatively less 'artificial' (Alesina et al., 2011). Examples of this include Morocco and Burkina Faso who have enjoyed relative continuity in their power structures, and relatively less state based violence (despite a number of coups).

I further argue that it is more likely that a post-colonial state has at least some basis in a pre-colonial state, in terms of institutions, legitimacy or elite networks, where the pre-colonial states were close to the modern capital. In cases where the pre-colonial state territory coincides with the post-independence capital, it is a strong indication of continuity. Moving further away one can observe 'hybrid' cases, such as the aforementioned Ashanti in Ghana.

Conversely, in cases where a pre-colonial state capital ends up far from the post-independence capital, there is less continuity. This bars the state capacity and political trust mechanism from being active, and the institutions, networks and symbols of the pre-colonial states act as regional counter weights instead. The central state has two options: either continue to allow some degree of indirect rule, or impose central authority. Empirically central states tend to expand their influence over time, even if it results in conflict (Ying, 2020). Nigeria is an interesting example of this as the post-independence capital Lagos is on the southern coast, whereas the North contained the lion's share of two pre-colonial empires (Sokoto and Bornu). In the years following independence 'Northerners' wielded a disproportionate share of power, as indicated by the location of numerous

development projects and military installations (Bates, 2008). This is another example of the effect of the political organization of pre-colonial states relative to the rest of the country. While 'Northerners' dominated the political system, that system was not in any way based on their own institutions, which were still relatively intact in both Sokoto and Borno. However, with time, their dominant position faded, and when in 1991 the government tried to split the federal state of Sokoto in two, the sultan opposed the regime and was instrumental in its downfall (Hiribarren, 2017). While not leading to violent confrontation between the state and the regional elite, the case nevertheless illustrates the tensions created when pre-colonial states do not form the basis of the post-colonial state, but exists rather as a competitor to the central state. While the causal chain is harder to trace, the current federal state of Borno has been a hot bed of state based violence, much of which has been centered around Maiduguri, the last capital of independent Borno. In Somalia, the Majarteen clan quickly came to dominate the new state following independence, but like the 'Northerners' in Nigeria they were squeezed out of power. While the Somali situation did not lead to conflict either, the autonomous federal state of Puntland largely corresponds to the borders of the old Majarteen sultanate. In other words, the Somali state has not yet developed the capacity to challenge the autonomy of Puntland.

In summary, I expect pre-colonial state presence[7] to correlate negatively with conflict in areas close to the (post-independence) capital, and positively in areas further away from the capital.

3.1 Pre-colonial states

Before testing the proposed relationship empirically, I need ot clarify the key concept of 'pre-colonial states'. For the purpose of this paper I follow the definition of 'state' used by the International Systems Data (ISD) v2 (Butcher and Griffiths, 2020) as a political entity with a population of at least 10,000, which has autonomy over a specific territory and sovereignty that is either uncontested or acknowledged by relevant international actors (Butcher and Griffiths, 2020)[8]. By this definition the ISD v2 identifies 109 pre-colonial states in Africa during the 1800-1914 period, of which 82 are included in the data used for this paper. This is a heterogeneous group of political entities along most metrics. In size they range from small city states like Harar (today part of Ethiopia), to empires like the Sokoto Caliphate. In political organization they range from loose federations (for example Oyo (Law, 1977)) to relatively centralized kingdoms (Abyssinia/Ethiopia, Buganda, or Zulu).

While smaller states might have been relatively mono-ethnic, larger states were often multi-ethnic, although often politically dominated by one group. While the geographic scope of the paper is Africa, pre-colonial states do include settler states, as long as they were independent. In

[7] This term is explained in detail below.

[8] For a more in depth discussion of the definition of and criteria for statehood that the ISD is based on, see Butcher and Griffiths (2017).

other words Liberia, the Boer Republics and eventually South Africa are included. Based on the relationship with regional powers, some states 'come and go' as sovereign entities. Examples of this include the North African states in their relationship with the Ottoman empire, or Zinder (Sultanate of Damagaram), a city state on the periphery of the Bornu empire, at times nominally subject, de facto subject, or fully independent of Bornu.

While it is difficult to generalize about what this heterogeneous group of states usually were, they were not modern states as we think of states today. For one, there were (to my knowledge) no polices forces nor welfare states in the way we think of them today.[9] Bureaucracies and state apparatus, while at times existing and relatively centralized, were rarely large in size. Nor did any of them have international boundaries in the sense that countries do today (with the exception of some European settler states toward the end of the 19th century).

In other words, states were 'shallow' relative to today. For most of the population, for most of the time, the state was embodied by a local representative (chief, bureaucrat, imam, lord etc.), often with some level of judicial and tax responsibility and wide autonomy. Nominal subjugation and local self rule was also wide spread. For example, the kingdom of Wadai/Bergoo (in Chad) did not have a civil government, but had a royal council (fásher) and a vertical network of political organization running down through regions, to provinces to tribes and villages (Barth, 1857). Tax (diván) rates differed on the basis of prosperity of the area, individual political standing, ethnic affiliation and religious holidays etc., but were generally more uniform in the central provinces. In the surrounding provinces tribute was paid by the province as a whole, reflecting the decreasing reach of the Wadai state. Immediately outside that control, lay the neighboring kingdom of Baghirmi. Who at least in some periods, paid tribute to Wadai while retaining its sovereignty (Barth, 1857).

Despite their relatively shallow state structures, there is ample evidence that many pre-colonial states left marks that were felt long after they were colonized, also in Africa. For example, Pre-colonial states left behind traditional political institutions (Beall et al., 2005; Holzinger et al., 2020; Neupert-Wentz et al., 2021; Ubink, 2008). These institutions have at times acted as mediators between ethnic groups and the central state (Boone, 2014; Englebert et al., 2002), and have been an important sources of legitimacy for current institutions (Wig, 2016)[10]. Nevertheless, some have argued that pre-colonial states have represented competitors to the central state as well (Herbst, 2014). There is also a growing literature on the role of pre-colonial states and institutions in long term economic development (Michalopoulos and Papaioannou, 2018; Acemoglu et al., 2014; Gennaioli and Rainer, 2007; Bockstette et al., 2002; Wilfahrt, 2021).

[9] Although some Islamic welfare systems may have existed in Sokoto (Buba, 2018) and other Muslim states (Weiss, 2002).

