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Abstract

A recent literature suggests that arbitrarily designed administrative borders are an important reason why sub-Saharan Africa remains one of the least developed regions on the globe. Accordingly, administrative border reforms may be a way to promote growth on the African continent. In this paper, we study the effect of subnational administrative border reforms on local economic development (proxied by nighttime luminosity) by tracking state–level border changes in Africa during 1992-2013 with GIS techniques. Difference-in-difference regressions suggest that mergers have strong positive effects on economic development. Splits, too, have positive effects, but they are substantially smaller on average. To understand why the economic impact of splits and mergers differs in magnitude, we investigate transmission channels. We link border changes to geocoded conflict data and survey evidence on political attitudes as well as service delivery. We find that the differences between splits and mergers are possibly due to different underlying motives for these two types of border reforms. Splits seem to affect development through higher political stability, i.e. a lower incidence of conflicts and more benign political attitudes of citizens, while mergers presumably work through an improvement in administrative efficiency.

Keywords: Administrative border reforms, economic development, night-light data, Africa
JEL codes: D73, H77, R11

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1 Introduction

A large literature suggests that legacy of the colonial period continues to impair African development. Two main channels have been identified: low contemporary government quality as a consequence of extractive institutions put in place by colonial powers (Acemoglu et al., 2001; Acemoglu and Johnson, 2005) and the slave trade, which ostensibly led to a persistent decline in public trust (Nunn and Wantchekon, 2011). Yet, while these are widely accepted explanations for African underdevelopment, they carry with them the discouraging implication that policy makers can do little – at least in the short to medium run – to promote economic progress on the continent: if prevailing levels of trust and institutions are pre-determined by events that lie hundreds of years in the past, even the most well-crafted polices will likely prove incapable to reverse the economic fortunes of African countries in the foreseeable future.

Perhaps because of this absence of practical policy implications, attention has recently shifted to another possible cause for African under-development: ill-designed administrative borders. In the scramble for Africa, colonial borders were drawn and spheres of influence determined by the European colonizers with little regard for the ethnic markup of the affected regions nor any other economic or political concerns of the African populations (Thomson, 2010). These borders were inherited by the newly formed African nation states after decolonization and have hardly changed ever since. The traditional homelands of many ethnic groups in contemporary Africa are hence split by arbitrary borders. At the same time, disparate groups are forced within the administrative confines of political jurisdictions to which they may harbor little allegiance. These circumstances are a natural breeding ground for political instability and obvious impediments to development. Indeed, Michalopoulos and Papaioannou (2016) show that the arbitrary nature of African national borders continues to be source of conflict and economic inefficiency on the continent.

If ill-drawn borders are one reason for African under-development, then the implied solution appears to be to simply reshape these borders. Several authors indeed bemoan a secessionist deficit on the continent (for instance, Englebert and Hummel (2005)). However, as national borders have essentially remained the same since decolonization, it is difficult to predict whether a reshaping of African borders will change the economic fortunes of the continent[1] – nor is it obvious how exactly borders should be reshaped. Should countries be split up into smaller nations or merged into larger supranational units? In addition, on a more practical level, it is not easy to change national borders and any attempts in this regard may have unforeseeable consequences.

Accordingly, if administrative border changes are one remedy to the current economic ills of Africa, they may be more feasible and more effective at the subnational rather than the national level. In this paper, we hence study first-level *subnational* border changes in Africa to advance our understanding of how territorial reorganizations may affect economic development on the continent. Unlike national borders, the borders of first-level subnational units in Africa – typically labeled states, regions, or provinces – were frequently changed in shape and structure over the last decades (Grossman et al., 2017; Fox

[1] The only secession on the continent in our sample took place in 2011, when South Sudan split from Sudan.

and Gurley, 2006).[2] These border changes were nominally often part of broader public sector reforms (Erk, 2014) or deliberate attempts to adjust administrative borders such that they better reflect the ethnolinguistic markup of the country (Fessha, 2012).[3] In any case, they provide a wealth of identifying variation to explore how administrative splits and mergers affect African development. At the same time, the first-level subnational units share many of the traits of national governments. They are generally important administrative units with an independent political life and their territorial organization is often a source of persistent controversy and conflict (Elaigwu, 2008).

In the empirical part of the paper, we identify subnational border changes by making use of shapefiles on administrative borders from the United Nations' Global Administrative Unit Layers (GAUL) project. The shapefiles are available for every year during the period 1992-2013 and indicate the borders of all first-level subnational units (henceforth referred to as regions) across the globe in a given year. Consequently, any changes to the line features that indicate borders from one to the next year imply a border change. After identifying these changes with GIS software, we classify them into splits or mergers depending on whether a new line feature emerged (split) or an existing feature vanished (merger) within an existing region.

A challenge for the subsequent analysis is to determine the unit of analysis. We cannot use the subnational regions themselves as units of analysis as those regions that are affected by a border change by definition cease to exist in their current form. This prevents us from constructing a consistent time series at the level of subnational regions.[4] We address this issue by dividing all of Africa into a grid of 1×1 degree pixels (about 110km $\times$ 110km). We then use these pixels as time-constant units of analysis in the estimations.[5] Specifically, we project the the changes to the line features identified from the GAUL dataset onto this grid of pixel to determine whether a particular pixel (or more specifically the territory it is overlayed on) was affected by a a split or a merger.

Another challenge is how to measure economic performance at the subnational level. First, as suggested by Jerven (2013), GDP calculations for developing countries are questionable due to poor statistical capacity. Moreover, even if existing GDP data were reliable, it is typically not available at lower levels of geography, notably not at the pixel-level. We thus follow recent research and use night light luminosity as measured by orbital satellites as proxy for economic performance (Henderson et al., 2012).

[2]Gottlieb et al. (2016) report the development of average numbers of subnational units per country for all developing countries over time. Sub-Saharan and North African countries as well as Near East countries experienced significant increases in the number of subnational units whereas nations in South Asia, Latin America or in the East Asian and Pacific Area had – on average – fairly stable subnational government unit numbers or even consolidated their local governments in the past decades. Large decreases in the number of subnational governments in Eastern Europe were due to new independent nations at the end of 1980s.

[3]However, there were also exceptional cases, for example in Rwanda, border changes were also implemented as an deliberate attempt to dilute subnational ethnic homogeneity.

[4]That is, if a existing region A is split into two new regions called B and C, the region A ceases to exist.

[5]The area covered by a pixel ($12,100 km^2$) roughly corresponds to the size of Los Angeles county ($12,305 km^2$). We choose this pixel size as baseline for two reasons. First, it is sufficiently large to capture the aggregate effects of border changes (rather than only effects immediately at the border). If e. g. a merger leads to cost-savings, the positive implications should spread over the entirety of the affected regions. On the other hand, this pixel size is also sufficiently small as to not dilute the effect of border changes if they are mostly local (the 1×1 degree pixels are smaller than the average subnational region in Africa).

Specifically, we calculate average light output in all 1×1 degree pixels for each year between 1992 to 2013 and match this data to the pixel-level data on subnational border changes.

Interpreting border changes as policy treatments, we then implement a difference-in-differences design at the pixel level as our baseline specification. Specifically, we explore whether pixels that were affected by a split or merger witness an improvement or deterioration in their economic conditions, as proxied by pixel-level night light luminosity. Our results indicate that mergers led to higher night light output in the post-treatment period. In our baseline specification, mergers increased pixel-level luminosity by about 42%. Using the estimate for the elasticity between night lights and GDP of 0.3 by Henderson et al. (2012), we calculate that pixel-level GDP increases in the long-run on average by 12.6% because of a merger. We find smaller, albeit still positive, effects for splits: luminosity increases by 13%, which translates to an increase in GDP by 3.9%.

One inherent limitation of our setting is that border changes are not random events. Accordingly, one obvious concern is that pixels (or regions) affected by a border change were on a different economic trajectory than unaffected pixels. If border changes are endogenous to economic developments, our estimates may be confounded. In fact, as mentioned above, policy makers often couch border changes in the language of decentralization and government efficiency. If this is indeed their true motive, then we would expect that regions facing economic difficulties are more likely to be subject to border changes.[6] On the other hand, non-economic, and in particular political concerns, often appear in practice to be main motivation for border changes. Hassan (2013), for example, notes that the creation of new administrative units (splits) in many African countries follows an electoral cycle.[7] To the extent that border changes are orthogonal to economic concerns, our empirical approach can produce unbiased estimates.

Overall, it is plausible that there will be a number of border changes in our sample that were implemented for economic reasons. It is not feasible to address such endogeneity concerns in our cross-country context by means of a quasi-experiment as there is no institutional mechanism that would induce quasi-random variation in subnational border changes across all of Africa. While we acknowledge this limitation, we attempt to address it to the extent possible. First, we verify the common trend assumption using event-study plots. We observe no systematic trends in night lights before splits or mergers, suggesting that border changes were at least not overwhelmingly driven by systematic differences in economic trajectories. Second, we estimate regressions where we control for country-level year effects to account for country-specific economic developments. Third, we control for a number of observable time-varying covariates. In these last two specifications, we again obtain similar results as in our baseline model.

Another noteworthy issue is that the magnitudes of the treatment effects for splits and mergers are noticeably different. This difference suggests the possibility that these two forms of border changes affect night lights through different channels. Exploring mechanisms, we indeed find evidence for this.

[6] The direction of the bias is unclear. On the one hand, if any economic difficulties persist to the period after the border change, the estimated treatment effect may be biased downward. On the other hand, there may also be a mean-reversion in the economic fortunes of a region, leading us to over-estimate the treatment effect.

[7] Hassan (2013) shows for Kenya that administrative units were formed to allow the central government to better target public resources to electorally decisive ethnic groups and to foster clientelistic networks.

One important motive as to why splits are implemented appears to be to increase political stability. Specifically, we observe a lower incidence of conflicts after splits.[8] Substantial evidence suggests that (violent) conflicts have negative economic implications (Cerra and Saxena, 2008; Abadie and Gardeazabal, 2003). Hence, the first-order effects of splits on political stability ostensibly have positive, even if relatively small, implications for development.

For mergers, concerns of political stability appear to be unimportant. We observe no effects on conflicts nor any heterogeneity in treatment effects between ethnically homogeneous and heterogeneous regions. We also find no robust effects on public service delivery using geocoded survey evidence. On the other hand, we find that mergers are particularly effective in countries that have a higher bureaucratic quality. These results suggest that mergers are primarily implemented to improve local administrative efficiency with an aim to make better use of limited public resources (i. e. affected regions maintaining similar levels of public services with presumably lower administrative overhead). This appears to be the main reason why economic implications of mergers are more positive than those of splits.

One drawback of our analysis of mechanisms is that, given the data limitations, we cannot provide direct evidence on whether mergers indeed improve administrative efficiency. Accordingly, the evidence for this channel is mostly indirect. The fact that the effect is more pronounced in countries with higher bureaucratic quality, however, implies that mergers are especially successful in countries that value administrative efficiency. Similarly, we cannot rule out other plausible channels through which both splits and mergers may affect development. For example, it is possible that splits, too, lead to improvements in administrative efficiency if they result in a better targeted provision of public goods (Oates, 1999). Mergers, on the other hand, may restrict inefficient inter-jurisdictional competition (Burgess et al., 2012). However, those channels that we pinpoint – reduced ethnic conflicts in the case of splits and increased administrative efficiency – are plausible and have been shown to be relevant in other contexts (e. g. in studies of mergers in industrialized countries Reingewertz (2012)).

This paper contributes to various strands of literature. First, our results are related to the emerging literature on subnational border changes in the developing world and their implications for economic outcomes (Burgess et al., 2012; Asher and Novosad, 2015; Swee, 2015; Grossman et al., 2017; Lipscomb and Mobarak, 2017).[9] For example, Asher and Novosad (2015) find that in India, living conditions in new states that were carved out of existing states improve after the split. Swee (2015) finds that the partitions of municipalities after the Bosnian War led to an improvement in schooling outcomes. On the other hand, as indicated above, administrative splits can also lead to harmful externalities and a race to the bottom through intensified jurisdictional competition. For example, Burgess et al. (2012) show that more government units in Indonesia exacerbate deforestation. Similarly, Lipscomb and Mobarak (2017) find evidence of negative water pollution spillovers after splits of counties in Brazil.

