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Abstract:

African states are both unusually large and well-known for having artificial borders created during the colonial period. While their size and shape have been previously shown to be correlated with negative development outcomes, so far no one has examined the origins of either phenomenon. Here we show that African state size and shape are a consequence of Africa's low pre-colonial population density, whereby low-density areas were consolidated into unusually large colonial states with artificial borders. We also show that state size has a strong negative relationship with pre-colonial trade, and that trade and population density alone explain the majority of the variation in African state size. Finally, we do not find a relationship between population density and state size or shape amongst non-African former colonies, thereby emphasizing the distinctiveness of modern African state formation.

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1. Introduction

The geographic size of states has long been of interest, with scholars from (Montesquieu, 1989 [1748]) to (Alesina & Spolaore, 2003; Spolaore, 2006; Wittman, 1991, 2000) weighing the benefits of the economies of scale of large states with the better representation of citizens' interests in smaller states. A similar but more recent debate has taken place on the shape of states, with the ease of drawing straight-line or artificial borders balanced by the negative effects of creating borders that cut through societies and trade routes (Alesina, Easterly, & Matuszeski, 2010; Englebert, Tarango, & Carter, 2002; Herbst, 2000; Holditch, 1916). In both cases, however, empirical evidence has come down strongly on one side. Large states have been shown to be correlated with a large number of poor developmental outcomes, including poor institutions (Olsson & Hansson, 2009), conflict (Buhaug & Rød, 2006; Englebert et al., 2002; Raleigh & Hegre, 2009), and ethnic diversity (Green, 2010a). Similarly, states with artificial borders have been shown to be correlated with boundary disputes and low GDP per capita (Alesina et al., 2010; Englebert et al., 2002).

Sub-Saharan Africa has been affected by large states and artificial borders perhaps more than any other part of the world. Indeed, while Sub-Saharan Africa and Europe both contain between 48 and 50 sovereign states each, Sub-Saharan Africa is around 2.4 times larger than Europe.[2] Moreover, with 44% of borders drawn as straight lines, 'Africa is the region most notorious for arbitrary borders' (Alesina et al., 2010, p. 7). Scholars have thus suggested that Africa's poor economic development and numerous conflicts have been at least partially a result of its large states and artificial borders (Alesina et al., 2010; Englebert et al., 2002).

However, there is very little scholarship explaining African state size or shape, with previous literature only focusing on the persistence of state size and borders in the post-colonial period rather than on their origins (Englebert, 2009; Herbst, 2000). Thus our goal here is to probe the origins of state size and shape in Africa. In the former case we examine a broad range of theories and find that pre-colonial population density and trade patterns between them explain the majority of variation in African state size, inasmuch as colonists constructed larger states in low-density and low-trade areas to save costs. We also find that pre-colonial population density is highly correlated with straight borders in Africa and alone explains more than one-third of the variation in state shape. In both cases we thus add to previous evidence that Africa's demographic history has had significant impacts on modern economic and political development (Austin, 2008a; Baker, Brunnschweiler, & Bulte, 2008; Cogneau & Guenard, 2003; Green, 2010b; Herbst, 2000; Nunn, 2008).

The rest of the paper is organized as follows. In Section 2 we examine various theories for the origins of state size, with special attention to both general political economy explanations centered around conflict, democratization, inequality and trade and more particular explanations for African state size. We then test these various theories in multivariate regression analysis. In Section 3 we examine

[2] Europe is 10.2 million km^2 while Sub-Saharan Africa is 24.2 million km^2. The number of states per region varies depending on one's definition of Europe and whether one includes states only partially recognized as sovereign such as Kosovo and Western Sahara.

theories of African state shape and test them again with multivariate regression analysis, using three separate dependent variables. Section 4 considers other former colonies outside Africa and finds that, while trade still holds a strong relationship with state size, population density does not correlate with state size or shape. Finally, in Section 5 we conclude.

2. The Origins of State Size

The literature on the origins of state size has largely focused on theoretical factors that might influence citizens to either secede or amalgamate their territories, especially the benefits of economies of scale and the costs of social heterogeneity, border defense and income inequalities (Alesina & Spolaore, 2003; Bolton & Roland, 1997; Cederman, 2003; Findlay, 1996; Friedman, 1977; Montesquieu, 1989 [1748]; Spolaore, 2006; Tam, 2004; Wittman, 2000). Yet comparatively little scholarship has been done on testing these various theories against each other, while those that have done so fail to find a single robust explanation for state size. Perhaps more importantly, they also find an 'Africa' dummy to be consistently statistically significant, thereby suggesting that prior theories do not explain state size in Africa (Lake & O'Mahony, 2004).[3] Indeed, in contrast to a substantial body of literature explaining state size in Europe (Friedman, 1977; Wittman, 1991), there exists as yet no empirical work on state size in Africa.

What is particularly striking about African states is their large size. Several African states are huge in comparison with their former colonizers: the Democratic Republic of Congo (colonized by Belgium), Angola (Portugal) and Sudan (the UK) are more than 75, 13 and 10 times the size of their former colonial rulers, respectively. Moreover, these states are not anomalies: Table 1 compares the median size of former colonies in Africa to those in Latin America and the Caribbean and Asia, with clear evidence that African colonies are noticeably larger than elsewhere whether one includes or excludes island states.

[Insert Table 1 here]

Yet, as already noted, African state sizes have not changed since the 1960s with the exception of the secession of Eritrea from Ethiopia in 1993;[4] moreover, even attempts at secession have been remarkably few in comparison with civil wars within Africa and secessionist conflicts elsewhere (Englebert, 2009).[5] Explanations for the unvarying nature of post-colonial African state size have focused both on the international norms promoting state stability (Herbst, 2000; Jackson & Rosberg,

[3] Besides North America (n = 3), Africa is the only continent dummy to be consistently significant across various specifications in (Lake & O'Mahony, 2004).

[4] The two instances of state size alteration in Africa prior to the secession of Eritrea were the peaceful amalgamations of former British and Italian Somilaland in 1961 and Tanganyika and Zanzibar in 1964.

[5] (Englebert, 2009, p. 17) estimates that the proportion of secessionist conflicts among all types of armed conflicts between 1960 and 2000 is significantly lower in Africa than in Asia, Europe or the Middle East

1982), and on the domestic 'legal command' of sovereign states that disincentivises secession (Englebert, 2009).

The persistence of African state size in the post-colonial era allows us to eliminate three theories of African state size before even considering other evidence. First, (Alesina & Spolaore, 2003; Spolaore, 2006) suggest that ethnic heterogeneity leads to poorer public goods provision due to diverse preferences, and that as a result citizens from ethnically heterogeneous states have the incentive to secede and create new, smaller states. They claim that these incentives would be enhanced as countries democratize and thus give their citizens greater latitude to choose their own future. Yet the large sweep of democratization that engulfed Africa in the 1990s had no effect on secession.

Second, various political economists have hypothesized a correlation between international war and larger states. (Montesquieu, 1989 [1748], p. 131), for instance, argues that, 'if a republic be small, it is destroyed by a foreign force.' More recently, (Alesina & Spolaore, 2006; Spolaore, 2006; Wittman, 2000) argue that a decrease in the probability of international conflict should lead to an increase in the number of countries as citizens are no longer interested in the benefits of protection and the lower defense costs per capita in larger states. However, while African colonial states were participants in both World Wars I and II, the post-colonial era has seen far fewer interstate wars in Africa than elsewhere in the world, with a concomitant drop in both military budgets and the numbers of soldiers per thousand citizens since the late 1970s (Herbst, 2000, p. 105; Lemke, 2003). Thus a theory which seems to explain the proliferation in the number of states after the end of the Cold War in Europe fails to explain the stability in African state size over the same time period.