[10] According to Mamdani (2018) colonial authorities also felt the need to legitimize their rule through ties to pre-colonial institutions, at times going as far as to invent pre-colonial roots.

4 The Geo-ISD

The availability of reliable data has been a persistent problem in the literature on pre-colonial states. The Murdock (1967) map of ethnic groups and their corresponding 'jurisdictional hierarchy' index of political organization is one of the most frequently used data sources for constructing per-ethnic-group measures of statehood. However, this data has a number of issues (as enumerated by Michalopoulos and Papaioannou (2018)), such as lack of potential overlap between ethnic groups, static borders, relatively short time span and a lack of within-group variation. A further disadvantage of this approach is that by using ethnic groups (and not states) as a starting point, there is a substantial potential for missingness (as not all states are easily tied to a specific ethnic group). For example, Paine (2019), despite using a 'low bar' for statehood and consulting numerous sources, only codes 28 groups in Sub-Saharan Africa as having ties to a pre-colonial state.[11] Using a similar approach Wig (2016) identifies 45 state groups in the same region. Using the State Antiquity Index (Bockstette and Putterman, 2012) as a starting point, Depetris-Chauvin (2016) avoids the limitation of only including state with clear ties to ethnic groups. Nevertheless, his data only includes 54 states in the 1800-1850+ period, as compared to 104 in the ISD version 2, despite using less strict criteria for statehood.

For this paper, as part of the Geo-ISD project consisting of Charles Butcher, research assistant Eirin Haugseth and myself, constructed a novel data set, which geocodes independent African states in the ISD v2 (Butcher and Griffiths, 2020). The ISD v2 picks up a large number of states that are missed by similar data sets, while avoiding the use of arbitrary criteria for statehood such as recognition by European powers (Butcher and Griffiths, 2020). The Geo-ISD builds on the original data set by geocoding the borders of the included states. It also introduces an innovative method for capturing the historical presence of pre-colonial states that addresses some of the weaknesses of the existing geocoded data, namely the number of states identified, static borders, lack of overlap and implied uniformity in state control across territory.

The Geo-ISD uses historically contemporary maps, as close to the primary sources as possible, and containing the borders of states, to determine the extent of different states as close to yearly as possible. Maps were georeferenced in QGIS by connecting recognizable features in the maps (cities, distinctive capes, islands, etc) to their real locations when compared to satellite imagery containing exact location data. The result is a version of the map that is slightly distorted to better fit reality, as can be seen in Figure 1.[12] Shapes of the states included in the ISD v2 for the given year, that were depicted in the map were traced in QGIS. For example, Bornou would be included, but not the neighboring Howssa in Figure 1, as the shape drawn could potentially refer to either the Haussa ethnic group (a common occurrence in these maps) or the multiple Houssa

[11] This is partially also a result of the criteria of 'independence on the eve of colonization'.

[12] The exact specifications for the georeferencing and subsequent transformation will be supplied in the code book, included in the online supplemental material.

states, neither of which qualify as states in the ISD in that year. This process was repeated for all the maps included in the David Rumsey project data base of historical maps, matching the region of Africa in the period 1800 to 1914. The start date was chosen due to the limitations of the ISD v2 which only extends back to 1816 (but includes the founding date of states going further back), and the fact that the quality of contemporaneous maps becomes substantially worse prior to the nineteenth century (Bassett, 1994). To control for some of the potential biases of relying on maps drawn a long time ago, and by non indigenous (mostly Western) mapmakers,[13] the same process was repeated using historical atlases compiled by later historians (several of which were also consulted by Depetris-Chauvin (2016) and Paine (2019)). The result was over 3400 polygons (state-shape-years) covering the period 1800 to 1914 for continental Africa and Madagascar. For some pre-colonial states in the ISD there were no maps for any years, some are covered only for some of the years they are in the ISD, but a number of them are covered by multiple maps for many years. Of the 109 states included for Africa in the ISD v2, the Geo-ISD includes at least one set of borders for 82 states. This is a considerable improvement on previous data sets, yet still not capturing the universe of independent African states in the period.

Figure 1: Example of georeferenced map

[13] Discussed further below.

4.1 The mountains of Kong

The accuracy of the historical maps used to create the polygons of the Geo-ISD is a natural concern. Who typically drew these maps? Based on what sources? For what purposes? And with what level of technical accuracy?

Most of the maps from the David Rumsey project were from atlases published for commercial purposes by individuals or small publishing companies specializing in this type of publications. Most are from English or American atlases, but French, Italian, German and other sources are included as well. The maps were based on a combination of existing maps updated with 'the latest sources' (a fact frequently boasted in the title of the atlas), which for the majority of the period meant explorers or geographers on missions from their respective geographical societies.[14] In the words of Stone (1995, 47-48): 'Cartography in Africa [in the 19th century] is still a mix of measurement, less accurate observations, word of mouth, previous maps and sources, educated guesses and pure conjecture. Nevertheless a distinct improvement on the maps of previous periods.'. Because of this, I expect two types of errors: errors resulting from measurement, and bias resulting from misconceptions (deliberate or not) of what constituted the borders of a polity at the time. I also expect errors to be replicated by other maps, before eventually being corrected. One example of this is the nonexistent Mountains of Kong, which can be seen in Figure 1 as the mountain range stretching across most of the continent from East to West. These mountains were replicated in maps for the better part of the nineteenth century before being finally wiped from the map (Bassett and Porter, 1991).

While the quote above might lead one to expect considerable measurement error, by my estimate this error only amounts to 36.9km on average for the shapes included in the GeoISD. This estimate is based on the estimated mean distance of the coastline in the maps to the real coastline, along the borders of the states that were traced. This captures measurement error explicitly, because regardless of where states did or did not extend their control, the coastline in the map should line up with the real coastline. This means that there are often multiple estimates for each map, reflecting how the accuracy is better in some places than in others. If this difference was above 100km, the maps were deemed too inaccurate and excluded from the sample. Error estimates for states that lay inland were not included, because consistently matching features from the maps to real geographical features was not feasible other than when using the coastline, which provides a visible line of comparison. Additionally, this type of error only adds noise, because it is equally likely to err in one direction or the other. Thus it should not affect coefficient estimates, but could potentially affect standard error estimates.