[8]This result is similar to what has been found for splits of administrative units in Indonesia (Bazzi and Gudgeon, 2016; Bazzi et al., 2018).

[9]Some papers address the consequences of administrative splits on politics or conflict activity. For instance, Bazzi and Gudgeon (2016) show that splits can reduce the incidence of conflicts in Indonesia. According to Bazzi et al. (2018) this effect only holds for administrative splits which increase the ethnic diversity of the local population. Moreover, Gottlieb et al. (2016) find evidence that administrative splits in Senegal are done for re-election purposes.

We contribute to this literature by linking border changes to aggregate economic performance (and other outcomes) at the subnational level in Africa. While there are prior studies that explore how border changes affect economic outcomes in Africa, we are the first to study their consequence at the subnational level for all countries on the continent.[10] We are also the first to study the economic consequences of both administrative splits and mergers in a joint framework. Most of the previous literature has focused primarily on splits of administrative units, arguably because they are the more common form of border change in the developing world (Grossman and Lewis, 2014; Grossman et al., 2017). However, as we show below, there were also a significant number of mergers in Africa. Finally, we are able to tie differences in the economic implications of mergers and splits to at least some underlying channels and thus identify relevant mechanisms of border reforms on economic development.[11]

By studying administrative mergers, this paper is also related to the literature on the economic consequences of amalgamations of administrative units. The existing studies on this question focus on local governments in industrialized countries. For example, Loumeau et al. (2017) show that municipal mergers have a positive net effect for economic activity in Germany. Pickering et al. (2016) find similar evidence for Japan. Blesse and Baskaran (2016) find that (voluntary) municipal mergers do not reduce local government costs and expenditures. Reingewertz (2012), on the other hand, shows that mergers significantly reduce local expenditures in Israel. While this strand of literature explores mostly mergers of local governments, there are ongoing debates in developed countries such as Germany about whether higher-level units, notably some of the states (*Länder*), should be merged in order to achieve cost-savings and more efficient governance (Blesse and Heinemann, 2018).[12]

This paper also contributes to the literature on the optimal size of political jurisdictions. This question is tied to the discussion on fiscal federalism and decentralization (Oates, 1999). On the one hand, the costs associated with the heterogeneity in preferences of the population likely increase with the size of a region. On the other hand, larger regional units presumably imply more cost-effective provision of public goods due to scale economies (Bolton and Roland, 1997; Alesina and Spolaore, 1997). A further consideration against smaller (and hence more) regional units is, as alluded above, that they would imply stronger inter-jurisdictional competition, which may lead to inefficient aggregate equilibria (Zodrow and Mieszkowski, 1986).

Finally, this paper is also related to the recent literature that makes use of African national borders in the context of economic development.[13] For example, Michalopoulos and Papaioannou (2013) document an association between pre-colonial ethnic institutions and regional development. Michalopoulos and Papaioannou (2016) study the long-run implications of the scramble for Africa by focusing on eth-

[10] Grossman et al. (2017), for example, finds that an increase in the number of state administrations per country (i. e. administrative unit proliferation due to splits) improves health outcomes. However, this analysis is conducted at the aggregate (national) level.

[11] Other related work includes Shenoy (2018) who finds ambiguous results regarding economic activity around newly established borders after splits of Indian provinces.

[12] Sparked by recent events such as the referendum on the partition of Catalonia from Spain, a related literature discusses more broadly the causes and economic effects of secessions in industrialized countries (Gehring et al., 2017).

[13] McCauley and Posner (2015) give an overview of quasi-experimental studies of African borders on various outcomes. However, subnational borders have been rarely studied for Africa.

nicities that were split by arbitrarily drawn national borders. Similarly, Huillery (2009) shows that the effects of colonial investments have lasting effects, affecting contemporaneous education outcomes and infrastructure provision in West Africa. Looking beyond Africa, it has also been found that pre-industrial border fragmentation had a positive effect in long-run economic development of Europe, primarily because of the importance of natural borders on this continent (Lagerlöf, 2014; Kitamura and Lagerlöf, 2016).

The remainder of this paper is structured as follows. The next section provides some background on subnational border changes in Africa over the last two decades. Section 3 introduces the data and discusses our empirical strategy. Section 4 presents the main results and Section 5 discusses mechanisms. Section 6 concludes.

2 Background

2.1 Historical background on border design in Africa

Many developing countries exhibit an artificial mapping of administrative borders inherited from colonial times. This problem is particularly prevalent in African countries (see Easterly and Levine (1997) for early evidence on the topic). Since the "scramble for Africa" in the late 19th century, African borders often follow latitudes and longitudes lines rather than natural borders (e.g. rivers) and do not coincide with the historical territories of the local ethnicities. Alesina et al. (2011) note that about 80% of African national borders can be categorized as such artificial lines. As for the main motives of these artificial borders, Pierskalla et al. (2017) point to the desire of the former colonial powers to effectively extract of resources as well as the wish to maintain political stability and exert territorial control.

With decolonization in the aftermath of World War II, independent nation states emerged on the African continent. These new nations kept the arbitrary national borders drawn by the colonial powers. Moreover, in their aim to mold the disparate ethnicities into unified nations and to engage in nation building, most African countries opted for a unitary model of governments rater than federalism.[14] These decisions reverberate to this day and manifest themselves in substantial ethnic fragmentation within and across political jurisdictions and sub-optimal state organization, both of which have been shown to lie at the heart of the continent's dismal economic performance (Michalopoulos and Papaioannou, 2016).

In the absence of changes to the borders of the nation states in our sample period (except for the split of South Sudan in 2011), subnational border changes by mergers or splits of administrative regions might provide a partial remedy for these impediments to development. However, in marked contrast to national borders[15], little attention has been devoted in the literature to African subnational borders. There is to our knowledge no comprehensive history of subnational border formation and evolution in Africa. Accordingly, little is known about how they were determined at the dawn of independence as well why (and why not) they were adjusted during the post-independence history of Africa.

[14]First, only three African countries (Ethiopia, Nigeria and Sudan) can be characterized as federations (Treisman, 2008). Second, African federalism is considered to be ineffective. National governments generally do not honor the constitutional arrangements and are reluctant to provide autonomy for ethnic minorities (Fessha, 2012).

[15]For a survey of empirical applications, see McCauley and Posner (2015).

It is plausible that the borders African countries inherited were as arbitrary as their national borders. Several pieces of evidence are consistent with this notion. First, there are well-known cases such as Nigeria, where the British created two regions (northern and southern) for which the common border traces the $7^{\circ}10'$ line of latitude (Berger, 2009). Second, while subnational border changes have been significantly more common than national border changes in Africa (Law, 1999), eyeballing Figure 1 reveals that subnational borders, too, often follow straight lines even in 2013. Hence, despite all adjustments that have been made in the post-independence periods, traces of the arbitrary nature of subnational borders seem to persist to this day.[16]

Second, the available anecdotal evidence on the creation of (new) subnational entities and the definition of their boundaries suggests that these were contentious negotiations in which the interests of several actors had to be taken into account. If various concerns needed to be simultaneously addressed, it is plausible that the resulting borders were neither politically nor economically optimal. An example is the creation of the provinces in South Africa during the transition to democracy after Apartheid. As Makgetla and Jackson (2010) note, the constitutional committee tasked with the delimitation of the provinces had to balance several political concerns (e. g. to gerrymander the provinces such that influential stakeholders would maximize their electoral clout as well as to respect the settlement patterns of ethnic and linguistic groups) and the need to create states that were economically viable.[17]

2.2 State-level border changes in Africa

We identify border changes using shapefiles from the GAUL project. This project provides shapefiles with the subnational boundaries of all countries on the globe. This data is updated annually and hence border changes and their precise location can be identified on a year-by-year basis by comparing shapefiles from two years (we describe the data in more detail below).

According to the GAUL data, border reforms at the state-level have been a frequent phenomenon in Africa in the last two decades.[18] Figure 1 shows the first-tier subnational boundaries in African countries in 1992 and 2013. As is obvious from this figure, subnational borders have changed significantly in several countries. Moreover, different types of border changes could be observed. The most straight-

[16] In the online appendix, we also follow Alesina et al. (2011) to asses the arbitrariness of subnational borders in a quantitative fashion. Alesina et al. (2011) argue that more "squiggly" borders are less arbitrary as they arguably reflect ancestral local ethnic settlement patterns. They consequently propose to calculate a measure for the squigglyness of a country's border that is based on a box counting method. Applying their method to regional borders in Africa, we find that they are less squiggly – more arbitrary– than regional borders in Europe. See the online appendix for more details.

[17] For example, the National Party (NP) supported the creation of the Northern Cape province as its demographics would seem to give it an electoral edge against the African National Congress (ANC) in provincial elections. Makgetla and Jackson (2010) state: "... technical committee members did not envision a Northern Cape, instead drawing a boundary between the Western Cape and North-West province. ANC members on the technical team noted that the Northern Cape had no history of local administration and that the cost of governing the sparse population, coupled with the region's modest local revenue, would make a provincial government's work additionally difficult." In the end, politics trumped the economic concerns and the Northern Cape province was created.

[18] See also Table 1 in Grossman and Lewis (2014) for important trends in administrative proliferation of local governments, i.e. at the state, district or municipal level, in Sub-Saharan Africa. This source, however, gives no information on mergers of subnational governments in the area.

forward type of border change is the split of an existing region into two or more regions. In these cases, the name of the original region can be retained by one of the new regions or both regions receive new names. The original name is typically retained by one of the new regions if one of the newly created regions is relatively small (i. e. if the split was a secession of a small part of a larger region).

The opposite type of border change is a merger of two or more existing regions into one larger entity. In these cases, either an entirely new region is created or an existing (typically large) region absorbs smaller regions. Finally, a third type of border change combines both mergers and splits. In these cases, regions are completely re-aligned.

According to the GAUL data, the number of regions in 1992 was 685. It has increased by 80 regions to 765 (10.5%) by 2013 (see Figure 2). Figure 3 shows that altogether 22 out of 48 countries in our sample were subject to some form of border reform at the state-level, i.e. to either administrative mergers or splits. Table 1 gives an overview of the affected countries per year and type of reform being implemented. The table also suggests that some countries experienced several border reforms. As there were more splits than mergers, the number of regions in Africa has increased on average as illustrated in Figure 2. 113 regions (according to the map in 1992) were affected by splits (16.4% of all regions) and 97 by mergers (14.1% of all regions) during our sample period.[19]

Figure 1 shows that in countries such as Egypt and Burundi, border changes were ostensibly isolated events that affected only a few regions. In other countries, for example Burkina Faso and Ethiopia, border changes affected the entire country and were ostensibly part of broader reforms.

The reasons for the border changes are specific to the country in question. In Burkina Faso, for example, a territorial reorganization was initiated in 2001 that saw the introduction of a new tier of government – called regions – that encompassed the old provinces. These changes were part of a wider public sector reform to improve administrative efficiency. In Rwanda, in contrast, the boundaries of the provinces were completely redrawn in 2006 in a deliberate attempt to reduce the degree of within-region ethnic homogeneity.

In other cases, countries implemented administrative splits to re-centralize power to the national tier as well as to reduce the intergovernmental bargaining power of the subnational units (Grossman and Lewis, 2014). Splits were also implemented for electoral reasons (Resnick, 2017), in particular to facilitate targeted fiscal transfers of the central government to specific voter groups in the new (and smaller) administrative unit (Hassan, 2013; Gottlieb et al., 2016), to strengthen relationships with local elites (Green, 2010), or to address ethnic grievances (Pierskalla, 2016).