Third and finally, (Bolton & Roland, 1997; Spolaore, 2006) suggest that interregional income inequalities lead rich citizens to favor secession to avoid the costs of redistribution to lower-income regions. However, evidence points to persistent and possibly growing levels of inter-regional income inequalities across Africa (Van de Walle, 2009), with no concomitant increase in secessions.

2.1. Population Density and African State Size

The reason why many of these political economy theories cannot explain state size in Africa is because colonial states were constructed along fundamentally different lines than sovereign states. Indeed, the partition of Africa in the late 19th century was in large part sparked by European concerns about the satiation of current markets and the idea that the African interior was 'the world's last great untapped reservoir of markets, resources and possible investment opportunities' (Sanderson, 1985, p. 103). In particular much of the speculation about Africa's market potential revolved around estimates of its large population. France, for instance, was concerned about obtaining the West African interior as a 'substitute India' around 1880 (Sanderson, 1985, p. 123), in part because it was assumed that the area comprised 'an inexhaustible new market' of some 80 to 100 million people according to the then

French Naval Minister (Wesseling, 1996, p. 179).[6] In Central Africa Henry Morton Stanley estimated in 1885 that the Congo basin had numerous agricultural and animal resources which could be of use to its European colonizers. However, he wrote that 'what is of far more value, it possesses over 40,000,000 of moderately industrious and workable people' (Worger, Clark, & Alpers, 2010, p. 233). Similarly, the British colonialist Lord Lugard speculated that the population of British East Africa (later Kenya) was between 6.5 and 12 million people in 1893 (Worger et al., 2010, p. 247). Finally, the British Chancellor of the Exchequer in 1899 called Nigeria 'the most valuable part of Equatorial Africa' in part because he estimated that the colony contained 30 million people at the time.[7]

However, upon exploring their new territories the European colonizers discovered that their previous population estimates were almost always grossly exaggerated. Indeed, low population densities were already apparent in the early colonial period for the Portuguese territories which would later comprise Mozambique: according to the British Prime Minister Viscount Palmerston in 1861,

> The Portuguese possessions on the eastern coast are of enormous extent, thinly populated, and the ports are separated by immense distances… They want all the labour for cultivation and improvement that the population will afford, and every man sent away is a man withdrawn from the development of the natural resources of the country.[8]

Yet similar concerns about low population levels soon arose among the British and French as well. The actual population of Nigeria in 1900 was some 10 million people less than the British had estimated, with a total population for the ten coastal West African colonies from Senegal to Nigeria of only 27 million in 1900 (McEvedy & Jones, 1978, p. 243). According to (Hochschild, 1998, p. 233), the population of the Congo was certainly no more than 20 million in 1880, or less than half of Stanley's estimate; (McEvedy & Jones, 1978, p. 249) instead propose a population of only 15 million for all of central Africa in 1900. As for Lugard's estimate in East Africa, the population of Kenya was probably only 3.5 million in 1900 (McEvedy & Jones, 1978, p. 253). Finally and most strikingly, the French West African interior held less than 1/10th the size of the French government's initial estimate, with roughly only 6 million inhabitants living in what would later become Burkina Faso, Mali, Niger and Mauritania in 1900 (McEvedy & Jones, 1978, p. 239).

The effect of these discoveries was to encourage penny-pinching among the colonialists, with the other European powers following the UK in establishing a policy of making the colonies pay for themselves, no matter how oddly shaped or small they were.[9] One consequence was the agreement among the European powers at the Berlin Conference of 1884/85 that colonial occupation need not actually involve pacification but merely the acquisition of sovereignty, thereby freeing up colonizers from the costs of extending control immediately over their new territories (Herbst, 2000, pp. 71-73).

[6] The British explorer Sir George Goldie similarly estimated in 1885 that the West African interior contained 60 to 80 million inhabitants (Partridge & Gillard, 1995b, p. 221).
[7] *Hansard Parliamentary Debates*, 3 July 1899, Vol. 73, p. 1291-1292.
[8] *Hansard Parliamentary Debates*, 26 July 1861, Vol. 164, p. 1658.
[9] The British established a principle of colonial self-sufficiency in 1815; similar laws were set in place for French and Belgian colonies in 1900 and 1908, respectively (Young, 1994, p. 97).

Moreover, with merchants and settlers adept at evading taxes, colonial states instead focused on a head or hut tax as the most sustainable form revenue generation (Young, 1994, pp. 126-127). Thus in Kenya the hut tax grew rapidly to comprise 29% of government revenue by 1904 (Lonsdale & Berman, 1979, p. 497), while in colonies such as Cameroun and Chad head tax reached up to 50% and 80% of government revenue in the interwar period, respectively (Guyer, 1980, p. 312; Stürzinger, 1983, p. 221).

The costs of extending colonial control over space plus the imperative to generate head tax revenue meant, of course, that small and thinly-populated colonies would be unprofitable. Concerns over governing under-populated areas weighed particularly upon the French, who measured the relative importance of their Empire according to the number of its inhabitants: according to one colonialist in 1922, 'it is not the size of our empire that matters but the number of human beings who live in it' (Van Beusekom, 1999, p. 199). The French were thus concerned about the 'demographic problem' of low population densities in their colonies, leading them to create economies of scale by maintaining a regional tier of colonial administration for French West Africa and French Central Africa (Cooper, 1996, p. 181); the former alone comprised 4.7 million square kilometers, or more than seven times the size of France. Low densities were especially a problem in the 'unpopulated, virgin land' of Côte d'Ivoire (Cordell & Gregory, 1982, p. 218); to alleviate this problem French administrators abolished the colony of Upper Volta in 1932, adding its more populated southern part to Côte d'Ivoire in order to help local planters recruit laborers (Gervais & Mande, 2000).[10]

As for the UK, upon acquiring the bulk of German East Africa after World War I the British government attempted to amalgamate Kenya, Tanganyika and Uganda into an East African Federation in the 1920s. According to the then Secretary of State for the Colonies,

> The primary clement in our deliberations was the administrative policy of considering the inefficiency and waste which inevitably occur where you have a number of Governments set up with no natural boundaries… From every point of view the case for maintaining the present arbitrary divisions – divisions which sprang up in the scramble for territory in the 'eighties of last century – is a weak one.[11]

However, the British were unable to push through a Federation due to opposition from the Buganda kingdom in Uganda and other Africans worried about the dominance of white settlers; the creation of a Central African Federation encompassing Nyasaland and Northern and Southern Rhodesia in the 1950s only lasted a decade due to similar concerns.

This link between population density and colonial state size was also evident in high-density areas as well. For instance, imperialists scrambled to control the highly populated areas of Rwanda and Burundi, which the British Colonial Secretary called the 'best part of all German East Africa' in 1919 (Louis, 1966, p. 888). As both the Belgians, who had occupied the territory during the war, and British wanted to control the two kingdoms, the British government enticed the Belgian government in

[10] Growing nationalist pressures later forced the French to reconstruct Upper Volta in 1947.
[11] *Hansard Parliamentary Debates*, 19 July 1927, Vol. 209, p. 285.

a three-swap: the Belgians would surrender Rwanda and Burundi in return for control over the Portuguese-held southern bank of the Congo river, and the Portuguese would receive a part of southern German East Africa (Tanganyika) from the British. However, the Portuguese failed to find interest in an under-populated region that they considered 'worthless territory' (Louis, 1966, p. 889), and the deal fell through.