Although I have not been able to find sources discussing specifically how cartographers determined the borders of different polities, it is probable that they in large part relied on local verbal

[14] Later maps additionally draw on the work of military surveyors, but as far as I have been able to tell the majority are still based primarily on the work of explorers and past maps.

sources (word of mouth). An example of this can be glimpsed when the explorer Mungo Park effectively dubbed the mountains of Kong.[15] Or from when expeditions such as Park's were escorted by representatives of the rulers of the various polities they passed through until reaching *frontier towns*, where they would be met by representative of the next ruler (Park et al., 2015). In the maps resulting from such encounters, both their sources as well as the cartographers themselves could have introduced bias to the resulting maps. Sources were likely to be rulers or their representatives, with incentives for aggrandisement. The explorers and cartographers on their part represented European rulers with an eye toward colonial expansion. It less clear how this would affect the resulting borders drawn. One potential bias would be to exaggerate the domains of your own governments prospective colonies, and vice versa. Another possibility is that colonial cartographers under reported state sizes to declare 'terra nullius'. However, I did not observe any systematic differences between the maps based on their nationality.[16] In fact, their colonial ambitions could just as easily have promoted accuracy, as any potential military expedition would benefit from accurate information (Bassett, 1994).

At the very least there should be heterogeneity in the conceptualization of territoriality. What determines where a given source (or the cartographer in the second instance) draws the borders of a polity, or how this would vary with their respective conceptualization of states, polities and ethnic groups, is impossible do determine. However, thanks to (usually) having multiple maps for each state, the variation can be leveraged to create a measure of the *degree* to which a state had a presence in a given area over the time period as a whole. When maps disagreed on where the various borders were, I interpret this as either true variation across time, or as an indication of the ambiguity of where a given state had nominal or real control. In the areas where all the maps agree, one could be quite sure that the given polity had real presence. While in areas where only one map indicated that the state was present, this could either be wrong, an indication of nominal as opposed to more real presence or some other form of limited presence. The coding process of looking at hundreds of maps strengthened this initial intuition, and the resulting figures of state presence drawn from the complete data lends it further credence. Figure 2 demonstrates how the estimate of the Libyan state's presence gradually faded into the desert, that the Benghazi/Cyraneica region was not always or fully under the control of Tripoli, and that it had even more tenuous hold on the Fezzan region to the south.

To counter balance some of the potential bias in the historically contemporaneous maps a number of maps from historical atlases were included. These are works compiled by historians

[15] 'I gained the summit of a hill, from whence I had an extensive view of the country. Towards the south-east, appeared some very distant mountains, which I had formerly seen from an eminence near Marraboo, where the people informed me, that these mountains were situated in a large and powerful kingdom called Kong; the sovereign of which could raise a much greater army than the King of Bambarra.' (Park et al., 2015, CHAPTER XVIII).

[16] If drawing borders was driven by colonial ambitions, there should be observable differences between the different colonial powers in line with their differing colonial ambitions.

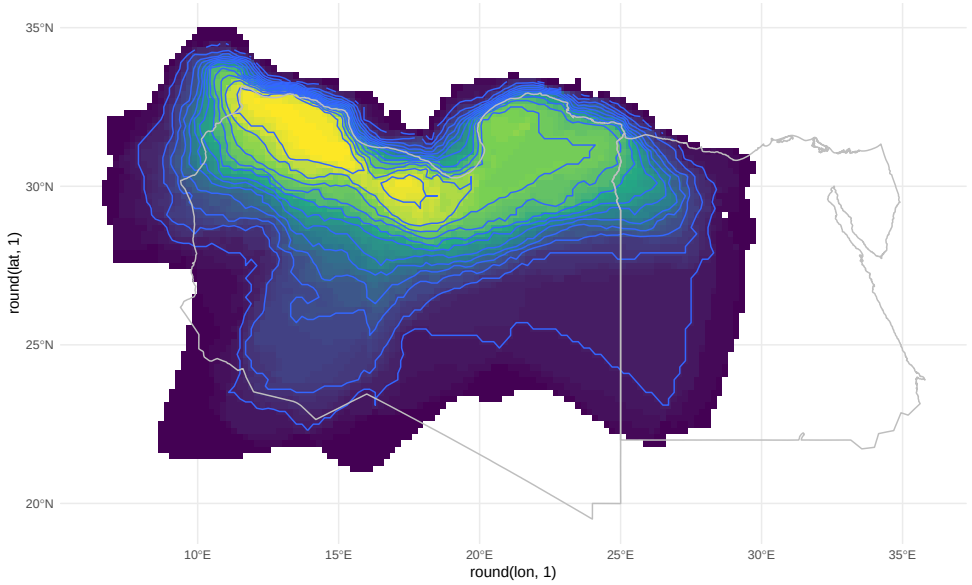

Figure 2: The historical state presence of Libyan state of Tripoli. Current borders of Libya and Egypt in red.

with both the accumulated knowledge of history and modern instruments of cartography at their disposal. These sources should be able to reduce problems of the historically contemporaneous maps, such as word of mouth sources exaggerating the extent of polities.[17] The historical atlases were scanned, then georeferenced and polities traced in the same manner as the pre-colonial states in the historically contemporaneous maps. The historical atlases frequently depicted the borders of states over a period of years in a single map. In these cases the resulting state shapes were duplicated for each year in the period. This has the benefit of placing a larger emphasis on the historical atlases, at the cost of being more static.[18] Figure 6 in the appendix lists the historical atlases used in the Geo-ISD.

The resulting data can be compiled in different ways, to provide different insights. For the analysis in this paper I rely on a measure of 'state presence', similar in concept to that of 'state history' introduced by Depetris-Chauvin (2016).[19] I measure 'state presence' the as number of maps that indicate that a state was present there, counting only those of the state most often present in that cell. If a cell bordering Tunisia and Libya contains 40 shapes of Tunisia and 7 shapes of Libya/Tripoli, only the Tunisian shapes are counted. Including the Libyan shapes would risk over

[17] Although they should also be more accurate in terms measurement error, I found that this was not always the case. For example (Kasule, 1998) completely misplaces Wadai, putting the capital of Wara (and thus the rest of the polity with it) at least 200km North West of its actual position.

[18] Implicitly assuming constant borders, and in the absence of other sources implying uniform control across territory.