Overall, it is plausible that subnational splits and mergers will affect economic outcomes. One of the goals that policy makers often claim to pursue with border reforms is an improvement in administrative efficiency. However, from a purely efficiency perspective, it is unclear what the optimal number and size of subnational regions is. As discussed above, larger regions may allow for the exploitation of scale economies. Duplications of bureaucratic activity can be avoided and a common administration should facilitate economic transactions. On the other hand, larger administrative units also imply that government is farther away from its citizens and arguably less responsive to local needs. In turn, policies may be too uniform to be able to realize the full growth potential of a region. The disadvantages of

[19]Note that 38 regions experience both mergers and splits at some point.

larger government units may be arguably even more pronounced with respect to service delivery. Public officials may be less accountable to local needs if they are responsible for larger geographical areas. Moreover, there are also political economy concerns. Ethnic fragmentation can be higher in larger units and peripheral areas may be more likely to be marginalized and neglected in the allocation of public resources (Grossman and Lewis, 2014).

Related to the previous point, border reforms will likely also affect political attitudes. Research on municipal amalgamations in industrialized countries indicates that mergers can be unpopular in the affected municipalities and lead to political unrest (Lapointe, 2015), a decrease in political efficacy (Lassen and Serritzlew, 2011), and trust (Hansen, 2013). On the other hand, splits of administrative units are often acceptable to or even desired by the affected citizens.[20] Accordingly, they may improve citizens' satisfaction with the (central) government (Hansen, 2015). The ensuing political stability may then have positive effects on economic performance that outweigh, at least in certain circumstances, the potential administrative inefficiencies associated with smaller government units.[21]

3 Data and empirical strategy

3.1 Data

3.1.1 GAUL data on border changes

Our data on border reforms stems from the GAUL project. This dataset provides annual shapefiles of subnational administrative boundaries across the globe. The main objectives of the GAUL project are to provide reliable spatial information on administrative units and to maintain a historical record of changes that occur to their shapes and extent (GAUL, 2014). Using various official sources, this project indicates subnational boundaries as line features in publicly available shapefiles.

The emergence or dissolving of a line from one to the next year ostensibly implies some form of border reform. We use ArcGIS to systematically track changes to the line features that represent the borders of the first-level subnational units. Line features can change in two ways. First, a line can emerge that crosses through an existing region. We classify these changes as splits. Second, an existing line between two regions may vanish. We classify these types of border changes as mergers. The categorizations of line feature changes as splits and mergers encompasses in particular two distinct types of border reforms. First, the emergence of a new line may be a generic split of a region into two (or more) regions. Second, the ceding of territory of one region to another already existing region would be classified by our algorithmic procedure as a split from the perspective of the ceding region. From the perspective of the receiving region, this border change would be classified as a merger (as an existing line vanishes).

For an illustration, consider Figure 1. Subfigure (a) overlays the regional boundaries across Africa in 1992 over the boundaries in 2013. The borders in 1992 are colored green while those in 2013 are

[20] Exceptions are those cases where splits are intended to diminish the administrative coherence of minorities.

[21] Anecdotal evidence indicates that demands for splits are indeed drivers of violent conflicts. In Ethiopia, for example, recent protests in the Amhara region can be traced back to demands by ethnic Amharas that their land is shifted from the Tigray region to the Amhara region; see `http://www.bbc.com/news/world-africa-36940906` and `http://www.africanews.com/2016/08/02/the-powerful-vs-the-populous-the-boundary-crisis-behind-ethiopia-s-protest//`.

colored blue (we indicate country borders with black lines). The observable blue lines hence indicate new borders that emerged over the sample period and thereby allow us to identify all splits from 1992 to 2013. Subfigure (b) overlays the regional boundaries in 2013 over those in 1992. In this case, the borders as of 1992 are colored blue and those in 2013 green. Therefore, the blue lines show those borders that vanished over the sample period and hence indicate mergers.

Since we have annual data, we can identify the year in which a particular region was split or merged. After identifying such changes to the line features, we project the emerging (in case of splits) or vanishing (in case of mergers) line to a 1×1 degree (about 110km $\times$ 110km) grid of pixels covering all of the African continent. As discussed above, unlike regions the 1×1 degree pixels can serve as time-constant units of analysis.

Based on the projection of the border changes to the grid of pixels, we classify pixels as being subject to a split or a merger in a given year. Consider subfigure (a) of Figure 4 which shows how Africa is divided into the 1×1 degree pixels. Pixels are colored depending on whether they were subject to splits or mergers over the sample period. As suggested by our discussion in Section 2, and in line with Figure 1, we observe that more pixels were subject to splits than mergers. There is also a large number of pixels where the corresponding territory underwent both at least one split and one merger over the sample period.

3.1.2 Luminosity as proxy for economic development

Following previous literature, we use night light data as a proxy for development at low levels of geography (Alesina et al., 2016; Hodler and Raschky, 2014; Michalopoulos and Papaioannou, 2016). This data is based on images of the earth at night obtained by satellites of the US Air Force (USAF) Defense Meteorological Satellite Program Operational Linescan System (DMSP-OLS). The original imagery is processed by the National Oceanic and Atmospheric Agency (NOAA) and released to the public as raster datasets.

The raster datasets consist of annual average stable night lights between 8.30pm to 10pm and are available at a resolution of 30 arc-seconds (about 0.86 square kilometer at the equator) for all years after 1992. Each pixel of the dataset stores a digital value ranging from 0 to 63 indicating the amount of average light of an area covering 30 arc-seconds. Higher values imply that a pixel emanates more light (Henderson et al., 2012).

To obtain a proxy for pixel-level GDP, we overlay the grid of pixels over the raster datasets and calculate the sum of the digital values of each cell with size 30 arc-seconds that falls within the boundaries of each of the 1×1 degree pixel as shown in subfigure (a) of Figure 4. Subfigure (b) plots average night lights over the sample period in each of these pixels. More strongly shaded pixels indicate higher luminosity. In general, the pattern of pixel-level luminosity matches with common views of African development. For example, coastal areas tend to have higher luminosity than the hinterland.

3.1.3 Afrobarometer data

To study how political attitudes and perceptions of service quality evolve after border changes, we rely on data from the Afrobarometer surveys. The Afrobarometer surveys are an "independent, nonpartisan

research project that measures the social, political, and economic atmosphere in Africa".[22] There are currently six waves of the survey, with a varying coverage of countries across waves. Later waves have generally a better coverage (the first wave covers 12 countries while the sixth wave covers 36 countries). The overall sample size increased throughout the first six waves, from about 21,000 to about 54,000 respondents.

For the surveys, interviewers conduct face-to-face interviews with representative samples of respondents in each wave and country (1,200 or 2,400 respondents, respectively) and ask several questions about their personal circumstances as well as their attitudes toward the current political climate. To explore the effect of border changes on political attitudes, we focus on responses regarding interest in politics and trust in the executive of the central government (president or prime minister). In addition, we exploit information on support of democracy, satisfaction with democracy and understanding of government. For service quality, we rely on responses for questions regarding access to health as well as water and food security.[23]

The wording of the questions is not identical across waves, but the meaning is similar. Specifically, to measure effects on political attitudes, we use responses to questions with the following content:

- **Trust in president**: How much do you trust the president?
- **Support democracy**: Is democracy preferable to any other kind of government?
- **Satisfied democracy**: How satisfied are you with the way democracy works in your country?
- **Understand government**: Politics and government sometimes seem so complicated that you can't really understand what's going on. Do you agree?
- **Interest in politics**: How interested are you in public affairs?

Responses are on an ordinal scale. We thus transform the data into binary variables to make them comparable across survey waves. If the relevant dummy variable assumes 1, then this implies higher interest in politics, more trust in the president, more support and satisfaction of democracy as well as a higher understanding of government.

To study the implications of border changes on service delivery, we use the following questions:

- **Without healthcare** In the past twelve months, how often have you or your family: gone without medicine or medical treatment that you needed?
- **Without water** In the past twelve months, how often have you or your family: gone without enough clean water to drink and cook with?
- **Without food**: In the last twelve months, how often have you or your family: gone without enough food to eat?

[22] See `http://afrobarometer.org/`.

[23] There are further questions covered in some waves that may be related to border changes. Unfortunately, they are not asked in a sufficient number of waves to be useful for our analysis below.

We focus on these outcomes as they are crucial determinants of citizens' welfare. Access to health care as well as food and water security are pressing issues across large parts of Africa and many decentralization reforms across the continent were specifically intended to improve the delivery of these services (Desai and McGregor, 2011; Babu, 1999; Kaseje, 2006).

As before, responses are on an ordinal scale, which we convert into binary variables which are 1 if respondents state that they went at least several times without these public services. We then project this data on the grid of pixels. This is possible because the Afrobarometer data is geocoded in the sense that we know the district of a respondent. We can hence match each respondent's district to each pixel and thereby construct a pixel-level panel (covering varying individuals within pixels).[24] Since the Afrobarometer has been started only around 2000, the covered period is 2000-2013.[25] Consequently, the number of time periods for which we can explore how border changes affect political attitudes as well as assessments of service quality is smaller than for the night lights regressions. On the other hand, border changes may affect political attitudes and service quality more quickly than economic development, which is a more aggregate measure. In any case, we have for all considered outcomes data from at least 3 waves. For most outcomes, we have data from 6 waves.

3.1.4 Conflict data

We use geocoded data on conflict events from the Armed Conflict Location and Event Data Project (ACLED) to explore how border changes affect the incidence of conflicts. This dataset collects, inter alia, information on the location and date of reported conflict events, e. g. violence committed by government forces, rebels, etc. The data covers all countries in Africa over the period 1997-2014. We use the information on violent conflicts (with fatalities) and project these conflict events on the 1×1 degree grid.

3.1.5 Data for ethnic fractionalization

To measure ethnic fractionalization, we rely on a shapefile provided by the Geo-Referencing of Ethnic Groups (GREG) project. This project uses maps and data from the Soviet Atlas Narodov Mira to georeference ethnic groups across the globe, including Africa. We project the ethnic groups boundaries on the grid of pixels and count the number of groups that fall within a pixel to construct a measure of pixel-level ethnic heterogeneity.[26]

[24] Specifically, we obtain "characteristic" geocodes for each districts by using a Google Maps algorithm and then use these geocodes to match Afrobarometer respondents to the 1×1 degree pixels.

[25] Note that the sixth wave of Afrobarometer covers 2016. To maximize sample size, we include observations from this wave even though our border changes data only lasts until 2013.

[26] Note that GREG denotes up to three major ethnic groups in each settlement area. We count all mentioned groups for our heterogeneity measure. Moreover, GREG measures the spatial location of ethnicities prior to our sample period. Hence, the numbers reflect values before the start of our sample period and accordingly, are not affected by the various border reforms during the time-frame of the analysis.

3.1.6 Data on subnational elections

To measure subnational autonomy, we hand-collect for each country data on whether it had any type of subnational election during our sample period. The idea is that the existence of subnational elections likely suggests some degree of regional political independence. Typically, subnational elections, if they take place, are held for legislative bodies and/or the regional executive. Table A.1 in the online appendix lists which countries held subnational elections, together with the years in which the elections took place.

3.1.7 Data for covariates

We use geographically disaggregated data on total population, forest cover, urban land area, the age and gender ratios as controls in some specifications. This data is obtained from various sources.

Data on total population is from the Gridded Population of the World Version 4 dataset, which relies on population census to model local population at a resolution of 30 arc-seconds. This data is available in five-year increments starting in 2000. As for the luminosity data, we overlay the grid of pixels over the raster datasets and calculate the sum of the digital values of each cell of 30 arc-seconds that falls within the boundaries of a given 1×1 pixel. Since we have no annual data for population, we replace missing population data with the information from the last available year (i. e. the value of a pixel in 2009 is the same as its value in 2005). For years before 2000, i. e. the first year with available data, we use the value in 2000.

Information on forest cover is from the MODIS Percentage Forest Cover Fraction dataset. This data is based on satellite imagery of the fraction of an area covered by trees or forests by the MODIS Sensor (Moderate Resolution Imaging Spectroradiometer). The data is available at a resolution of 250 meter grid cells and for all years between 2001-2010 from the US Geological Survey and Integrated Climate Data Center. As for the population data, we aggregate the forest cover data to the level of 1×1 grid cells and replace missing values before 2001 with the value in 2001 and after 2010 with value in 2010.