2.2. Alternative Theories

Population density is not, however, the only plausible variable explaining African state size. Economic theories of state size repeatedly emphasize the role of trade in promoting either larger or smaller states. As per the former, (Friedman, 1977) claims that trade should lead to larger states inasmuch as states located along a trade route can capitalize on economies of scale if they expand to control the entire trade route, and finds evidence to support his theory from European history. However, (Alesina & Spolaore, 2003; Spolaore, 2006; Wittman, 2000) argue that openness to trade should lead to smaller states as the economies of scale brought by large state size diminish in importance; (Alesina & Spolaore, 2003) find empirical support for their theory in global time-series data on trade openness and the number of sovereign states since the late 19th century.

In Africa there appears to be historical evidence supporting the latter theory, inasmuch as imperialists sought to use trade to help pay for colonial administration. As already noted, the large costs involved in governing Africa pushed British Prime Minister William Gladstone, for instance, to push Portuguese interests in the Congo in the early 1880s, with the ultimate goal that 'Lisbon would do the governing, London would do the trade' (Robinson, Gallagher, & Denny, 1961, p. 170). In fact, the main reason why the British pushed for control over the lower Niger river was not due to interests in administering the region, but rather in thinking that it was 'the one region where merchants could be made to pay the bill' (Robinson et al., 1961, p. 177). Thus the British failed to expand their West African territories for the simple reason that 'the value of the trade was not worth the taking of more territory' (Robinson et al., 1961, p. 383).

Another theory about state size proposed by (Tam, 2004) suggests that there should be a positive and significant correlation between how much of a country's border is naturally protected by the sea, rivers, mountains and deserts, and its size. More specifically, (Tam, 2004) claims that people will avoid consumption uncertainty by seceding from countries that lack natural borders and joining those that have such borders, leading to an equilibrium where countries with natural borders are larger than those which lack them.

Finally, (Alesina & Spolaore, 2003) argue that, *ceteris paribus,* heterogeneity and diverse preferences should lead to secession as citizens are located far away from the median voter and thus become increasingly dissatisfied with government policies. This argument has two empirical predictions. First, if modernization theory holds and industrialization, urbanization and other modern phenomena contribute to the formation of larger ethnic groups or nations and lower levels of

heterogeneity (Gellner, 2006 [1983]), modernization in Africa should lead to the creation of larger states as citizens move closer to the median voter over time. However, if one assumes that heterogeneity is fixed and not equally distributed, then citizens should secede until all states have similar levels of ethnic diversity; in this equilibrium states in regions with lower pre-existing diversity would be larger than those in more diverse neighborhoods.

2.3. Empirical Analysis

2.3.1. Variable Codings

Our dependent variable is state size, as measured here by the natural log of state size in kilometres squared. Inasmuch as the size of island states is determined by geography we only include African states which have at least some land borders in our dataset; thus we include Equatorial Guinea (despite having its capital city on an island) but exclude Madagascar and Cape Verde, among others. For pre-colonial population density we employ the estimates from (McEvedy & Jones, 1978) for the year 1850 to account for the fact that European colonization of Africa only really began in the late 19th century. Despite earlier European presence in such areas as Equatorial Guinea, the Gambia and South Africa, we employ this late date as (McEvedy & Jones, 1978)'s estimates of pre-colonial population figures are largely estimated through backward projections of colonial data and thus lose accuracy rapidly in estimating earlier dates.[12]

We also test three of the alternative hypotheses noted above. First we test the theory that trade should correlate with smaller states. However, the lack of accurate economic data for pre-colonial and early colonial Africa makes the trade variable difficult to measure. Here we thus employ average distance to coast and sea-navigable rivers (*Distance*) as a proxy for pre-colonial trade. While not perfect, *Distance* nonetheless captures the ways in which coastal areas and rivers in pre-colonial Africa had heavier trade than elsewhere. For instance, Portuguese traders first introduced manioc (cassava) to Africa around the Congo river delta in the 15th century, with a similar history for maize; in return for these and other European items Africans traded cotton, gums, palm oil, peanuts, pepper, and wood (Eltis & Jennings, 1988; Hogendorn, 1975). The coastal and riverine nature of trade was especially true for Africa's biggest trade of all, namely the slave trade. As documented by (Nunn, 2008), most slaves originated in coastal regions with others coming from inland areas with sea-navigable rivers like Mali or the Congo.[13] After the external slave trade ended slaves were employed as laborers on rice, palm oil and yam plantations 'near the coast and along the rivers of Sierra Leone, in Asante, Dahomey and the Yoruba states' (Lovejoy, 2000, p. 166). In contrast, however, trade volumes in the interior parts of Africa were much smaller due to poor transportation facilities, with

[12] For more criticism of (McEvedy & Jones, 1978) see (Austin, 2008b; Hopkins, 2009).
[13] Strikingly, (Nunn, 2008) estimates that a total of zero slaves combined were exported from five land-locked countries lacking easy river access to the sea, namely Botswana, Burundi, Lesotho, Rwanda and Swaziland.

internal trade largely focussing on subsistence trade rather than the market trade present along the coasts (Duignan & Gann, 1975).[14]

Second, we test (Tam, 2004)'s theory that there should be a positive and significant correlation between natural borders and state size; here we measure natural protection as the ratio of a country's coastline to its total border length.[15]

Third, we wish to test (Alesina & Spolaore, 2003)'s theory that ethnic heterogeneity should lead to secession and similar levels of ethnic diversity. Yet without a reliable database of pre-colonial ethnic diversity we cannot eliminate the possibility of reverse causality, namely that state size has affected ethnic diversity rather than vice-versa.[16] For this same reason we cannot test our prediction that lower levels of heterogeneity in some parts of Africa in the 19th century should have led to the creation of larger colonial states than in other areas.[17] However, if we assume fixed and unequally distributed levels of heterogeneity then we should see a small standard deviation for ethnic diversity across African states as citizens secede over time from more diverse states to join less diverse states. Yet (Fearon, 2003) calculates that the standard deviation for African ethnic diversity is 35% higher than any other region of the world, thereby suggesting that (Alesina & Spolaore, 2003)'s theory does not hold for Africa.

Finally, we test a variety of control variables. First, we control for pre-colonial political centralization (*Centralization*) as measured by the proportion of people that were members of ethnic groups with a centralized political system (Gennaioli & Rainer, 2007). Second, we test for independent effects of individual colonial powers with dummy variables taking the value of one if a state was ever colonized by the three European powers which held four or more non-island African colonies, namely Britain, France and Germany. Third, we control both for average elevation to take into account (Cederman, 2003)'s argument that mountainous terrain limits state conquest and thus should correlate negatively with state size, and for rainfall to account for the construction of larger states in desert areas.

2.3.2. Empirical Results

The above analysis thus suggests that pre-colonial population density and trade patterns explain the existence of large states in Africa. We first examine the relationship between our two

[14] While the trans-Saharan gold and slave trade may have been important in the medieval period, it was the Atlantic slave trade which brought Africa's share of world trade to its historic peak in the late 18th and early 19th centuries. Thus, despite the previous dominance of trade routes by the inland savannah areas of western Africa, the region was unable to capitalize on the slave trade as much as Africa's coastal regions (Eltis & Jennings, 1988).

[15] (Tam, 2004) uses other measures such as the ratio of relief, river and desert borders to total border length; the coastline ratio, however, is more statistically significant than these other measures in his regression analysis.