[19] The main difference between these measures is that 'state history' is measured in 2 by 2 decimal degree grid cells, only includes Sub Saharan Africa, includes fewer states despite going further back in time, usually only includes one shape per state, which implies static borders and uniform presence throughout the territory.

counting, as it most likely does not represent additional state presence, but rather overlapping or contested state presence.

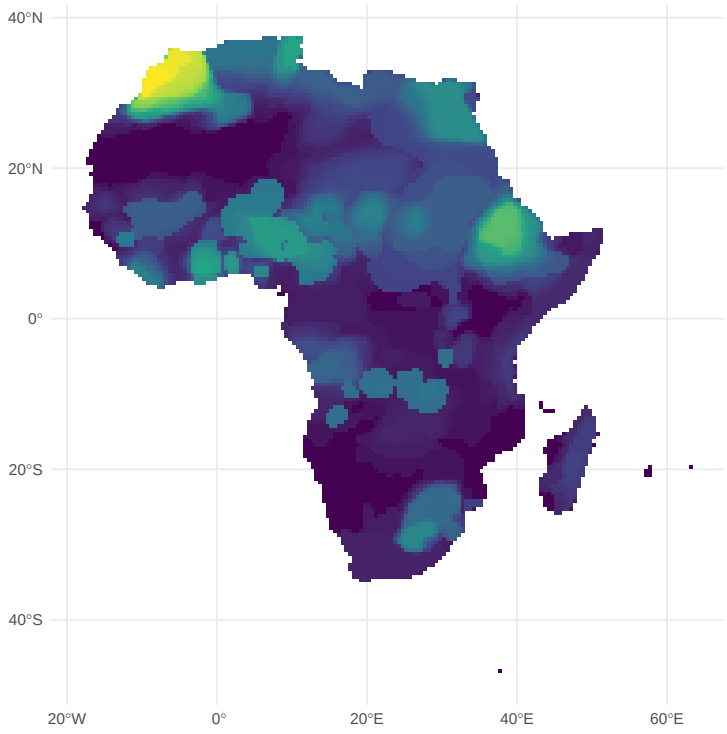

Figure 3: State presence (sqrt transformed) with interpolated years based on historical atlases.

5 Research design

5.1 Dependent variable

The units of analysis are PRIO 0.5 by 0.5 decimal degree grid cells with a non-zero population density in 1600,[20] which equals about 55 by 55km at the equator (Tollefsen et al., 2012). Due to the explanatory variable being time-invariant, the analysis is a cross section. The dependent variable is state based conflict related fatalities per grid cell over the period 1989-2020, from the GED project (Sundberg and Melander, 2013). This is a measure of the overall level of conflict in the post cold war period. The start date of 1989 was dictated by availability rather than chosen by design, as it likely biases against finding results (positive or negative), because the mechanisms discussed in the theory section should have a more powerful effect closer to independence and would fade in relative importance with the passing of time.

[20]This primarily excludes the Sahara and Kalahari deserts.

As an alternative to combat related fatalities, I also ran models using the count of state based conflict events. This captures much of the same general level of conflict during the period as the fatalities measure does, but the focus is slightly different. Fatalities captures the severity of conflict, whereas the number of conflict events captures the frequency of conflict. This would be the difference between few, or short, but highly lethal conflicts, versus lengthy conflict of relatively low intensity, or recurring conflicts. I do not expect there to be a substantial difference in the results from these measures based on the theory presented above.

5.2 Independent variable

The first explanatory variable is the per grid cell state presence, as defined in section 4.

Because I do not expect the relationship between pre-colonial state presence and civil conflict to be linear, and because the data is heavily skewed, the variable is square root transformed. While log transformation is more often employed in the previous literature, the variable contains zeros which means adding a constant to all values. This could potentially introduce bias, and complicates the interpretation of the results (Ekwaru and Veugelers, 2018). I therefore present the more conservative approach of reporting square root transformation as the main findings. This has the benefit of not having to add a constant, but produces a less evenly distributed variable. In addition to the square root transformed version of the main independent variable, I also ran models using the more common log transformation. The results remained substantially the same (see online appendix?).

As a further robustness check I also ran models using a measure of state presence that sums if there ware any maps that included a state in a grid-cell-year (as a sum of yearly dummies). In other words, this could be at most 214, and is more a measure of the maximum *extent* of state presence, and is less accurate in terms of variations in depth. The benefit of this measure is that it avoids some of the potential over representation of countries frequently mapped by Europeans, such as the North African states (due to proximity). As with the main measure of state presence, only the shapes of the state that was most present in that grid cell throughout the sample period were traced. Results remain substantially the same for all specifications.

The main explanatory variable is an interaction between per grid state presence (square root transformed) and distance to capital (log transformed). The theoretical expectation is that pre-colonial state presence is conflict reducing in areas close to the post independence capital, and conflict inducing in more remote areas. In other words that the effect of pre-colonial state presence is moderated by distance to capital. Distance to capital is log transformed because I do not anticipate a linear effect. Because the variable is measured by distance from the center of each grid cell to a point indicating the capital, there are no zeros and log transformation is unproblematic. Distance to capital is sourced from the PRIO-grid data set, but originally from Weidmann et al. (2010).

5.3 Controls

Because the treatment variable in this case predates the outcome by a long period of time, there is a substantial risk of introducing post treatment bias when including control variables. In choosing which control variables to include, I therefore balanced a trade off between potential post treatment bias and omitted variable bias.

Mountains facilitate early state formation by providing protection and limiting the exit options of sedentary farmers (Carneiro, 1988). Mountainous terrain has also been linked with civil conflict by providing shelter for rebel groups (Hegre and Sambanis, 2006), although this relationship is debated (Buhaug and Gates, 2002). The data is from the PRIO-grid data set, but originally from Blyth et al. (2002), and measures the percentage of the cell with mountainous terrain based on elevation, slope and local elevation range.

Water is essential for state formation. States typically formed either as coastal cities, close to navigable rivers or by the shores of great lakes. People still tend to live next to a source of water, thus this acts as a proxy for population density, and fighting usually happens where there are (at least some) people. The data on water as a percentage of the grid surface is from the PRIO-grid data set, but originally from the European Space Agency (Bontemps et al., 2009).