Disaggregated data on the demographic and gender composition of African regions is taken from the United Nations Population Division, World Population Prospects (2015 Revision). This dataset is mainly based on detailed official subnational data and is available for 5-year age groupings, both for male and female at a resolution of about 0.01×0.01 decimal degrees (about 1km $\times$ 1km) for 2000 and 2005. As before, we aggregate this 0.01×0.01 pixels to our 1×1 degree pixels and replace missing years with the closest available values.

Data on land cover is obtained from the MODIS land surface type dataset from the US Geological Survey and Integrated Climate Data Center. The data measures the land area fraction by land use type at a resolution of 0.5×0.5 decimal degrees for each year in 2001 to 2012. We use the fraction of urban or developed land as a measure of urbanized land area. Again, we aggregate the urban land area to the level of 1×1 degree pixels for later analysis.

3.2 Empirical strategy

To estimate the causal effect of border changes on local development, we implement a difference-in-difference design using the 1×1 degree pixels as units of observations. The basic specification is:

$$y_{i,t} = \alpha_i + \gamma_t + \beta_s \text{Split}_{i,t} + \beta_m \text{Merger}_{i,t} + \varepsilon_{i,t}, \quad (1)$$

where $y_{i,t}$ is log of aggregate night light output in pixel i in year t.[27] $\text{Split}_{i,t}$ is a dummy that is one for all $T \leq t \leq 2013$ after a new feature line in the GAUL files emerged in T within the territory covered by a particular pixel (i. e. from the first split by which a pixel is affected until the end of the sample period). Similarly, $\text{Merger}_{i,t}$ is a dummy variable that is 1 for all $T \leq t \leq 2013$ after a feature line vanished within the territory covered by a pixel.[28]

To account for year-specific effects, we include year fixed effects γ_t. Year fixed effects also account for annual variations in measured night light output due to different calibrations of the satellites used to record luminosity. To control for systematic (but time-invariant) differences between treated and control pixels, we include pixel fixed effects. For hypothesis tests, we rely on heteroscedasticity-robust standard errors that are clustered at the level of the pixels.

As always with difference-in-difference designs, the identifying assumption is that treated and control pixels would have had common trends in the absence of treatment. This identifying assumption is particularly important in our context as border changes do not take place randomly. To explore the robustness of our results to possible violations of the common trends assumption, we control for a number of time-varying pixel-level variables in robustness tests. We also report results from event-study regressions where we can observe whether there are any differences in how light output evolves immediately before a particular border change takes place, i.e. we verify the common trend assumption.

4 Results

4.1 Baseline

4.1.1 Main results

Table 2 collects the baseline results where we relate border changes to night light output. We observe a positive and significant coefficient for both splits and mergers across all specifications, indicating that pixels that were affected by either type of border change experience an improvement in economic conditions, compared to unaffected pixels. More specifically, the results indicate that night light output is on average about 13% higher after splits and 42% higher after mergers. Using the elasticity between night-lights and GDP of 0.3 estimated by Henderson et al. (2012), these results imply that splits cause an increase of GDP by 3.9% while mergers cause an increase of 12.6%.

While plausible when viewed in isolation, it may appear paradoxical that both splits and mergers have a positive effect on development. As we show below, an explanation for this apparent paradox is that splits and mergers work through different transmission channels. However, before exploring transmission channels, we first establish the robustness of the baseline estimates.

[27] For pixels that have a value of 0 for aggregate night light output, we add 1 before taking the log.

[28] Note that by this definition of the treatment dummies, we implicitly account for the (few) pixels affected by border changes in two separate years.

4.1.2 Robustness

Time-varying covariates. To establish the robustness of the previous results, we replicate the baseline specification after controlling for various time-varying covariates at the pixel-level: population, forest cover, the share of a pixel that is urbanized, the share of young among the total population (age < 25 years), the share of old (age > 65), and the gender ratio (number of women / men).[29]

Table 3 collects the results. The share of urban area is the only variable that shows a significant correlation with night light output: as pixels become more urbanized, night light output increases. However, the estimates for splits and mergers remain virtually unchanged.

Omitting countries. Next, we study whether the results are dependent on the inclusion of one specific country. It would be reassuring to confirm that our results are not driven by only a few outliers. We therefore estimate 48 versions of model (3) in Table 2 after omitting, in turn, all pixels that fall within a given country.[30] The results are collected in Figure 5, where we plot for splits (Subfigure a) and mergers (Subfigure b) 48 coefficient estimates and 90% confidence intervals. Each estimate notes the country that was dropped.

We observe that the statistical significance of splits is dependent in particular on the inclusion of Sudan. While the estimated coefficient is still positive, it turns insignificant once Sudan is dropped. The importance of Sudan for the estimated coefficient is likely driven by the fact that many splits took place in this country during the sample period. These splits ostensibly had a positive effect on development.[31] Accordingly, these results indicate that the average treatment effect of splits is fragile and depends on the sample of countries that are included in the analysis. We explore the fragility of the average treatment effect of splits in more detail below and show that splits have large and thus arguably more robust effects in specific circumstances, i. e. in contexts with high ethnic fragmentation.

For mergers, we find that while the omission of Sudan and Ethiopia reduces the coefficient estimates, they remain comfortably significant. Dropping South Africa, on the other hand, leads to a higher estimate. Overall, the estimates for mergers are generally robust to the omission of individual countries.

Country-specific year effects. While the baseline regressions include year fixed effects and hence control for continent-wide common shocks, it is possible that countries that implemented border reforms were from the outset on different economic trajectories than countries that did not change their territorial structure. Consequently, the common trends assumptions may be violated in our baseline regressions.

To test for this, we re-estimate Equation 1 while including country-specific rather than continent-wide year fixed effects, i.e. holding institutional and economic changes at the country-level constant. We hence identify the effect of border changes by within-country variation. The identifying assumption is that pixels which were not affected by a border change were on the same economic trajectory than

[29] We include all variables in logs.

[30] We assign pixels that are cut by country borders to the country where most of the area of the pixel is located.

[31] South Sudan became an independent country in 2011, i. e. at the end of the sample period. We treat South Sudan as part of Sudan in the last three years of our sample for the sake of simplicity.

treated pixels within the same country. As before, we assign pixels to countries, allocating pixels that are cut by country borders to that country that encompasses the largest fraction of a pixel.

The results are collected in Table 4. The estimated coefficients are similar to the baseline results, suggesting that the common trends assumption is reasonable in our context. While this specification does not rule out the possibility that control pixels within the same country were on a different economic trajectory than treated pixels, this is less less likely than different trends across countries that did and did not implement border reforms.

Different grid sizes. We now explore whether the results are an artifact of our choice of grid size. First, rather than using a 1×1 degree grid, we re-estimate the baseline model after plotting the border change and night lights data to 0.5×0.5 degree pixels (about 55km $\times$ 55 km). Second, we use regions in their boundaries as of 1992 as time-constant units of analysis. That is, we project border changes in the 1992-2013 period to regional boundaries as of 1992 and use those boundaries as time-constant units of analysis (ignoring the fact that regions which were later affected by a border reform would cease to exist). To compare the granularity of these alternative units of analysis, consider first the total number of pixels per grid (see also Figure 6). The total number of pixels in the 1×1 grid is 2758, while it is 10,652 for the 0.5×0.5 grid. Similarly, the number of regions in 1992 was 685.

The results are collected in Table 5. As can be seen from Panel A, halving the pixel size does not change the estimates qualitatively: both splits and merges continue to have a significantly positive effect on night lights. The results are also quantitatively similar, with splits having a slightly larger effect on luminosity than in the baseline regressions. These results suggest that the effects of border changes can be identified at a highly disaggregated level of geography.

Panel B reports the results on the level of the 1992 regions. The results show that the estimate for splits are insignificant, again pointing to the fragility of the average treatment effect of splits. The estimates for mergers, on the other hand, remain both statistically significant and numerically large.

4.2 Event-studies

In this section, we report results from event-study regressions. The main purpose of these specifications is to asses how quickly the economic benefits of border changes emerge, and thus to gain a more comprehensive picture of how border changes affect economic development. In addition, event studies can help us to evaluate the common trends assumption further.

We hence estimate models of the following form:

$$\begin{aligned} y_{i,t} =& \alpha_i + \gamma_t + \beta_{<-5}\text{Border change}_{i,t<-5} + \sum_{t=-5}^{-1} \beta_t \text{Border change}_{i,t} \\ &+ \sum_{t=1}^{5} \beta_t \text{Border change}_{i,t} + \beta_{t>5}\text{Border change}_{i,t>5} + \varepsilon_{i,t}, \end{aligned} \tag{2}$$

with Border change $\in \{\text{Split}, \text{Merger}\}$ and $t = -1$ as the base year. That is, we explore luminosity in treated pixels in all years before and after a border change relative to luminosity in the year immediately

before the border change. For the first four years before the base year and the first five years after the border change, we provide annual estimates. For the remaining years, we estimate an average effect over all remaining years.

We collect the results for splits in subfigure (a) of Figure 7. While some of the event dummies are significant for the pre-treatment period, there is no obvious trend, suggesting that there were no systematic differences in the economic trajectories of pixels affected and not affected by splits. After a split takes place, we observe no change in night lights for the first five years. Only after five years, the effect turns significantly positive.

Subfigure (b) reports the results for mergers. As for splits, we observe similar pre-treatment trends in the treated and control pixels.[32] After a merger, the positive effects accumulate over time. We begin to observe a significant positive effect from year three onwards. After five years, luminosity is about 50% higher in treated pixels compared to the control pixels. Overall, these results confirm the previous findings. Mergers have a quick yet persistent effect on night lights while the effects of splits are more muted.

5 Mechanisms

The above results suggest that the subnational border changes observed in Africa, and in particular mergers, had on average a positive effect. Since these estimates are average treatment effects on the treated, one conclusion that follows is that those regions which were affected by border changes were in general not of optimal size. Changing their size and shape led to improvements, both in the case of mergers and, to a lesser extent, in the case of splits.

It is, however, intriguing that the estimates for splits and mergers are of significantly different magnitudes.[33] This points to different channels through which splits and mergers affect development. In the following, we focus on two specific channels. First, border changes may increase administrative efficiency. Splits may increase efficiency if they make it easier for public officials to tap into local knowledge and to better tailor policies to heterogeneous populations. Mergers may increase efficiency if they lead to a reduction in administrative overhead and enable public officials to exploit economies of scale in the provision of public services.

The second channel works through increased political stability. As discussed, one apparent shortcoming of the border design in Africa is that ethnic groups can be either arbitrarily split by borders or lumped together with other and dissimilar groups into a single administrative unit. Splits and mergers may hence lead to a better match of the historical settlement areas of the different groups and the administrative borders, thereby improving political stability and reducing conflicts. This increase in political stability may then have positive effects for development. We explore these questions in detail below.

[32] While we observe that the event dummy is statistically significant 3 years before mergers, there is no systematic trend in the pre-treatment period.

[33] Conducting t-tests for the baseline estimates for both mergers and splits yield a significant difference at the 1% level.

5.1 The role of ethnic fractionalization

If improved political stability is a relevant channel, we should expect that the economic effects of administrative border changes depend on whether they have changed the degree of regional ethnic fractionalization. If border changes increase ethnic homogeneity, i. e. align with the historical settlement areas of ethnic groups, regional ethnic fractionalization should be reduced. On the other hand, if splits take place in ethnically homogeneous regions or mergers happen between heterogeneous regions, then regional fractionalization should increase. In this subsection, we study whether more heterogeneous or more homogeneous pixels experience a stronger effect on night lights after a border reform. The idea is that if splits or mergers affect luminosity through an improvement in political stability, we should observe stronger effects for splits in pixels that are heterogeneous (since the new borders are presumably drawn in a way to divide two disparate groups) and for mergers in pixels that are homogeneous (since the vanishing borders used to divide one homogeneous group into different regions).