[16] Indeed, (Green, 2010a) argues that large states have contributed to Africa's currently high level of ethnic diversity, inasmuch as African ethnic groups are largely territorially concentrated and colonial states were built before European rulers had a clear idea of which peoples they contained.

[17] However, (Green, 2010a) shows that urbanization has led to lower levels of heterogeneity in late 20th century Africa without any concomitant increase in state size.

independent variables and state size visually in Figures 1 and 2; in both cases the fit of the data is clear.

[Insert Figures 1 and 2 here]

As reported in Table 2 we test our analysis through multivariate OLS regression analysis. We use heteroskedasticity-robust standard errors inasmuch as many of (McEvedy & Jones, 1978)'s pre-colonial population density estimates were calculated by region rather than by country, which, uncorrected, would bias our results due to clustering effects. In regressions 1-3 we regress state size on population density and *Distance*, first individually and then together. In all three regressions both variables are positive and highly significant; moreover, regression 3 shows that pre-colonial population density and *Distance* alone explain over 50% of the variation in state size across Africa. In regression 4 we include the coastline ratio which (Tam, 2004) found to be positively correlated with state size;[18] however, here the coefficient is negative (albeit not significant), suggesting that naturally protected borders have not led to larger states in Africa. In regression 5 we introduce our control variables; our two key independent variables maintain significance while none of the control variables are significant at the 10% level. To test for robustness in regressions 6-8 we then restrict our sample by excluding former British and former French colonies, and then to states that do not have Muslim-majority populations to account for institutional and cultural differences across Africa;[19] again our results do not differ.

[Insert Table 2 here]

While African state size has not changed since the 1960s with the exception of Eritrea, it did however, change significantly during the colonial period. Indeed, if state size was determined in part by pre-colonial population density we should see its effects during the early 20th century. Thus to test for robustness we reconstruct colonial African borders at different times and regress these historical state sizes on pre-colonial population density in Table 3. We reconstruct colonial states in 1910, before the dissolution of the German colonial empire and before French colonies had acquired their present borders; in 1930, after the partition of former German colonies; in 1940, when Upper Volta was temporarily no longer a colony, and in 1955, when the Central African Federation encompassed what would become Malawi, Zambia, Zimbabwe.[20] In all cases we also regress population density alone and with the same three colonial dummy variables. (Unfortunately we do not, however, have a historical measure of *Distance* or any other such proxy for pre-colonial trade for these data sets.) As indicated in Table 3 population density remains significant across all columns.

[18] As the coastline ratio and *Distance* are correlated within the Africa sample we do not include them in the same regression.
[19] Data on religion is from (LaPorta, Lopez-de-Silanes, Shleifer, & Vishny, 1999). States with a Muslim majority include Djibouti, the Gambia, Guinea, Mali, Mauritania, Niger, Senegal and Somalia.
[20] See Appendix 3 for the details of each dataset.

[Insert Table 3 here]

Finally, as with (Acemoglu, Johnson, & Robinson, 2002) we test population density per square kilometer of arable land and use population density in 1500 as an instrument for density in 1850; in neither case do our results change (not reported here).

To summarize, our results suggest that pre-colonial population density and trade routes both have significant negative relationships with state size, and that these relationships are robust to a variety of controls, sub-samples and historical datasets from the colonial period.

3. State Shape

The literature on the shape of state borders is even smaller than that on state size, with scholars from (Holditch, 1916) to (Alesina et al., 2010) arguing that artificial borders are bad for international security and economic development without attempting to explain the origins of these borders. Indeed, the only existing hypothesis about state size comes from (Alesina et al., 2010, p. 18; Ratner, 1996), both of whom argue in passing that lower population densities in the western United States explain why state borders are straighter than in the higher-density eastern US, but without testing their hypotheses.

The consequences of poorly drawn borders have been more obvious than their origins, in particular in Africa. For instance, Somalia, the African country with the most artificial borders according to (Alesina et al., 2010), has had decades of ongoing irredentist strife with its neighbors and internal anarchy in large part due to the division of the Somali people across three sovereign borders. Similarly, secessionist attempts and civil war violence in Angola were at least in part due to the artificial borders which split members of the Bakongo ethnic group across sovereign borders and left the Cabinda enclave separated from the rest of the country (Englebert et al., 2002, p. 1099).

3.1. Population Density and State Shape

The most obvious explanation for straight borders in Africa is that they were drawn where the costs involved in demarcating borders were high. This was particularly true in regions with low population densities such as the desert Sahel and Sahara regions and the forested regions of central Africa, where large pre-colonial states were few and far between. Moreover, those pre-colonial states that did exist like Bunyoro (in what became Uganda) had borders that were so loosely defined that ‘it would have been difficult to say where the Nyoro state ended’ (Beattie, 1971, p. 255), thereby making it very difficult for Europeans to draw boundaries according to local political realities. Indeed, in demarcating the border between Rhodesia and Mozambique in 1899 the British Prime Minister Lord Salisbury noted that ‘no such absolute lines of ethnic division can be laid down, as the tribes overlap in

nearly every direction' (Partridge & Gillard, 1995a, p. 36). Finally, even if Europeans had had the desire to draw accurate borders there were few incentives for them to do so, inasmuch as African colonies and their borders were unusually large and lengthy, respectively.

Thus Africa's international borders in low-density areas were drawn along latitude and longitude markers rather than any local demarcations. For instance, in 1905 King Victor Emmanuel III was asked to arbitrate the Angolan-Rhodesian border by judging the extent of the British-controlled Barotseland kingdom. The king found that 'any precise delimitation is impossible,' in part due to an 'imperfect knowledge of localities… [and] the notorious instability of the tribes and frequent overlappings' (Capenny, 1905, p. 444), and as a result he decided to demarcate the borders of the kingdom along straight astronomical lines. Similarly, in German South-West Africa (Namibia) low population densities prevailed in the Kalahari desert areas which formed the straight-line border with Bechuanaland (Botswana) and the strangely-shaped Caprivi strip that links the country to the Zambezi river; in both cases the borders were decided by 1890, or before the British or Germans had discovered that the border split the Tswana ethnic group in two (Griffiths, 1986, pp. 210-211).

In contrast, borders in higher populated areas like Burundi and Rwanda and parts of Southern and West Africa were demarcated along non-straight lines due to colonial interests in maintaining ethnographic borders. Thus in high-density areas such as the Benin/Nigeria and Burkina Faso/Ghana borders, colonial demarcations were drawn not according to natural features but according to local settlements (Griffiths, 1986, pp. 207-209). Indeed, when borders disagreed with local political realities strong opposition often ensued. After World War I, when German East Africa was split into Belgian-controlled Ruanda-Urundi and British Tanganyika, protests at the League of Nations claimed that the initial Ruandan-Tanganyikan border caused 'social, political and economic harm' to the Kingdom of Rwanda by splitting it between two colonies; a subsequent adjustment of the border was thus carried out under guidance from the League (Griffiths, 1986, p. 206).

Moreover, when colonial powers were focused on obtaining labour supplies for their colonies boundary-drawing could often be controversial. Indicative in this respect was the work of the Anglo-Portuguese Provisional Boundary Delimitation Commission, whose job it was to draw the border between Nyasaland (Malawi) and Mozambique in 1900. While most of the border was uncontroversial, the British delegate Alfred Swann wrote of the area near Fort Mlangeni that 'I realized that we were here at a most important point of the boundary in this large labour-producing district, and I used great care before accepting a boundary-line.' According to Swann, however, the Portuguese delegate argued forcibly that 'we were dealing with the assets of a large company (the *Companhia da Zambezia*), and that in this case he had been instructed by his Government not to prejudice the interests of the Company by alienating villages on which they relied for supplying labour' (Partridge & Gillard, 1995a, p. 141).