Distance to the coast could affect both state presence and conflict in a number of ways. First, as stated above, states were more likely form along the coast as it connected cities and people. A special case for Africa is also the existence of slave raiding/trading states that formed along the eastern and western coasts of the continent. These state's raison d'être was raiding slaves from tribes and peoples inland and selling them to coastal traders (European in the West and Arab in the east). Nunn (2008) argues that this state of affairs left legacies of mistrust and antagonism, which has resulted in increased levels of current day conflict. Distance to the coast could also be related to the measure of state presence through the fact that our measure is based on European observations (maps), which undoubtedly had better coverage along the coast, especially for the earlier periods. Distance to the coast could further be related to conflict through lower levels of development. The distance to coast data is from Wessel and Smith (1996). The variable was log transformed to account for a non-linear relationship.

As with water, barren terrain could be a (negative) pre-condition for state building as well as proxy for later population densities, and thus could correlate with both state presence and levels of conflict. The data is from Bontemps et al. (2009).

The states of North Africa are overrepresented in the Geo-ISD data, due to the geographical proximity, and the accompanying historical familiarity to European map makers. This affects Morocco most particularly, as can be seen in Figure 3. The reason this affects Morocco in particular is that the remaining North African states were under Ottoman suzerainty for much of the period, meaning more time for more maps to accumulate. If North Africa is also more or less conflict prone than the rest of Africa on average, the inflated values of state presence would bias the estimated

coefficients. Accordingly, a dummy variable for the region of North Africa was included.

Population density is added as an extended control despite the stronger theoretical expectation that it could be a confounding variable. There are few accurate measures of population densities that predate most of the states in the Geo-ISD. The best available estimates come from the HYDE project (Goldewijk et al., 2016), and I use the estimates from 1600.

Distance to international boundaries could be related to state presence because, despite their reputation, African borders were not drawn completely at random (or along meridian lines). For example, the boundary between northern Nigeria and Niger were based on the extent of the Sokoto Caliphate and the neighboring Kanem-Bornu (or just Bornu) empire (Hiribarren, 2017). Proximity to an international boundary has also been found to predict conflict (Buhaug and Gates, 2002). I use the measure included in the PRIO grid data, which is originally from Weidmann et al. (2010).

5.4 Modelling

To account for the potential post treatment bias (vis-a-vis potential omitted variable bias) controls were added step wise with increasing potential for post treatment bias. The baseline model only geographic variables, and subsequent models add controls according to likelihood of introducing post treatment bias.

To account for the dependent variable being count data (count of deaths (fatalities) and count of conflict events (state based)) all model specifications reported below are negative binomial regressions or zero inflated negative binomial regressions. A fitness test for whether negative binomial or Poisson regression is most appropriate, was conducted and confirmed that negative binomial produced a better fit than Poisson.

The dependent variable contains excess zeros (8937 zeros relative to 100 counts of 1 fatality, the second most frequent outcome). Additionally, I cannot be sure that the main independent variable affects affects the likelihood of there being any fatalities in a cell (or if it remains a zero), the same way it might influence the severity of conflict once a cell has seen at least one fatality. I therefore employ a zero inflated negative binomial model. The first step of this two step approach is a logit model that models whether cells experience conflict or not. I used the same set of controls as I do not expect any of them to exclusively affect conflict severity, nor do I expect their relation to the main independent variable to be substantially different for an onset model. The second step is a negative binomial estimation of conflict severity, or the number of fatalities in a cell that has seen at least one.

Given what is known about spatial diffusion of conflict, there is reason to suspect some spatial autocorrelation. However, controlling for this would introduce a source of post treatment bias. Nevertheless, as an additional robustness check I ran some models with queen pattern spatial lags. Most of these models did not converge, but those that did remained substantially similar to the main models.

5.5 Testing the mechanism

Testing the proposed mechanisms explicitly would require data on where elite networks and institutions have survived from pre-colonial states, or data on rebel groups use of symbols invoking past statehood. Fortunately, the differences in the approach to colonial governance between Britain and France could provide a proxy for the elite networks and institutions mechanisms. France generally sought (more successfully in some cases than in others) to fully incorporate and rule their colonies directly, dismantling existing institutions and avoiding a reliance on native administrators (Blanton et al., 2001). Britain, on the other hand, pursued a strategy of indirect rule, preferring to leave local rulers to administer their own territories, and relying on their own institutions to do so (Blanton et al., 2001). Former British colonies should therefore be more likely to have preserved the elite networks and institutions that could be used to mobilize against the state. I therefor ran all the models including controls for former French and British colonies. In these models, the North Africa control had to be dropped because most of North Africa were French colonies at some point and models would not converge with both included.

6 Results

Despite the data on conflict starting nearly three decades after most of Africa achieved independence (at which point the effects of pre-colonial state presence on conflict should be most pronounced), there is a significant and positive direct effect of state presence on conflict (.11, SE = .01 and .10, SE = .01 in the main models). This effect is robust and stable across all models (see Table 2 and Table 4). All controls have the expected signs except distance to coast in Table 4, using state based conflict events as the dependent variable. However, the coefficient indicates a substantially negligible effect, and the statistical significance might be more a reflection of the large number of observations (9492) rather than any causal effect. The second model in Table 2 indicates that North Africa has experienced more conflict fatalities than the rest of Africa comparatively. However, this effect becomes smaller and is no longer significant at the $p < .01$ level after controlling for population density in 1600, suggesting at least part of the effect could be due to higher levels of population density.

However, the results of the interaction models reveal a more nuanced picture. As seen in Table 3 and Table 5, when adding the interaction term between state presence and distance to capital, state presence has a conflict reducing effect, albeit a non-significant effect in the fatalities models. All control variables behave as expected, and similarly as in the non interaction models. Unsurprisingly, distance to capital (log) is negative, as there is generally less conflict in and around capital cities. The interaction term is significant and positive across all model specifications, in line with the theoretical expectations.