Table 6 expands the baseline specification with interaction effects between mergers and splits and different measures of ethnic fractionalization. In Panel A, we rely on a binary definition of ethnic fractionalization. We define pixels that are inhabited by only one ethnic group as defined by the GREG shapefile as homogeneous and all other pixels as heterogeneous. In Panel B, we construct a count variable to measure ethnic fractionalization by counting the number of distinct ethnic groups in a pixel.

We find that ethnically heterogeneous pixels experience a strong increase in night lights after a split. In Panel A, the estimated coefficient for splits is positive and highly significant for heterogeneous pixels but insignificant with a negative sign for homogeneous pixels. In Panel B, the interaction term between splits and the number of ethnic groups is significantly positive. Accordingly, we conjecture that splits lead to higher growth if they reduce regional ethnic fragmentation.

For mergers, we find no significant differences between homogeneous and heterogeneous pixels. That is, while the interaction effect in Panel A is only significantly different from zero in heterogeneous pixels, t-tests show no significant difference between the two interaction effects for mergers. The apparent irrelevance of ethnic heterogeneity for mergers is further confirmed in Panel B, where the interaction between the merger dummy and the number of groups is insignificant.

Overall, these results indicate that the weak positive effects of splits found in the baseline regressions comes at least in part from a reduction of political instability in ethnically heterogeneous regions. For mergers, on the other hand, this channel appears to be unimportant, arguably because subnational mergers in Africa were implemented for reasons other than to improve political stability.

5.2 Border changes and conflict

To buttress the above interpretation, we next explore whether border changes affect the incidence of conflicts. For this, we relate the treatment dummies for splits and mergers to conflict events. First, we estimate the average effects of either mergers and splits on conflict incidence. Second, we estimate interaction models where we interact the dummies for splits and mergers with the dummy for whether a pixel has more than one ethnicity (i. e. the binary measure of ethnic fractionalization).

The average effects of border reforms of either type on the incidence of armed conflicts are collected in Table 7. Splits result in about 17% fewer conflicts, while mergers have no significant effect. Second,

we study whether the effect of border changes depends on the degree of ethnic fractionalization in a pixel. Border changes should have a stronger effect on political stability and conflicts in more fragmented regions. We collect the results in Table 8. Splits have no effect on the incidence of conflicts in homogeneous regions. In heterogeneous regions, on the other hand, they have a significantly negative effect.

These results reaffirm that one channel through which splits affect development is a pacification of conflicts in ethnically diverse regions. They also suggest that this channel is not relevant for mergers, again because mergers are presumably intended to achieve other goals than political stability.

5.3 Subnational elections

To investigate the link between the specific institutional context and border changes further, we next study whether splits and mergers are more effective when they are implemented in countries where subnational units have significant autonomy. It is plausible that subnational autonomy is a necessary precondition for border changes to pacify (ethnic) conflicts. If a new region is created through a split or merger, but its policies as well as the chief administrators are still determined at the center, the border change may be merely symbolic and hence have no substantive consequences.

Panel A of Table 9 reports regressions where we interact the border change dummy with a dummy for whether in a given year the country into which (the largest share of) a pixel falls has any type of subnational elections, which we interpret as a proxy for subnational (political) autonomy.

The results indicate that splits are only effective in increasing growth if they take place in countries with subnational elections. For mergers, on the other hand, we again find no interactions with the existence of subnational elections.

These findings indicate that the main channel through which splits affect growth is the mitigation of (ethnic) conflicts. Giving marginalized ethnicities their own regions will only mitigate conflicts if the regions have meaningful political autonomy. This is confirmed by Panel B of Table 9, where we find only a significantly negative effect of splits on conflicts for countries that have subnational elections. For mergers, the existence of subnational elections appears to be unrelated to the incidence of conflicts.

5.4 Political attitudes

If splits affect economic development through a reduction in conflicts, we should observe a corresponding change in political attitudes in the affected regions. In particular, inhabitants should be more likely to be satisfied with the political system. It is also possible that mergers, even if they do not lead to more conflicts, affect political attitudes. Notably, studies of municipal mergers in industrialized countries indicate citizens become disenchanted with the political process if they are forced into larger political units. These effects are especially likely if the growth effect found for mergers is due to cuts in public services and cost savings rather than increased administrative efficiency.

To explore these questions, we use Afrobarometer survey data, which we match to our pixel-level border change data. We then estimate different variants of the following model:

$$d_{n,i,t} = \alpha_i + \gamma_t + \beta_s \text{Split}_{i,t} + \beta_m \text{Merger}_{i,t} + + \varepsilon_{i,t}, \tag{3}$$

where $d_{n,i,t}$ are our re-coded variables that record the response of an individual n residing in pixel i in year t to one of the five questions on political attitudes discussed in Section 3.1.3. In all regressions we control for pixel-fixed effects α_i and year fixed effects γ_t[34], respectively.

The results are collected in Table 10. We find that splits have strong and statistically significant effects on political attitudes. Respondents that were subject to splits show an increase in their trust in the president and display both higher support and satisfaction with democracy. Hence, splits ostensibly increase the satisfaction with the political system. Respondents also voice a lower interest in politics, which we interpret as evidence that potentially divisive conflicts are pacified.

For mergers, we find no effects on political attitudes. However, respondents are less likely to state that they understand how government works. This indicates that mergers move government further away from citizens and makes it less accessible to them. This does, however, not necessarily imply that mergers lead to a decline in public services, especially since we do not observe a lower satisfaction with the political processes or any other negative effects on political attitudes.

5.5 Service delivery

A related channel through which border changes may be related to development is the provision of key public services, notably healthcare or water and food security. How such services evolve in the wake of border changes is closely linked to the mechanisms through which they affect development. Improvements in key services may lead to more political stability and satisfaction with the government, but they also tie up scarce public services that could be allocated into areas that have more immediate or potentially larger effects on growth, e .g. physical infrastructure such as roads or telecommunications networks.

To explore this issue, we relate the border change dummies to the self-reported indicators of public service provision from the Afrobarometer described in Section 3.1.3: whether a respondent did not receive adequate health care, whether she had to go without sufficient water, and whether she had to go without food. The empirical specification follows Equation 3.

The results are collected in Table 11. We find that splits ostensibly lead to an improvement in service delivery. Respondents in pixels that were affected by a split report a significantly lower likelihood of not receiving basic public services. Accordingly, splits seem to be associated with higher public spending on services, which may be one reason why their effect on luminosity is noticeably smaller than that of mergers. While it is conceivable that splits lead to higher public services because, as discussed above, they increase administrative efficiency (rather than higher public spending) and allow for a better targeting of public resources, this seems unlikely since they by definition involve a duplication of administrative units and hence higher costs. The fact that they mitigate political conflicts also indicates public services increase because the new units allocate additional resources to previously disenfranchised groups rather than using a fixed amount of resources more efficiently.

For mergers, we find no effect on health services and on water supply. We only find a beneficial effect on food supply. Our interpretation of these results is that mergers reduce administrative overhead and

[34] Year fixed effects are preferable to survey wave fixed effects since a wave captures a broader period of time (usually 2 to 3 years).

increase efficiency since they appear to lead to more luminosity while keeping public services largely constant. That is, we observe no cuts and only improvements for one of the three outcomes we explore.

5.6 Bureaucratic efficiency

In this section, we study the link between administrative efficiency and border changes further. If mergers lead to higher luminosity primarily because they imply higher administrative efficiency, then their effect should be more pronounced in countries that have a more competent bureaucracy. These countries should be most equipped to fully reap the economies of scale that may come with mergers.

We explore this issue by estimating interaction models of the following form:

$$y_{i,t} = \alpha_i + \gamma_t + \sum_k \beta_k \text{Border change}_{i,t} \times \text{Bureaucratic quality}_{k,t} + \varepsilon_{i,t}, \tag{4}$$

where $\text{Bureaucratic quality}_{k,t}$ measures the country-level bureaucratic quality. As discussed, we obtain country-level information on government effectiveness as measured by bureaucratic quality from the International Political Risk Guide. Specifically, we use the composite score of government effectiveness which is normalized to values between 0 and 1.

Table 12 collects the results. In the most complete specification (Model 3), we find that mergers are significantly more effective in raising economic activity in countries with higher bureaucratic quality. This is consistent with the interpretation that one important channel through which mergers affect luminosity is administrative efficiency. While we find that splits also have a stronger effect in countries with better bureaucracies, the effect is not robust once we control for the effect of mergers.

6 Conclusion

In this paper, we study the economic consequences of subnational border changes in Africa. Tracking all state-level border changes during 1992-2013 in all of Africa, we find that regions that were affected by mergers and splits experience stronger economic development as measured by nighttime luminosity. The effect of mergers is larger and more robust than that of splits, indicating that these two types of border reforms work through different channels. Indeed, we find suggestive evidence that splits increase political stability and reduce conflicts, possibly by leading to a more comprehensive provision of public services and more benign political attitudes by the affected inhabitants. We find no effects of mergers on political attitudes or conflicts, but we also observe no decline in public service delivery. While only circumstantial, this evidence is consistent with the interpretation that mergers have a positive effect on development because they increase administrative efficiency. Splits appear to be implemented rather for political than for economic reasons and as a consequence have only second-order, albeit still positive, effects on economic growth.

Overall, these results suggest that the present shape of subnational borders in Africa, just as presumably those of national borders, is inefficient. If African countries want to improve economic performance, they should consider merging regional units. These types of reforms may increase administrative efficiency and thereby improve economic performance. If the main aim is to reduce ethnic conflicts and

foster political stability (i. e. more benign political attitudes and fewer conflicts with fatalities), splits seem to be an effective strategy. As an added benefit, the improvement in political stability may also offer a growth dividend in the long-run.

Our subnational results have also implications for the national level. Secessions from nation states are clearly more difficult than subnational territorial reorganizations and arguably involve many unmanageable risks. However, supranational integration, the equivalent of mergers at the subnational level, may be a feasible way forward. Indeed, small steps towards regional integration have already been taken on the continent with the emergence of organizations such as the Economic Community of West African States (ECOWAS) or the Economic Community of Central African States (ECCAS) (Hartzenberg, 2011). Our results would imply that such efforts should continue.

References

Abadie, A. and J. Gardeazabal (2003). The economic costs of conflict: A case study of the basque country. *American Economic Review 93*(1), 113–132.

Acemoglu, D. and S. Johnson (2005). Unbundling institutions. *Journal of Politcal Economy 113*(5), 949–995.

Acemoglu, D., S. Johnson, and J. A. Robinson (2001). The colonial origins of comparative development: an empirical investigation. *American Economic Review 91*(5), 1369–1401.

Alesina, A., W. Easterly, and J. Matuszeski (2011). Artificial states. *Journal of the European Economic Association 9*(2), 246–277.

Alesina, A., S. Michalopoulos, and E. Papaioannou (2016, April 2016). Ethnic inequality. *Journal of Political Economy 124*(2), 428–488.

Alesina, A. and E. Spolaore (1997). On the number and size of nations. *Quarterly Journal of Economics 112*(4), 1027–1056.

Asher, S. and P. Novosad (2015). The impacts of local control over political institutions: evidence from state splitting in India. Mimeo.

Babu, S. C. (1999). Designing decentralized food security and nutrition policies: a knowledge based system approach in Malawi. *Quarterly Journal of International Agriculture 38*, 78–95.

Bazzi, S. and M. Gudgeon (2016). Local government proliferation, diversity, and conflict. Mimeo.

Bazzi, S., M. Gudgeon, et al. (2018). The political boundaries of ethnic divisions. Technical report, CEPR Discussion Papers.

Berger, D. (2009). Taxes, institutions, and local governance: evidence from a natural experiment in colonial Nigeria. Mimeo (New York University).

Blesse, S. and T. Baskaran (2016). Do municipal mergers reduce costs? Evidence from a German federal state. *Regional Science and Urban Economics 59*, 54–74.