3.2. Alternative Theories

As with state size it is possible that state shape was not wholly determined by population density. In particular it is possible that colonial borders were decided according to the degree of centralization of pre-existing states. For instance, Lord Salisbury wrote in 1885 about the British-German border between Nigeria and Kamerun, noting in particular that

> [The inhabitants of the] Upper Benue [river] are heathen tribes, split up into small districts, and powerless against Europeans; there was consequently little difficulty in making an arbitrary border between the spheres of influence of the two countries [Germany and the UK] in their territories. The same conditions are found on the Lower Niger and the Lower Benue; but Europeans, in advancing up the latter river, come into contact with the large Mussulman territories, in which there is concentrated power and a higher civilization; if an artificial line of separation were carried through these territories it might be impossible to observe it in practice (Partridge & Gillard, 1995b, p. 226).

Thus, as before, we test as well to see if *Centralization* is correlated with state shape.

3.3. Empirical Analysis

3.3.1. Variable Codings

The best measure of state shape comes from (Alesina et al., 2010), whose *Fractal* variable measures the degree to which a country's land borders are one or two dimensional. More specifically, *Fractal* takes a value between 0 and 0.1 for each country, whereby the lower the number the closer the country's borders are to a straight line. As this variable is the most sophisticated such measurement of state shape we employ it as our main dependent variable here. However, to check for robustness we employ an earlier alternative measurement from (Englebert et al., 2002), who examine all of Africa's 104 interstate borders to see which of them are at least partially straight. Based on this data we can compute both a straight line percentage variable (which computes the percentage of a given country's borders which are at least partially straight) and a straight line dummy variable (whereby a state is coded as 1 if at least one of its borders is at least partially straight). In the latter case we employ a logistic regression as the dependent variable is binary.

For the independent variables we again employ population density, *Centralization* and the same control variables that we used to explain state size. We also test to see if *Distance* has a similar effect on state shape as it did on state size.

3.3.2. Empirical Results

To examine the relationship between population density and state shape we again begin with a visual representation; as seen in Figure 3, the fit is quite strong.

[Insert Figure 3 here]

Table 4 reports our regression analysis results; in all regressions except the one reported in column 8 we again employ OLS. A univariate regression in column 1 shows a very strong fit between *Fractal* and population density, with 36% of the variation in African state shape explained by pre-colonial population density. In column 2 none of the control variables – including *Centralization* – alter the significance of population density or reach the 10% level of statistical significance with the exception of the French dummy variable ($p = 0.08$); however, in regression 4 removing the other control variables makes the French dummy insignificant. As shown in columns 4-5 population density retains its significance in sub-samples which exclude former British or French colonies and Muslim states. Finally, when employing our two alternative measures of state shape in columns 7 and 8 population density maintains its significance as well. (Here the sign of the coefficient is the opposite, since the dependent variable now increases the closer a state's borders get to a straight line.)

[Insert Table 4 here]

To summarize, our results are again unequivocal. We find that pre-colonial population density has a significant relationship with state shape, such that the higher the density of population, the less artificial are the state's borders.

4. Non-African Countries

Before concluding we should test to see if the same relationship between population density and state size and shape holds among former colonies outside Africa as well. As already noted, we would expect that the dynamics of African state formation do not hold elsewhere, for two reasons. First, the post-colonial norms which have operated to check secessionist tendencies in Africa have not operated among former colonies elsewhere, as demonstrated by (Englebert, 2009). Thus former colonies such as New Grenada and Pakistan split apart into separate countries after independence, while other former colonies such as North Borneo, Sarawak and Malaya consolidated after independence (into Malaysia in this case).[21]

Second, the revenue imperatives in other colonies were less severe. For instance, India and Indonesia provided substantial surplus revenues to the UK and the Netherlands, respectively, leading in the former case to the subsidization of British colonialism elsewhere, including in Africa. Even more impressive, of course, were the large revenues generated in the New World by coffee, sugar and tea plantations and gold and silver mining (Young, 1994, pp. 251-255). Indeed, due in part to the huge decline in the Native American population in the 16th century, head taxes comprised less than a tenth of Spanish colonial revenue, or significantly less than taxes on mining, sales and monopolies (Klein &

[21] (Englebert, 2009) does note that the preponderance of secession in Latin America is even lower than that for Africa. However, his dataset only includes the years 1960-1999, thereby neglecting the large number of secessions in post-colonial 19th-century Latin America.

Barbier, 1988, p. 46). With profits already assured head taxes were thus not particularly important for non-African colonies, leading us to hypothesize that there should not be a strong relationship between pre-colonial population density and state size or shape for this set of countries.

To examine this relationship we regress both state size and shape on both the entire set of non-island former European colonies and sub-sets of former African and non-African colonies. (Focusing on former colonies means that we drop Ethiopia from our sample.) As before we only include in our sample countries which have at least one land border, meaning that we include Indonesia (due to its land border with Papua New Guinea) but exclude Australia and Cuba, among others. We continue to use *Distance* as a proxy for pre-colonial trade due to extensive evidence that trade in the pre-colonial world outside Africa was, for the most part, historically concentrated around rivers and oceans (Chaudhuri, 1985; Curtin, 1984). Finally, to account for differences in the onset of colonial rule we measure population densities in 1500.

As listed in Table 5, the results conform with our expectations. The full samples in columns 1 and 5 still maintain statistical significance due to the large percentage of African countries in the samples, and sub-samples of the African countries demonstrate even strong correlations in columns 2 and 6. However, when we exclude African former colonies we find that the relationship between population density and state size is now only very weakly significant ($p = 0.08$) in column 3 and its relationship with state shape has lost significance altogether in column 7. Moreover, when we add *Distance* to the regression in column 4 population density we find a very strong relationship with state size outside Africa, thereby providing evidence for (Alesina & Spolaore, 2003)'s theory that trade should be inversely correlated with state size. Moreover, we find that (Tam, 2004)'s hypothesized relationship with *Coastline* holds outside Africa as well; together with *Distance* the specification generates a high R^2 of 0.76.[22]

[Insert Table 5 here]

The findings thus confirm our hypothesis that population density explains state size and shape in Africa but not elsewhere, and that previous explanations by (Alesina & Spolaore, 2003; Tam, 2004) better explain state shape among non-African former colonies. By supporting the thesis that African state size and shape have different origins from other parts of the world we thereby confirm (Young, 1994)'s argument that the African colonial state was constructed along different lines than colonies in other parts of the world.

5. Conclusions

[22] If we exclude population density from regression 4 the R^2 remains at 0.76. Unlike in Africa *Coastline* and *Distance* are not very correlated outside Africa (Pearson correlation coefficient of -0.317).

This paper has investigated the origins of African state size and shape, and found that the former can be explained by both pre-colonial population density and trade while the latter is a consequence of population density alone. These results were shown to be robust to a number of controls, sub-samples and different measures for state shape. We did not find any evidence for independent effects of different colonial powers, pre-colonial centralization or geographical factors such as elevation or rainfall.