In terms of substantial effects Figure 4, which models the predictions of the second stage ZINB

model included in Table 7, provides a more intuitive interpretation of the interaction between state presence and how it affects the severity state based conflict. State presence is negatively correlated with both conflict measure close to the capital, but becomes positive and significant further away from the capital. This is in line with an interpretation that state presence can be conflict reducing in those cases where it makes a territory less artificial, by providing institutions and elite networks on which to build a state. In cases where there is no state presence in capital areas, the model predicts an additional 406 fatalities from state based conflict. The effect drops rapidly as state presence increases. On the other hand, in areas with no experience of statehood that are far from the capital, the model predicts almost no additional fatalities (similar to high levels of state presence in/around the capital). However, as state presence increases, so does predicted fatalities. For a moderately high level of pre-colonial state presence of 200, the main model predicts an additional 380 fatalities. While this is not a test of the specific mechanisms outlined in the theory section, the results do indicate that institutions, elite networks or some other legacy of pre-colonial statehood raises the scope of conflict when far from the capital area.

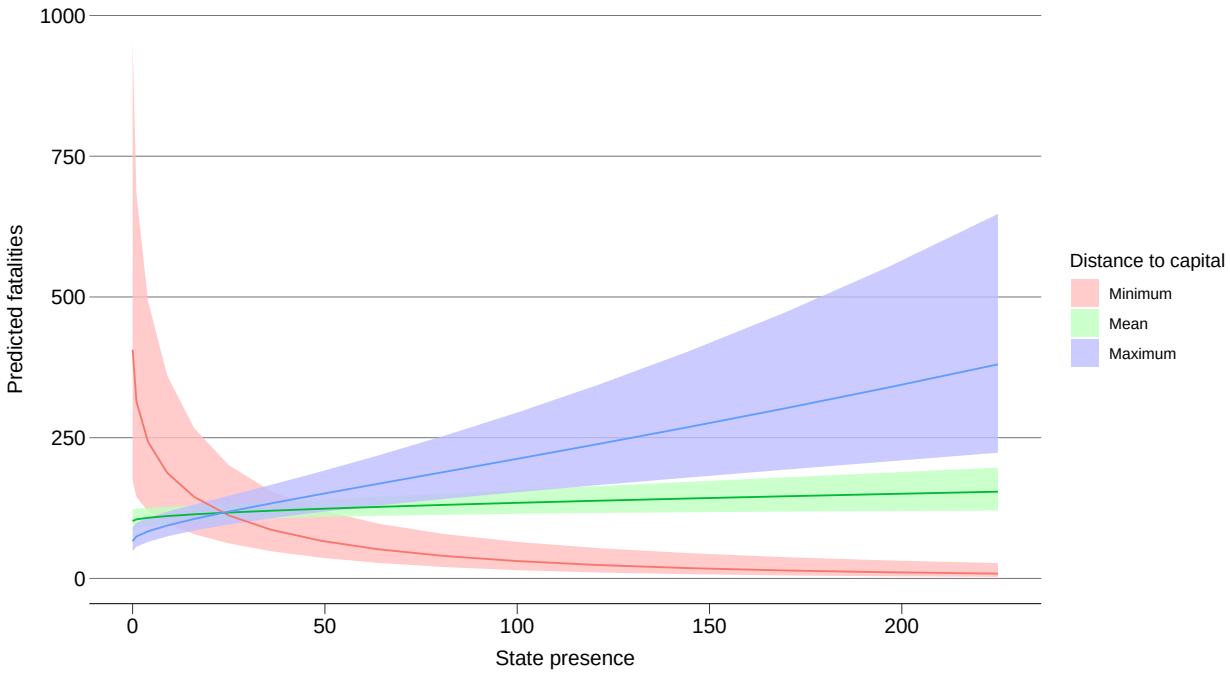

Figure 4

The results of the models including controls for French and British colonies (see Table 7) are interesting in that the predicted increase in conflict severity in capital areas without prior experience of statehood is at 991 additional fatalities. The signs of the colonial controls are as expected. However, the conflict inducing effect of being a former British colony is only significant on conflict onset (the first stage logit model). Similarly, the conflict reducing effect of being a former French

colony is only significant in terms of reducing conflict severity (second stage negative binomial count model). These results can not be interpreted with any certainty, but do perhaps suggest that French style governance left stronger central government that were better equipped to limit the scope of conflicts, while the British tradition of indirect rule left a larger number of potential rivals to the central government.

6.1 Alternative explanations

An alternative interpretation of the results could be that this is a story of more coherent ethnic groups being more likely to be associated with states, and more likely to (perhaps better able to) challenge the government when situated far from the capital. However, getting closer to the real causality requires untangling, in each case, if a given conflict is related to an ethnic group's ties to a pre-colonial state or not. This lies outside the scope of this paper, if it is even possible.

Another interpretation that is not controlled for in this paper is the possibility that past conflict drives both state creation and current conflict. However, data on past conflict is meager, especially so for Africa. To my knowledge the Brecke (1999) data set is the most complete. Even so, it relies on written histories of which there is little for pre-colonial sub-Saharan Africa. What is worse, the missing will be considerably biased because kings and states are far more likely to chronicle their warfare in the form of written records.

7 Conclusion

Drawing on the emerging literature on pre-colonial states (Paine, 2019; Depetris-Chauvin, 2016), institutions (Wig, 2016; Englebert et al., 2002; Michalopoulos and Papaioannou, 2018) and civil conflict, and on newly compiled data, this paper reexamined the relationship between pre-colonial states and civil conflict. I find support for a conflict reducing effect of pre-colonial state presence, but this is conditioned on proximity to the post-colonial capital. On the other hand, I find strong evidence for a conflict inducing effect, particularly in areas far from the post-independence capital. These results are robust to alternative measurements and model specifications.

These findings have a few important implications. First, they demonstrate that pre-colonial states can be a blessing or a curse depending on whether they form the basis of the modern state or a point of opposition to it. Second, that local political histories matter, and should be taken into consideration by policymakers and scholars alike. Finally, these results suggests that wherever colonizers left novel constellations of pre-existing polities, they potentially sowed the seeds of future conflict. More research using global data is needed to test whether general trends for Africa hold outside that continent as well.