Blesse, S. and F. Heinemann (2018). Selling my state's autonomy for 100 euro? Voter preferences on german state mergers in a survey experiment. Mimeo.

Bolton, P. and G. Roland (1997). The breakup of nations: a political economy analysis. *Quarterly Journal of Economics 112*(4), 1057–1090.

Burgess, R., M. Hansen, B. A. Olken, P. Potapov, and S. Sieber (2012). The political economy of deforestration in the tropics. *Quarterly Journal of Economics 127*, 1707–1754.

Cerra, V. and S. C. Saxena (2008). Growth dynamics: the myth of economic recovery. *American Economic Review 98*, 439–457.

Desai, V. and D. McGregor (2011). Food security and decentralization in a changing climate: an African case study. *Geography and You 11*(65).

Easterly, W. and R. Levine (1997). Africa's growth tragedy: policies and ethnic divisions. *Quarterly Journal Of Economics 112*(4), 1203–1250.

Elaigwu, J. I. (2008). *The politics of federalism in Nigeria*. Adonis & Abbey Publishers Ltd.

Englebert, P. and R. Hummel (2005). Let's stick together: understanding Africa's secessionist deficit. *African Affairs 104*, 399–427.

Erk, J. (2014). Federalism and decentralization in sub-Saharan Africa: Five patterns of evolution. *Regional & Federal Studies 24*(5), 535–552.

Fessha, Y. T. (2012). Federalism, territorial autonomy and the management of ethnic diversity in africa: reading the balance sheet. *L'Europe en Formation* (1), 265–285.

Fox, W. F. and T. Gurley (2006). Will consolidation improve sub-national governments? World Bank Working Paper No. 3919.

GAUL (2014). The global administrative unit layers gaul 2015: technical aspects of the gaul distribution set.

Gehring, K., C. Schweiger, K. Lenk, K. Schrader, C.-F. Laaser, G. Maass, et al. (2017). Am besten allein? Separatismus in Europa: Welche Kraefte treiben die Unabhaengigkeitsbewegungen an? *ifo Schnelldienst 70*(23), 03–18.

Gottlieb, J., G. Grossman, H. A. Larreguy, and B. Marx (2016). The effect of administrative unit creation on electoral behavior: Evidence from Senegal. *Unpublished manuscript*.

Green, E. (2010). Patronage, district creation, and reform in Uganda. *Studies in Comparative International Development 45*(1), 83–103.

Grossman, G. and J. I. Lewis (2014). Administrative unit proliferation. *American Political Science Review 108*(1), 196–217.

Grossman, G., J. H. Pierskalla, and E. Boswell Dean (2017). Government fragmentation and public goods provision. *The Journal of Politics 79*(3), 823–840.

Hansen, S. W. (2013). Polity size and local political trust: a quasi-experiment using municipal mergers in Denmark. *Scandinavian Political Studies 36*(1), 43–66.

Hansen, S. W. (2015). The democratic costs of size: how increasing size affects citizen satisfaction with local government. *Political Studies 63*(2), 373–389.

Hartzenberg, T. (2011). Regional integration in Africa. World Trade Organization Staff Working Paper ERSD-2011-14.

Hassan, M. (2013). District creation in Kenya under president Moi. Mimeo (University of Michigan).

Henderson, J. V., A. Storeygard, and D. N. Weil (2012). Measuring economic growth from outer space. *American Economic Review 102*, 994–1028.

Hodler, R. and P. Raschky (2014). Regional favoritism. *Quarterly Journal of Economics 129*(2), 995–1033.

Huillery, E. (2009). History matters: The long-term impact of colonial public investments in French West-Africa. *American Economic Journal: Applied Economics 1*(2), 176–215.

Jerven, M. (2013). *Poor numbers: how we are misled by African development statistics and what to do about it*. Cornell University Press.

Kaseje, D. (2006). Health care in Africa: challenges, opportunities and an emerging model for improvement. Mimeo (Paper presented at the Woodrow Wilson International Center for Scholars).

Kitamura, S. and N.-P. Lagerlöf (2016). Geography and state fragmentation. Technical report, Working Paper, Institute for International Economic Studies.

Lagerlöf, N.-P. (2014). Population, technology and fragmentation: the European miracle revisited. *Journal of Development Economics 108*, 87–105.

Lapointe, S. (2015). The role of group diversity in preferences for local jurisdiction borders: Evidence from municipal referendums in Quebec.

Lassen, D. D. and S. Serritzlew (2011). Jurisdiction size and local democracy: Evidence on internal political efficacy from large-scale municipal reform. *American Political Science Review 105*(2), 238–258.

Law, G. (1999). *Administrative subdivisions of countries: a comprehensive world reference, 1900 through 1998*. McFarland Inc.

Lipscomb, M. and A. M. Mobarak (2017). Decentralization and the political economy of water pollution: Evidence from the re-drawing of county borders in Brazil. *Review of Economic Studies 84*, 464–502.

Loumeau, G., M. Koethenbuerger, and P. H. Egger (2017). Local border reforms and economic activity.

Makgetla, T. and R. Jackson (2010). Negotiating divisions in a divided land: creating provinces for a new South Africa. ISS Policy Note.

McCauley, J. F. and D. N. Posner (2015). African borders as sources of natural experiments promise and pitfalls. *Political Science Research and Methods 3*(2), 409–418.

Michalopoulos, S. and E. Papaioannou (2013). Pre-colonial ethnic institutions and contemporary African development. *Econometrica 81*(1), 113–152.

Michalopoulos, S. and E. Papaioannou (2016). The long-run effects of the scramble for Africa. *American Economic Review 106*, 1802–1848.

Nunn, N. and L. Wantchekon (2011). The slave trade and the origins of mistrust in Africa. *American Economic Review 101*, 3221–3252.

Oates, W. (1999). An essay on fiscal federalism. *Journal of Economic Literature 37*(3), 1120–1149.

Pickering, S., S. Tanaka, and K. Yamada (2016). The impact of municipal mergers on local public spending: Evidence from remote-sensing data.

Pierskalla, J., A. De Juan, and M. Montgomery (2017). The territorial expansion of the colonial state: Evidence from German East-Africa 1890–1909. *British Journal of Political Science*, 1–27.

Pierskalla, J. H. (2016). Splitting the difference? the politics of district creation in Indonesia. *Comparative Politics 48*(2), 249–268.

Reingewertz, Y. (2012). Do municipal amalgamations work? Evidence from municipalities in Israel. *Journal of Urban Economics 72*, 240–251.

Resnick, D. (2017). Democracy, decentralization, and district proliferation: The case of Ghana. *Political Geography 59*, 47–60.

Shenoy, A. (2018). Regional development through place-based policies: Evidence from a spatial discontinuity. *Journal of Development Economics 130*, 173–189.

Swee, E. L. (2015). Together or separate? post-conflict partition, ethnic homogenization, and the provision of public schooling. *Journal of Public Economics 128*, 1–15.

Thomson, A. (2010). *An Introduction to African Politics*. London: Routledge.

Treisman, D. (2008). Decentralization Dataset. `http://www.sscnet.ucla.edu/polisci/faculty/treisman/`.

Zodrow, G. R. and P. Mieszkowski (1986). Pigou, Tiebout, property taxation and the under-provision of local public goods. *Journal of Urban Economics 19*, 356–370.

(a) 1992

(b) 2013

Figure 1: Subnational borders in Africa in 1992 and 2013. Subfigure (a) overlays the 1992 boundaries of first-tier regions over the 2013 boundaries. Subfigure (b) overlays the 1992 boundaries of first-tier regions over the 2013 boundaries.

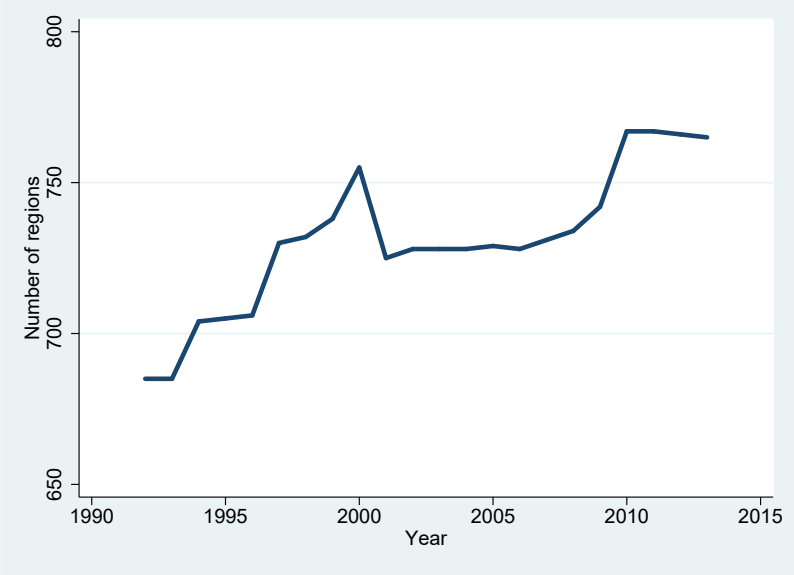


Figure 2: Number of first-level regions in Africa, 1992-2013.