This paper thus suggests that contemporary African state size and shape is a result of colonial decisions based on the continent's pre-colonial population distribution, and that this result does not hold for state size or shape in non-African former colonies. In other words, this result not only adds to previous literature on the modern impacts of Africa's colonial and demographic history but also suggests that state formation in Africa was markedly different from other parts of the world. We thus add to a growing literature that has gone beyond the simple use of an Africa dummy variable towards understanding the mechanisms by which Africa's political economy has evolved in a distinct fashion (Englebert, 2009; Nunn & Puga, 2009).

There are several further avenues for research. First, the analysis here is contingent upon an old dataset of historical population estimates (McEvedy & Jones, 1978), and better estimates of pre-colonial population figures in 1850 would provide more accurate estimates of the effect of population density on state size and shape. Second, our proxy for pre-colonial trade could also be refined with better data on 18th and 19th century trade patterns. Finally, more research is necessary on the origins of state shape, which remains unexplained for the non-African former colonies examined in Section 4.

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Table 1a: Median Former Colony Size by Region (including island states)

Name	Size (in km^2)	Number
Latin America and Caribbean	108,890	33
Asia	181,035	25
Sub-Saharan Africa	270,873	48

Table 1b: Median Former Colony Size by Region (excluding island states)

Name	Size (in km^2)	Number
Asia	185,180	20
Latin America and Caribbean	235,685	20
Sub-Saharan Africa	322,460	42

Table 2: African State Size
(Dependent Variable: Natural Log of Km2)

	(1)	(2)	(3)	(4)	(5)	Without Ex-British Colonies (6)	Without Ex-French Colonies (7)	Without Muslim States (8)
Population Density	-.609***		-.513**	-.618***	-.520**	-.719***	-.572**	-.523**
	(.140)		(.182)	(.145)	(.184)	(.196)	(.207)	(.190)
Distance		.876***	.803***		1.088***	.693**	.848***	.738**
		(.183)	(.171)		(.272)	(.210)	(.199)	(.226)
Coastline Ratio				-.903				
				(1.285)				
Centralization					-1.018			
					(.666)			
British Colony					-.086			
					(.432)			
French Colony					-.148			
					(.478)			
German Colony					-.403			
					(.507)			
Elevation					-.279			
					(.345)			
Rainfall					.010			
					(.245)			
Constant	13.192***	7.411***	8.435***	13.311***	9.089***	9.423***	8.160***	8.784***
	(.287)	(1.032)	(1.152)	(.354)	(1.906)	(1.142)	(1.303)	(1.500)
N	43	43	43	42	41	28	30	35
R^2	0.209	0.364	0.509	0.220	0.597	0.600	0.511	0.417

† $p \leq 0.1$, * $p \leq 0.05$, ** $p \leq 0.01$; *** $p \leq 0.001$; robust standard errors in parentheses.

Table 3: Historical African State Size
(Dependent Variable: Natural Log of Km2)

	1910 Dataset	1910 Dataset	1930 Dataset	1930 Dataset	1940 Dataset	1940 Dataset	1955 Dataset	1955 Dataset
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Population Density	-0.598*	-0.694*	-0.551***	-0.631**	-0.551***	-0.628**	-0.615**	-0.675**
	(0.235)	(0.300)	(0.159)	(0.198)	(0.160)	(0.201)	(0.191)	(0.226)
British Colony		-.566		-.589		-.585		-.527
		(.761)		(.686)		(687)		(.714)
French Colony		.560		.205		.252		.197
		(.971)		(.562)		(.575)		(.565)
German Colony		.640		-.290		-.306		-.340
		(.650)		(.484)		(.490)		(.498)
Constant	13.671***	13.934***	13.512***	13.910***	13.519***	13.903***	13.691***	14.019***
	(.235)	(.847)	(.416)	(.762)	(.417)	(.766)	(.506)	(.817)
N	32	32	46	46	45	45	44	44
R^2	0.077	0.141	0.093	0.154	0.092	0.156	0.099	0.151

† $p \leq 0.1$, * $p \leq 0.05$, ** $p \leq 0.01$; *** $p \leq 0.001$; robust standard errors in parentheses.

Table 4: African State Shape
(Dependent Variable: Fractal)

				Without Ex-British Colonies	Without Ex-French Colonies	Without Muslim States	Straight Line % as Dep. Variable	Straight Line Dummy As Dep. Variable
Regression Type	OLS	OLS	OLS	OLS	OLS	OLS	OLS	Logit
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Population Density	.007***	.006*	.007***	.009***	.007**	.007**	-.090*	-.711*
	(.002)	(.003)	(.002)	(.002)	(.002)	(.002)	(.041)	(.305)
Distance		-.001						
		(.002)						
Centralization		.009						
		(.007)						
British Colony		.003						
		(.005)						
French Colony		.008†	.005					
		(.004)	(.003)					
German Colony		.005						
		(.006)						
Elevation		-.001						
		(.003)						
Rainfall		.004						
		(.003)						
Constant	.022***	-.003	.020***	.020***	.021***	.023***	.431***	1.542**
	(.003)	(.021)	(.003)	(.004)	(.003)	(.003)	(.071)	(.556)
N	40	38	40	26	28	33	43	43
R^2	0.359	0.494	0.389	0.512	0.310	0.311	0.099	0.088

† $p \leq 0.1$, * $p \leq 0.05$, ** $p \leq 0.01$; *** $p \leq 0.001$; robust standard errors in parentheses.

Table 5: State Size and Shape for former European Colonies

Dependent Variable	Size	Size	Size	Size	Fractal	Fractal	Fractal
Sample Size	Full	Only Africa	Outside Africa	Outside Africa	Full	Only Africa	Outside Africa
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Population Density in 1500	-.408** (.150)	-.548** (.168)	-.358† (.198)	-.035 (.092)	.003* (.001)	.007*** (.002)	.002 (.002)
Distance				1.588*** (.159)			
Coastline				1.845** (.652)			
Constant	12.596*** (.192)	12.726*** (.259)	12.535*** (.287)	4.189*** (.965)	.030*** (.002)	.027*** (.002)	.031*** (.003)
N	88	41	47	45	82	39	43
R^2	0.107	0.163	0.087	0.758	0.094	0.299	0.038

† $p \leq 0.1$, * $p \leq 0.05$, ** $p \leq 0.01$; *** $p \leq 0.001$; robust standard errors in parentheses.

Figure 1: State Size and Population Density per Km2 in 1850
(Source: (McEvedy & Jones, 1978))