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Appendix

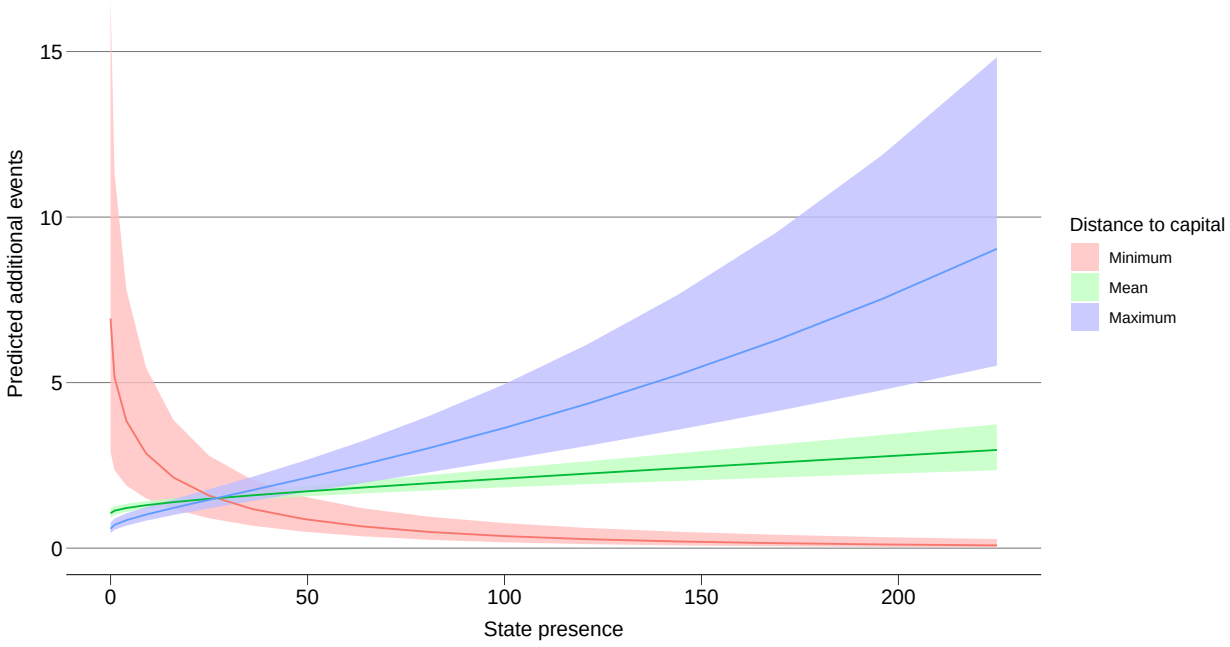

Figure 5: Predicted conflict events per state presence, grouped by distance to capital.

Table 1: Summary Statistics

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Fatalities	10,652	45.8	883.1	0	0	0	79,920
Conflict events	10,652	2.4	27.0	0	0	0	1,940
State presence	10,652	50.2	88.1	0	2	62	629
Distance to boundary	10,652	138.1	122.6	0.003	39.6	200.7	668.0
Distance to capital	10,652	671.3	411.0	3.7	338.0	956.2	2,482.5
Barren	10,652	32.7	44.4	0	0	97.9	100
Mountainous	10,492	0.1	0.3	0.0	0.0	0.1	1.0
Water	10,652	4.8	17.7	0.0	0.0	0.1	100.0
Distance to coast	10,652	599,064.4	460,732.6	0	185,784.8	956,404.4	1,761,700
popd	10,559	2.5	9.9	0.0	0.1	2.1	447.9

	Geography	North Africa	Population densisty	Distance to border
Precolonial state presence (sqrt)	0.11^{***}	0.10^{***}	0.10^{***}	0.10^{***}
	(0.01)	(0.01)	(0.01)	(0.01)
Mountainous terrain	1.37^{***}	1.54^{***}	0.95^{***}	0.91^{***}
	(0.23)	(0.23)	(0.23)	(0.23)
Water (%)	-0.01	-0.01	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Barren (%)	-0.02^{***}	-0.03^{***}	-0.02^{***}	-0.02^{***}
	(0.00)	(0.00)	(0.00)	(0.00)
Distance to coast (log)	-0.11^{***}	-0.11^{***}	-0.09^{***}	-0.07^{**}
	(0.02)	(0.02)	(0.02)	(0.02)
Population density (log)			0.75^{***}	0.74^{***}
			(0.09)	(0.09)
Distance to international boundary (log)				$-0.11^{\cdot}$
				(0.06)
North Africa		0.58^{**}	0.44^{*}	0.46^{*}
		(0.18)	(0.18)	(0.18)
AIC	27567.25	27553.42	27484.75	27483.20
BIC	27617.36	27610.69	27549.18	27554.79
Log Likelihood	-13776.63	-13768.71	-13733.38	-13731.60
Deviance	3520.82	3522.27	3528.42	3528.71
Num. obs.	9492	9492	9492	9492

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$; $^{\cdot}p < 0.1$

Table 2: Fatalities

	Geography	North Africa	Population densisty	Distance to border
Precolonial state presence (sqrt)	−0.06	−0.11	−0.18$^{\cdot}$	−0.16
	(0.10)	(0.10)	(0.10)	(0.10)
Mountainous terrain	1.54***	1.74***	0.99***	0.95***
	(0.23)	(0.23)	(0.23)	(0.23)
Water (%)	−0.00	−0.01	−0.00	−0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Barren (%)	−0.03***	−0.03***	−0.02***	−0.02***
	(0.00)	(0.00)	(0.00)	(0.00)
Distance to coast (log)	−0.07**	−0.08**	−0.09***	−0.08**
	(0.02)	(0.02)	(0.02)	(0.03)
Population density (log)			0.81***	0.79***
			(0.09)	(0.09)
Distance to international boundary (log)				−0.11$^{\cdot}$
				(0.06)
North Africa		0.57**	0.40*	0.42*
		(0.18)	(0.18)	(0.18)
Distance to capital (log)	0.06	−0.04	−0.08	−0.06
	(0.12)	(0.12)	(0.12)	(0.12)
Interaction term	0.03$^{\cdot}$	0.03*	0.05**	0.04**
	(0.02)	(0.02)	(0.02)	(0.02)
AIC	27605.09	27573.77	27478.52	27477.00
BIC	27669.51	27645.36	27557.26	27562.90
Log Likelihood	−13793.54	−13776.89	−13728.26	−13726.50
Deviance	3517.95	3520.87	3529.37	3529.64
Num. obs.	9492	9492	9492	9492