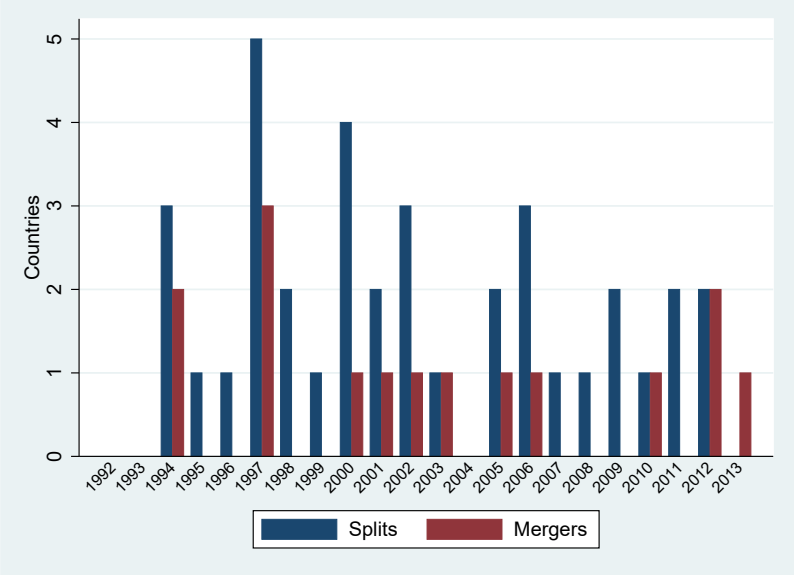
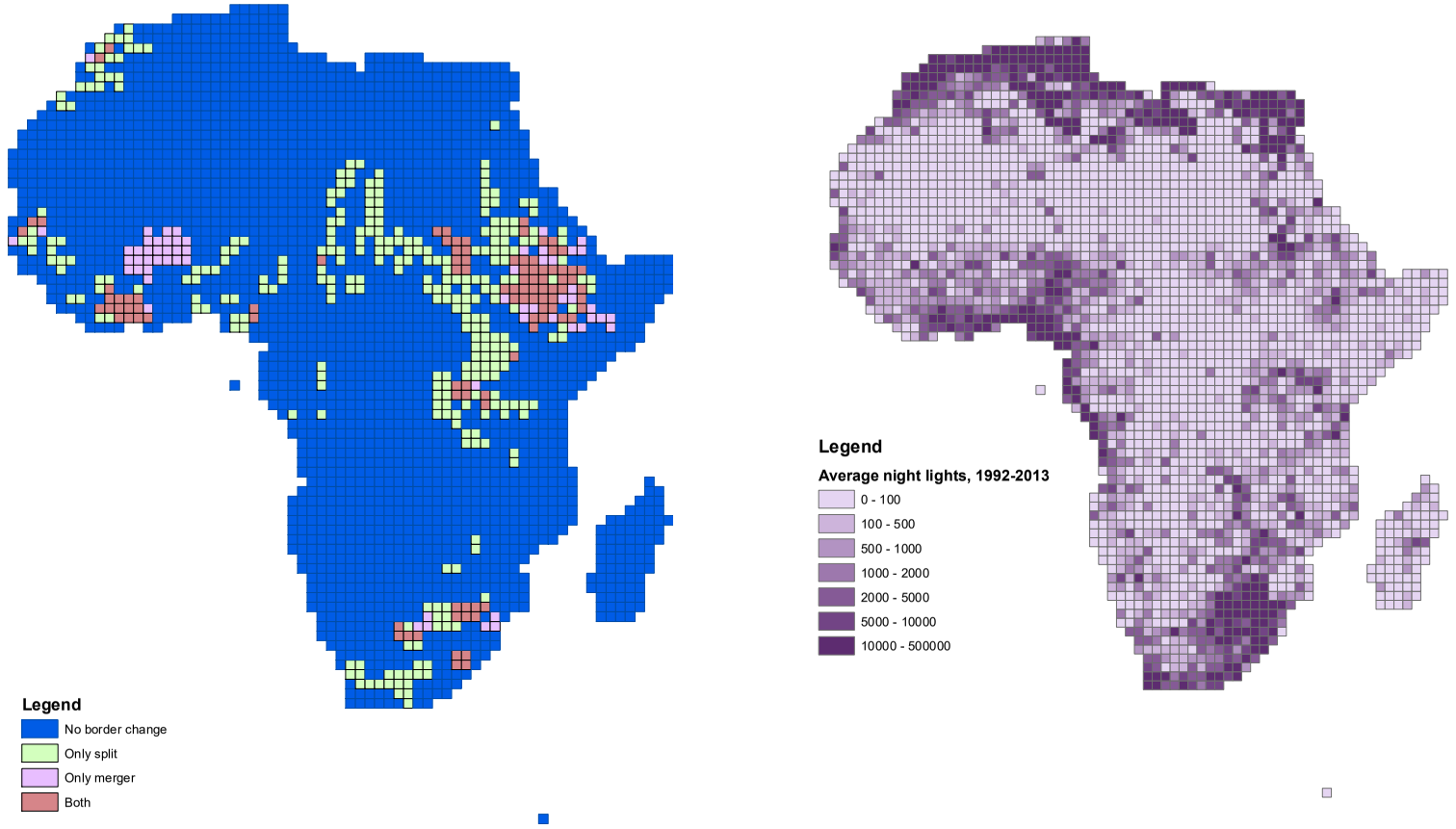
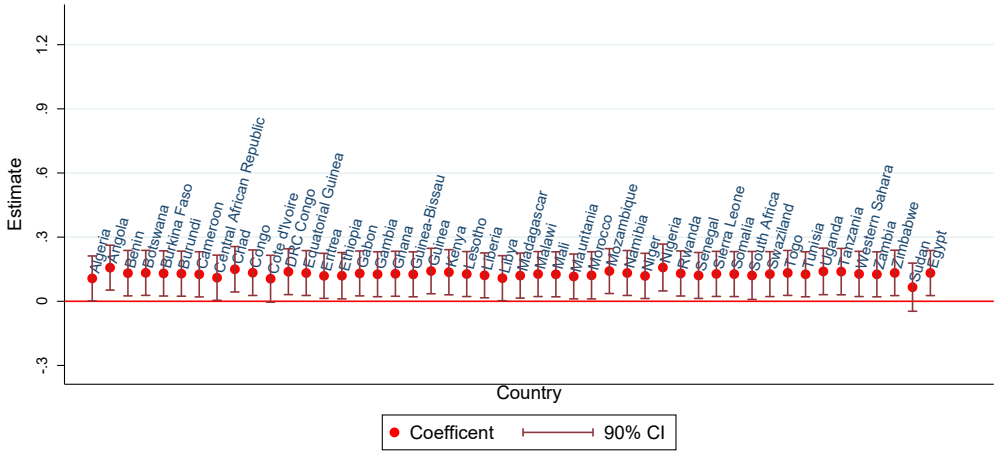


Figure 3: Number of countries with border changes in Africa, 1992-2013.

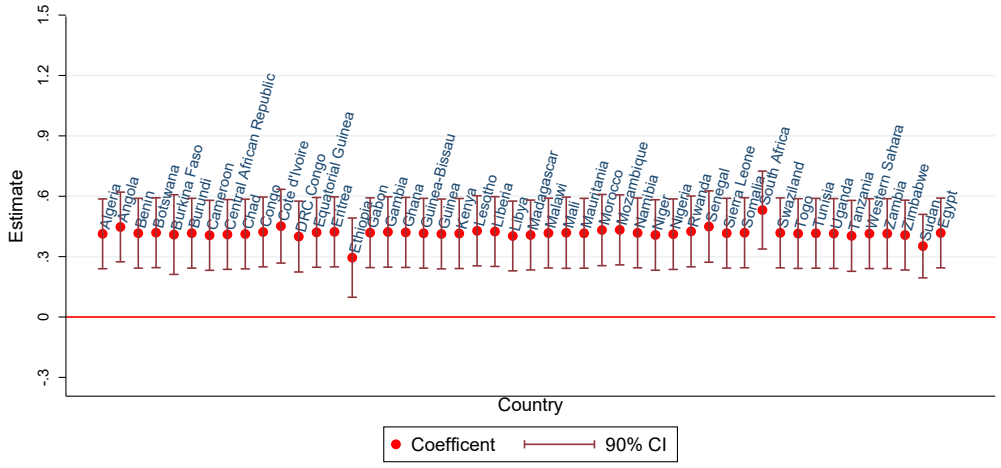


(a) BORDER CHANGES **(b)** NIGHT LIGHT OUTPUT

Figure 4: Border changes and light output at the pixel-level. Subfigure (a) shows the pixels affected by a split, merger, or both during the sample period. Subfigure (b) shows average night light output of each pixels over the sample period.

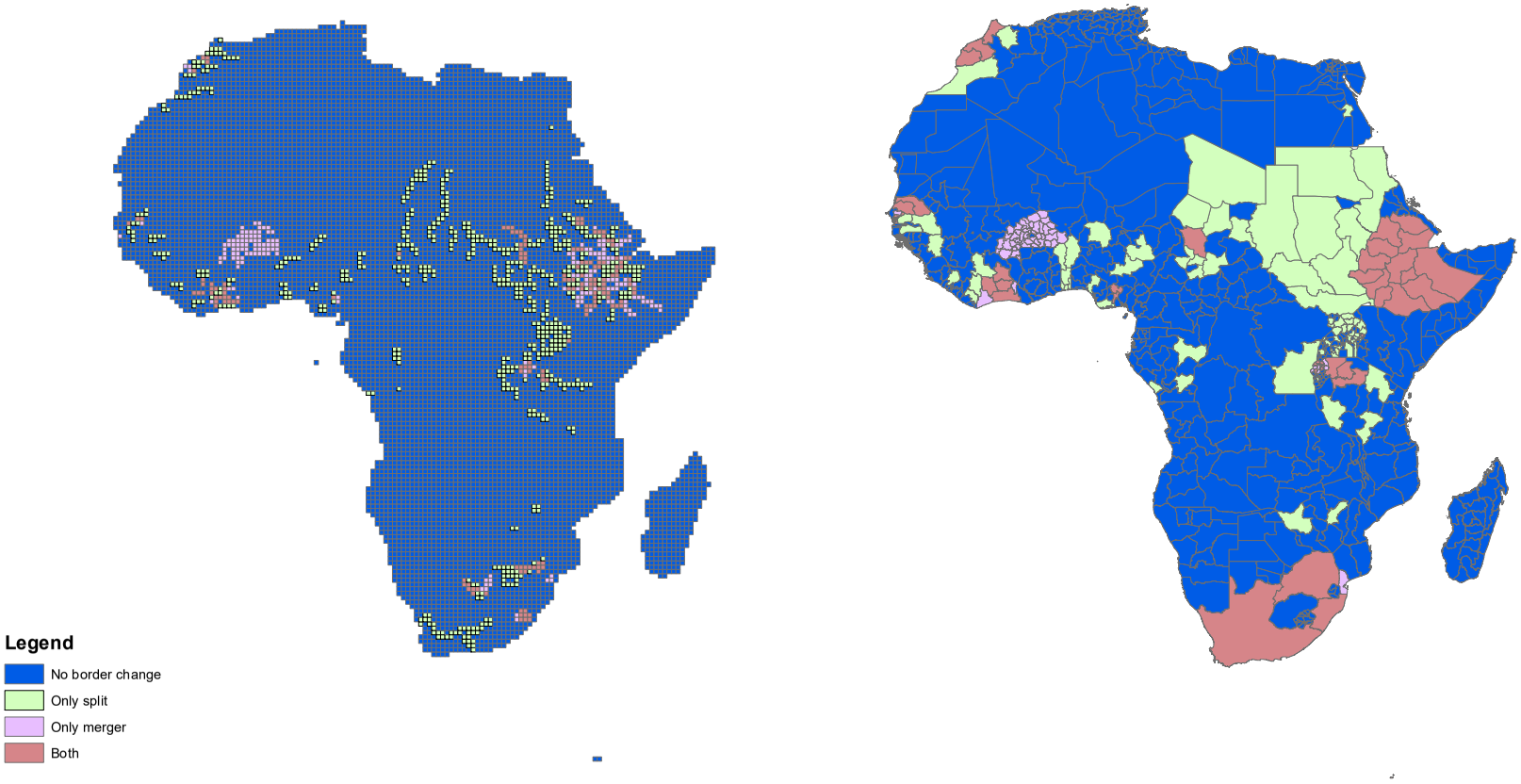


(a) SPLITS



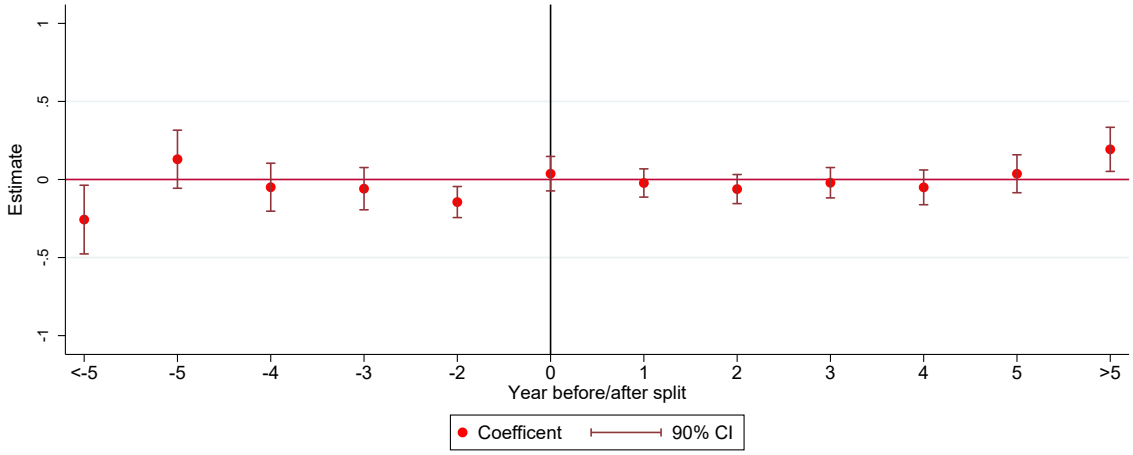
(b) MERGERS

Figure 5: Robustness test: Omission of countries form sample.