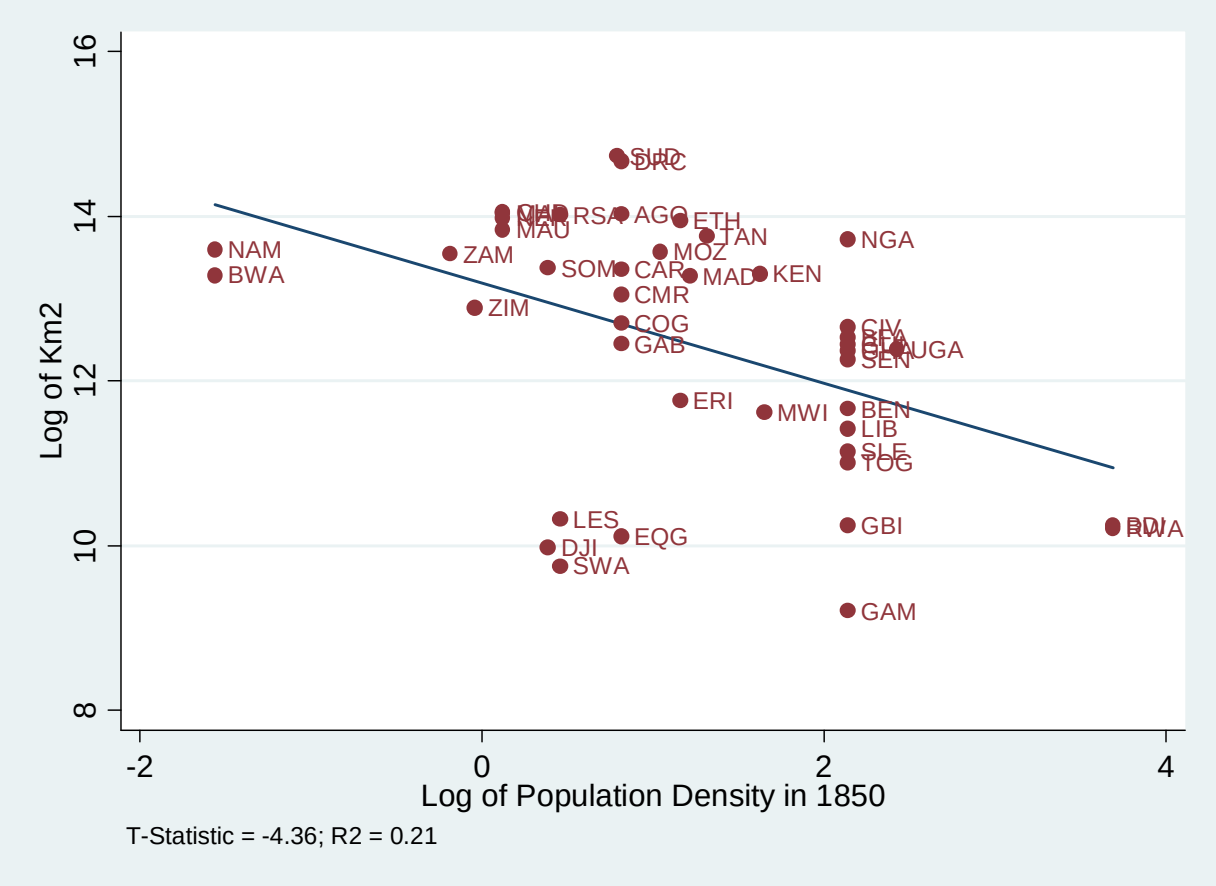


Figure 2: State Size and Distance to Coast or Navigable Rivers
(Source: Center of International Development, Harvard University)

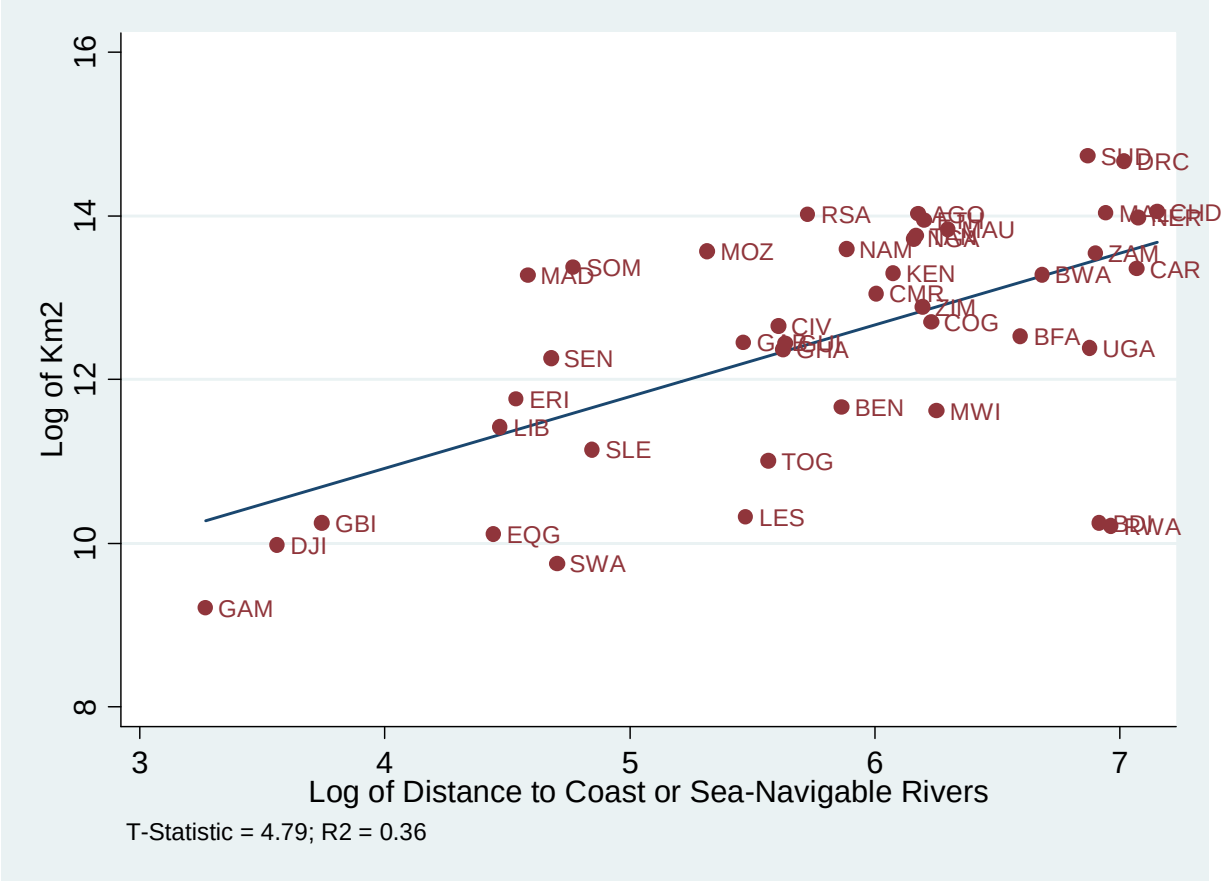
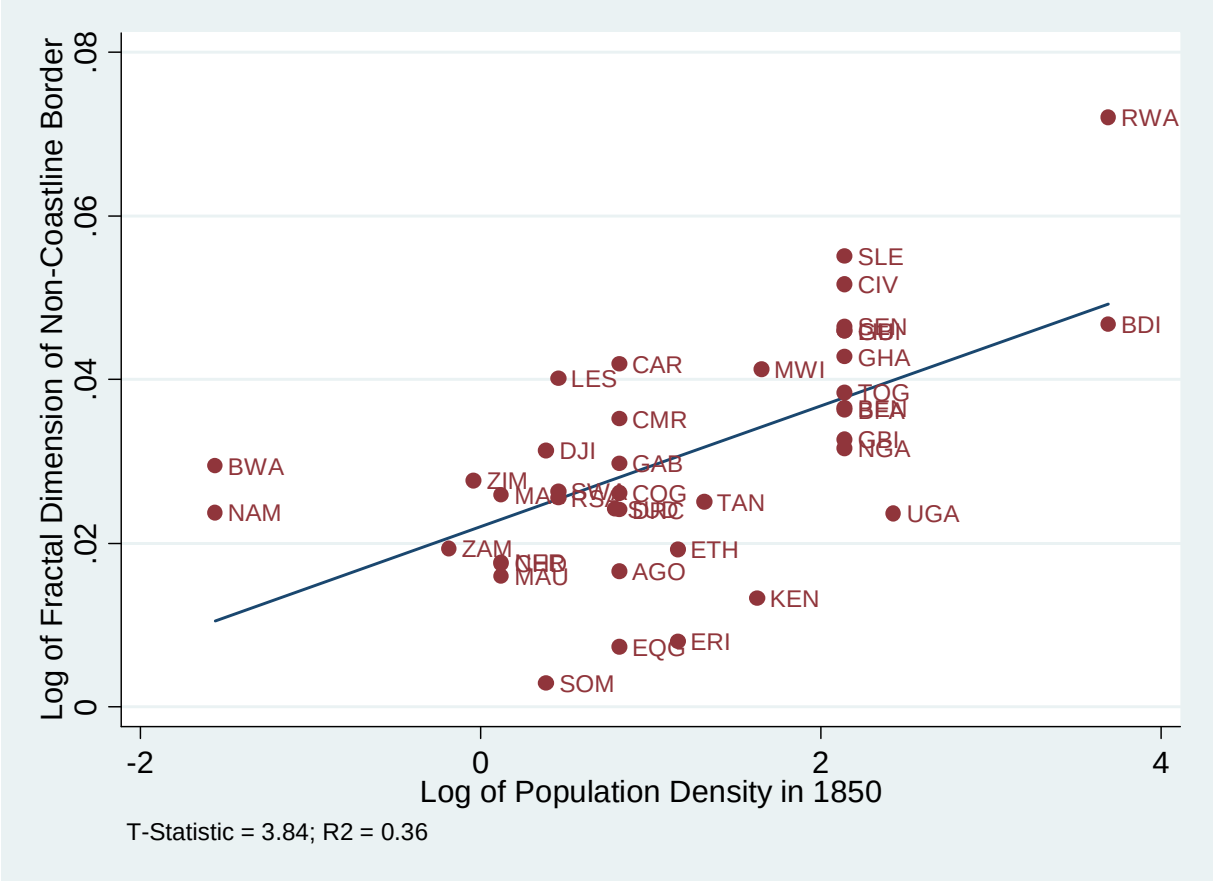