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$; $^{\cdot}p < 0.1$

Table 3: Fatalities * Distance to capital

	Geography	North Africa	Population densisty	Distance to border
Precolonial state presence (sqrt)	0.07***	0.05***	0.04***	0.04***
	(0.01)	(0.01)	(0.01)	(0.01)
Mountainous terrain	0.87***	0.81***	−0.22	−0.28·
	(0.16)	(0.16)	(0.15)	(0.15)
Water (%)	−0.01*	−0.01*	−0.01**	−0.01***
	(0.00)	(0.00)	(0.00)	(0.00)
Barren (%)	−0.02***	−0.02***	−0.01***	−0.01***
	(0.00)	(0.00)	(0.00)	(0.00)
Distance to coast (log)	−0.16***	−0.14***	−0.11***	−0.08***
	(0.02)	(0.02)	(0.02)	(0.02)
Population density (log)			1.00***	0.94***
			(0.06)	(0.06)
Distance to international boundary (log)				−0.20***
				(0.04)
North Africa		0.51***	0.38**	0.47***
		(0.13)	(0.12)	(0.12)
AIC	20314.22	20297.34	20007.10	19979.16
BIC	20364.33	20354.61	20071.52	20050.74
Log Likelihood	−10150.11	−10140.67	−9994.55	−9979.58
Deviance	4106.74	4112.96	4158.66	4164.26
Num. obs.	9492	9492	9492	9492

***$p < 0.001$; **$p < 0.01$; *$p < 0.05$; ·$p < 0.1$

Table 4: State based conflict events

	Geography	North Africa	Population densisty	Distance to border
Precolonial state presence (sqrt)	-0.25^{***}	-0.30^{***}	-0.36^{***}	-0.33^{***}
	(0.07)	(0.07)	(0.06)	(0.06)
Mountainous terrain	0.88^{***}	0.87^{***}	0.01	-0.05
	(0.15)	(0.15)	(0.15)	(0.15)
Water (%)	-0.01	-0.00	-0.01^{**}	-0.01^{***}
	(0.00)	(0.00)	(0.00)	(0.00)
Barren (%)	-0.02^{***}	-0.02^{***}	-0.01^{***}	-0.01^{***}
	(0.00)	(0.00)	(0.00)	(0.00)
Distance to coast (log)	-0.13^{***}	-0.09^{***}	-0.12^{***}	-0.09^{***}
	(0.02)	(0.02)	(0.02)	(0.02)
Population density (log)			1.00^{***}	0.95^{***}
			(0.06)	(0.06)
Distance to international boundary (log)				-0.19^{***}
				(0.04)
North Africa		0.39^{**}	0.36^{**}	0.44^{***}
		(0.13)	(0.12)	(0.12)
Distance to capital (log)	-0.45^{***}	-0.37^{***}	-0.30^{***}	-0.28^{***}
	(0.08)	(0.08)	(0.08)	(0.08)
Interaction term	0.05^{***}	0.06^{***}	0.06^{***}	0.06^{***}
	(0.01)	(0.01)	(0.01)	(0.01)
AIC	20284.02	20282.75	19982.19	19957.16
BIC	20348.44	20354.33	20060.93	20043.06
Log Likelihood	-10133.01	-10131.37	-9980.09	-9966.58
Deviance	4117.11	4118.67	4168.50	4172.13
Num. obs.	9492	9492	9492	9492

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$; $^{\cdot}p < 0.1$

Table 5: Conflict events * Distance to capital

Atlas maps
Ajayi and Crowder (1985)
Flint et al. (1976)
Gailey (1967)
Kasule (1998)
McEvedy (1996)
Oliver et al. (1985)
Reid (2012)
The Times atlas of world history (1978)

Table 6: List of maps from historical atlases used in the Geo-ISD

	Model 1	Model 2	Model 3
Count model: (Intercept)	5.33***	3.43***	7.10***
	(0.53)	(0.55)	(0.60)
Count model: sqrtSpAll	−0.33***	−0.39***	−0.36***
	(0.07)	(0.07)	(0.07)
Count model: logCapdist	−0.28**	−0.38***	−0.46***
	(0.09)	(0.09)	(0.09)
Count model: mountains_mean	1.50***	0.13	1.15***
	(0.18)	(0.17)	(0.19)
Count model: region3	0.59***		0.18
	(0.13)		(0.14)
Count model: water_gc	0.01*	−0.01**	0.01*
	(0.00)	(0.00)	(0.00)
Count model: logCDist	0.02	−0.09***	0.07***
	(0.02)	(0.02)	(0.01)
Count model: logPopd	0.83***	1.16***	0.56***
	(0.07)	(0.07)	(0.07)
Count model: logBDist	−0.06	−0.18***	−0.14**
	(0.05)	(0.04)	(0.05)
Count model: sqrtSpAll:logCapdist	0.06***	0.07***	0.06***
	(0.01)	(0.01)	(0.01)
Count model: Log(theta)	−2.51***	−2.58***	−2.43***
	(0.05)	(0.03)	(0.06)
Zero model: (Intercept)	0.39	−11.90	−0.54
	(0.96)	(3235.61)	(0.91)
Zero model: sqrtSpAll	−0.38.	1.40	−0.16
	(0.21)	(136.83)	(0.18)
Zero model: logCapdist	−0.07	−73.25	0.05
	(0.14)	(701.24)	(0.13)
Zero model: mountains_mean	0.24	27.63	−0.01
	(0.23)	(59.19)	(0.23)
Zero model: region3	0.45**		0.35*
	(0.15)		(0.15)
Zero model: water_gc	0.01*	−5.83	0.01*
	(0.01)	(20.18)	(0.01)
Zero model: logCDist	0.02	−6.07	0.02
	(0.02)	(22.85)	(0.02)
Zero model: logPopd	−2.81***	−20.02	−2.50***
	(0.28)	(46.62)	(0.28)
Zero model: logBDist	0.30***	1.12	0.29***
	(0.07)	(10.80)	(0.06)
Zero model: sqrtSpAll:logCapdist	0.04	3.83	0.01
	(0.03)	(32.32)	(0.03)
Count model: gbr			0.10
			(0.15)
Count model: fra			−1.46***
			(0.14)
Zero model: gbr			0.62***
			(0.14)
Zero model: fra			0.20
			(0.18)
AIC	42529.07	19988.38	42367.09
Log Likelihood	−21243.53	−9975.19	−21158.55
Num. obs.	9492	9492	9492

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$; $^{.}p < 0.1$

Table 7: Statistical models