Figure 3: Artificial Borders and Population Density in 1850
(Source: (Alesina et al., 2010; McEvedy & Jones, 1978))



Appendix 1: Descriptive Statistics

Name	Mean	St. Deviation	Min	Max
Log of Area	12.48	1.49	9.21	14.73
Fractal	0.03	0.01	0.00	0.07
Distance	5.78	1.03	3.27	7.15
Population Density	1.17	1.12	-1.56	3.69
Straight Line Dummy	0.65	0.48	0	1
Straight Line Percent	0.33	0.32	0	1
Coastline Ratio	0.14	0.16	0	0.58
Log of Area (1910)	12.43	1.84	8.01	15.29
Log of Area (1930)	12.35	1.56	8.01	14.73
Log of Area (1940)	12.36	1.59	8.01	14.73
Log of Area (1955)	12.37	1.60	8.01	14.73

Appendix 2: Data Sources

Dependent Variables

Area: Natural log of a country's area in square kilometers. Source: Center of International Development, Harvard University.

Fractal: Natural log of a measure computing the degree by which a given country's non-coastal borders are one- or two-dimensional, with the measure decreasing as the border approaches a straight line. The data is based on the World Vector Shoreline GIS dataset from the National Oceanic and Atmospheric Administration. Source: (Alesina et al., 2010).

Straight Line Dummy: A dummy variable taking the value of one when any of a country's borders are at least partially straight and zero otherwise. Source: (Englebert et al., 2002).

Straight Line Percent: The percentage of the number of a country's borders which are at least partially straight. Source: (Englebert et al., 2002).

Independent Variables

British: Dummy equals 1 if a state was ever colonized by the UK (n = 18) and 0 otherwise.

Centralization: The percentage of a country's pre-colonial population which consisted of ethnic groups living under a centralized political system, based on anthropological data from the *Ethnographic Atlas* (1967) and ethnic diversity data from the Soviet *Atlas Narodov Mira* (1964). Source: (Gennaioli & Rainer, 2007).

Coastline Ratio: The ratio of a country's coastline length to its total border length. Source: CIA World Factbook.

Distance: Mean distance to the nearest coastline or sea-navigable river. Source: Center of International Development, Harvard University.

Elevation: Natural log of a country's mean elevation. Source: Center of International Development, Harvard University.

French: Dummy equals 1 if a state was ever colonized by France (n = 15) and 0 otherwise.

German: Dummy equals 1 if a state was ever colonized by Germany (n = 6) and 0 otherwise.

Population Density: Population Density per country in 1850. Source: (McEvedy & Jones, 1978).

Rainfall: The natural log of the annual mean rainfall per country, 1961-2001. Source: (Mitchell, Carter, Jones, Hulme, & New, 2004).

Appendix 3: Colonial African States in Historical Database

1910
Angola
Basutoland
Belgian Congo
Bechuanaland
British Somaliland
Eritrea
Ethiopia
French Central Africa
French Somaliland
French West Africa
The Gambia
German East Africa
Gold Coast
Kamerun
East Africa Protectorate
Italian Somaliland
Liberia
Madagascar
Nyasaland
Mozambique
Nigeria
Portuguese Guinea
Rhodesia
Rio Muni
Sierra Leone
South Africa
South-West Africa
Sudan
Swaziland
Togo
Uganda
Zanzibar

1930
Angola
Basutoland
Belgian Congo
Bechuanaland
British Cameroons
British Somaliland
British Togoland
Cameroun
Chad
Cote d'Ivoire
Dahomey
Eritrea
Ethiopia
French Guinea
French Somaliland
French Sudan
French Togoland
Gabon
The Gambia
Gold Coast
Italian Somaliland
Kenya
Lesotho
Liberia
Madagascar
Mauritania
Middle Congo
Mozambique
Niger
Nigeria
Northern Rhodesia
Nyasaland
Portuguese Guinea
Ruanda-Urundi
Senegal
Sierra Leone
South Africa
South-West Africa
Southern Rhodesia
Spanish Guinea
Sudan
Swaziland
Tanganyika
Ubangi-Shari
Uganda
Upper Volta
Zanzibar

1940
Angola
Basutoland
Belgian Congo
Bechuanaland
British Cameroons
British Somaliland
British Togoland
Cameroun
Chad
Cote d'Ivoire
Dahomey
Eritrea
Ethiopia
French Guinea
French Somaliland
French Sudan
French Togoland
Gabon
The Gambia
Gold Coast
Italian Somaliland
Kenya
Lesotho
Liberia
Madagascar
Mauritania
Middle Congo
Mozambique
Niger
Nigeria
Northern Rhodesia
Nyasaland
Portuguese Guinea
Ruanda-Urundi
Senegal
Sierra Leone
South Africa
South-West Africa
Southern Rhodesia
Spanish Guinea
Sudan
Swaziland
Tanganyika
Ubangi-Shari
Uganda
Zanzibar

1955
Angola
Basutoland
Belgian Congo
Bechuanaland
British Cameroons
British Somaliland
British Togoland
Cameroun
Central African Federation
Chad
Cote d'Ivoire
Dahomey
Eritrea
Ethiopia
French Guinea
French Somaliland
French Sudan
French Togoland
Gabon
The Gambia
Gold Coast
Italian Somaliland
Kenya
Lesotho
Liberia
Madagascar
Mauritania
Middle Congo
Mozambique
Niger
Nigeria
Portuguese Guinea
Ruanda-Urundi
Senegal
Sierra Leone
South Africa
South-West Africa
Spanish Guinea
Sudan
Swaziland
Tanganyika
Ubangi-Shari
Uganda
Upper Volta
Zanzibar