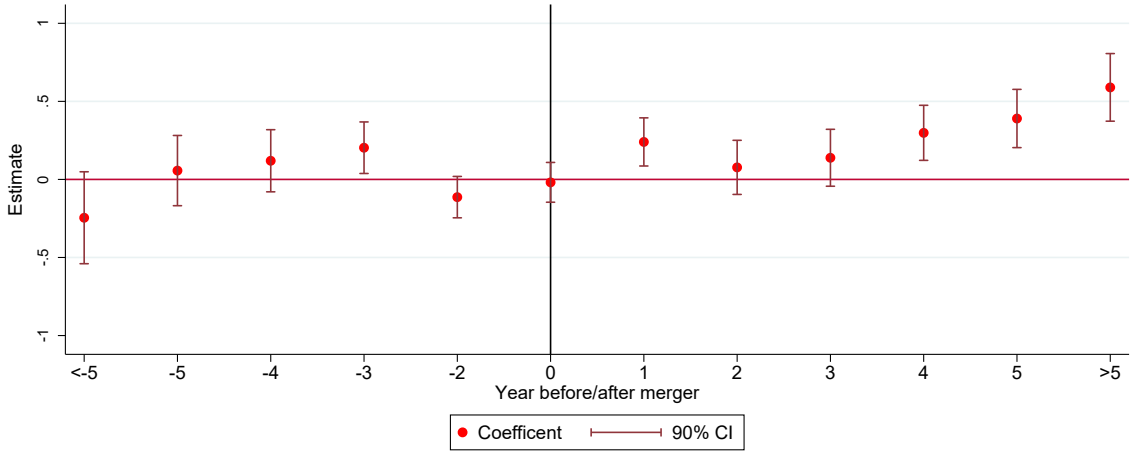


(a) 0.5 × 0.5 DEGREES **(b)** 1992 REGION-LEVEL

Figure 6: Different pixel sizes and border changes. Subfigure (a) shows border changes at the pixel size of 0.5 × 0.5 degrees. Subfigure (b) shows border changes at a pixel size of 1992 regions.



(a) SPLITS



(b) MERGERS

Figure 7: Event-study of splits and mergers around a 5-year window. This figure shows event study plots at the pixel-level for splits and mergers covering the first five pre-border change and the first five post-border change years. The baseline level of night lights is the one in the year before the border change.

Table 1: BORDER CHANGES IN AFRICA

Year	Splits	Mergers
1994	Ethiopia; SouthAfrica; Sudan	Ethiopia; SouthAfrica
1995	Congo	
1996	Guinea	
1997	Côted'Ivoire; DRC Congo; Morocco; Nigeria; Zimbabwe	Côted'Ivoire; Morocco; Nigeria
1998	Burundi; Ethiopia	
1999	Benin	
2000	Chad; Côted'Ivoire; Liberia; Sudan	Chad
2001	Côted'Ivoire; Liberia	BurkinaFaso
2002	Congo; Senegal; Tanzania	Senegal
2003	Congo	Gambia
2005	SouthAfrica; Uganda	SouthAfrica
2006	Rwanda; Sudan; Uganda	Rwanda
2007	Uganda	
2008	Senegal	
2009	Egypt; Uganda	
2010	Uganda	Uganda
2011	Congo; Sudan	
2012	Côted'Ivoire; Tanzania	Côted'Ivoire; Tanzania
2013		Mozambique

This table collects which countries under-went border changes (either split or mergers) during the sample period.

Table 2: BORDER CHANGES AND ECONOMIC GROWTH IN AFRICA: BASELINE REGRESSIONS

	(1)	(2)	(3)
Split	0.181***		0.127**
	(0.063)		(0.064)
Merger		0.453***	0.417***
		(0.104)	(0.105)
Pixel FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Pixels	2758	2758	2758
N	60676	60676	60676

[a] This table collects difference-in-difference regressions that relate border changes in Africa (splits or mergers) to the log of night light output. The unit of observation are 1 $\times$ 1 degree pixels.

[b] Stars indicate significance levels at 10%(*), 5%(**) and 1%(***).

[c] Standard errors (in paranetheses) are clustered at the pixel-level and robust to heteroscedasticity.

Table 3: BORDER CHANGES AND ECONOMIC GROWTH IN AFRICA: REGRESSIONS WITH PIXEL-LEVEL COVARIATES

	(1)	(2)	(3)
Split	0.181***		0.128**
	(0.063)		(0.064)
Merger		0.446***	0.410***
		(0.104)	(0.106)
Population	-0.027	-0.004	-0.011
	(0.144)	(0.143)	(0.144)
Forest cover	-0.011	-0.010	-0.010
	(0.018)	(0.018)	(0.018)
Urban share	0.369***	0.369***	0.374***
	(0.109)	(0.106)	(0.109)
Young share	67.190	62.355	61.807
	(61.386)	(65.365)	(65.051)
Old share	1.379	0.902	0.631
	(16.750)	(16.915)	(16.902)
Gender ratio	-24.191	-23.372	-22.260
	(58.068)	(58.853)	(58.897)
Region FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Regions	2758	2758	2758
N	60676	60676	60676

[a] This table collects difference-in-difference regressions that relate border changes in Africa (splits or mergers) to the log of night light output. The unit of observation are 1 $\times$ 1 degree pixels.
[b] Stars indicate significance levels at 10%(*), 5%(**) and 1%(***).
[c] Standard errors (in paranetheses) are clustered at the pixel-level and robust to heteroscedasticity.

Table 4: BORDER CHANGES AND ECONOMIC GROWTH IN AFRICA: REGRESSIONS WITH COUNTRY-SPECIFIC YEAR EFFECTS

	(1)	(2)	(3)
Split	0.161**		0.133*
	(0.074)		(0.074)
Merger		0.369***	0.340***
		(0.124)	(0.124)
Pixel FE	Yes	Yes	Yes
Country-specific year FE	Yes	Yes	Yes
Regions	2758	2758	2758
N	60676	60676	60676

[a] This table collects difference-in-difference regressions that relate border changes in Africa (splits or mergers) to the log of night light output. The unit of observation are 1 $\times$ 1 degree pixels.
[b] Stars indicate significance levels at 10%(*), 5%(**) and 1%(***).
[c] Standard errors (in paranetheses) are clustered at the pixel-level and robust to heteroscedasticity.

Table 5: BORDER CHANGES AND ECONOMIC GROWTH IN AFRICA: ROBUSTNESS TO DIFFERENT SIZES FOR TREATED UNITS

	(1)	(2)	(3)
Panel A: 0.5 × 0.5 grid size			
Split	0.250***		0.204***
	(0.043)		(0.043)
Merger		0.525***	0.483***
		(0.072)	(0.073)
Region FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Regions	10652	10652	10652
N	234344	234344	234344
Panel B: 1992 region boundaries			
Split	0.026		-0.095
	(0.099)		(0.110)
Merger		0.562***	0.582***
		(0.124)	(0.132)
Region FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Regions	685	685	685
N	15070	15070	15070

[a] This table collects difference-in-difference regressions that relate different type of border changes to the log of night light output to pixels of size 0.5 × 0.5 and regional borders in 1992.
[b] Stars indicate significance levels at 10%(*), 5%(**) and 1%(***).
[c] Standard errors (in paranetheses) are clustered at the pixel-level and robust to heteroscedasticity.

Table 6: BORDER-INDUCED ETHNIC CHANGES AND ECONOMIC EFFECTS

	(1)	(2)	(3)
Panel A: Dummy ethnicity variable			
Split × Ethnicity($N = 1$)	-0.130		-0.150
	(0.103)		(0.103)
Split × Ethnicity($N > 1$)	0.261***		0.201***
	(0.076)		(0.077)
Merger × Ethnicity($N = 1$)		0.281	0.334
		(0.221)	(0.222)
Merger × Ethnicity($N > 1$)		0.468***	0.404***
		(0.116)	(0.118)
Pixel FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Pixels	2684	2684	2684
N	59048	59048	59048
Panel B: Continuous ethnicity variable			
Split	-0.123		-0.126
	(0.129)		(0.128)
Split × Ethnicity count	0.112**		0.095*
	(0.050)		(0.049)
Merger		0.050	0.073
		(0.261)	(0.262)
Merger × Ethnicity count		0.134	0.113
		(0.098)	(0.098)
Pixel FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Pixels	2684	2684	2684
N	59048	59048	59048

[a] This table collects interaction models of the count of ethnicities in a 1 × 1 degree pixel with a treatment dummy on whether that pixel was affected by a merger or split ina specific year and all subsequent years. We relate border changes in Africa (splits or mergers) to the log of night light output. Panel (A) measures ethnic fractionalization, i.e. the number of ethnicities in a given pixel as a dummy variable equaling one if identifying more than one ethnicity in a given pixel. Panel (B) refers to ethnic fractionalization as a continuous variable of all ethnicities observable in a given pixel. The unit of observation are 1 × 1 degree pixels.

[b] Stars indicate significance levels at 10%(*), 5%(**) and 1%(***).

[c] Standard errors (in paranetheses) are clustered at the pixel-level and robust to heteroscedasticity.

Table 7: BORDER CHANGES AND CONFLICTS IN AFRICA

	(1)	(2)	(3)
Split	-0.165***		-0.167***
	(0.061)		(0.062)
Merger		0.003	0.020
		(0.047)	(0.046)
Region FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Regions	2758	2758	2758
N	46886	46886	46886

[a] This table collects difference-in-difference regressions that relate border changes in Africa (splits or mergers) to the log of total conflict events. The unit of observation are 1×1 degree pixels.
[b] Stars indicate significance levels at 10%(*), 5%(**) and 1%(***). Standard errors (in paranetheses) are clustered at the pixel-level and robust to heteroscedasticity.

Table 8: BORDER CHANGES AND CONFLICTS IN AFRICA: THE ROLE OF ETHNIC FRACTIONALIZATION

	(1)	(2)	(3)
Split $\times$ Ethnicity($N = 1$)	-0.039		-0.038
	(0.037)		(0.037)
Split $\times$ Ethnicity($N > 1$)	-0.208***		-0.210***
	(0.080)		(0.080)
Merger $\times$ Ethnicity($N = 1$)		-0.013	-0.013
		(0.067)	(0.068)
Merger $\times$ Ethnicity($N > 1$)		0.006	0.029
		(0.054)	(0.053)
Pixel FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Pixels	2684	2684	2684
N	45628	45628	45628

[a] This table collects interaction models of the count of ethnicities in a 1×1 degree pixel with a treatment dummy on whether that pixel was affected by a merger or split in specific year and all subsequent years. We relate border changes in Africa (splits or mergers) to the log of conflict counts in a given pixel. The table measures ethnic fractionalization, i.e. the number of ethnicities in a given pixel as a dummy variable equaling one if identifying more than one ethnicity in a given pixel. The unit of observation are 1×1 degree pixels. This table collects difference-in-difference regressions that relate border changes in Africa (splits or mergers) to the log of conflict incidence. The unit of observation are 1×1 degree pixels.
[b] Stars indicate significance levels at 10%(*), 5%(**) and 1%(***).
[c] Standard errors (in paranetheses) are clustered at the pixel-level and robust to heteroscedasticity.

Table 9: BORDER CHANGES AND SUB-NATIONAL ELECTIONS

	(1)	(2)	(3)
Panel B: Growth			
Split × Elections	0.396***		0.325***
	(0.093)		(0.095)
Split × No Elections	0.026		-0.001
	(0.070)		(0.072)
Merger × Elections		0.472***	0.365***
		(0.113)	(0.113)
Merger × No Elections		0.308	0.333*
		(0.198)	(0.202)
Elections	0.055	0.088**	0.049
	(0.041)	(0.039)	(0.041)
Pixel FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Pixels	2758	2758	2758
N	60676	60676	60676
Panel B: Conflict			
Split × Elections	-0.124		-0.128
	(0.078)		(0.078)
Split × No Elections	-0.193***		-0.189***
	(0.059)		(0.059)
Merger × Elections		0.041	0.041
		(0.052)	(0.050)
Merger × No Elections		-0.095	-0.053
		(0.077)	(0.073)
Elections	-0.007	0.001	-0.008
	(0.011)	(0.011)	(0.011)
Pixel FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Pixels	2758	2758	2758
N	46886	46886	46886

[a] This table collects interaction models for whether the country into which the largest share of a pixel falls has sub-national elections and the border change dummies. We relate border changes (splits and mergers) in Africa to the log of night light output. The dependent variable in Panel (A) is the log of night light output. The dependent variable in Panel (B) is the log of total conflict events. The unit of observation are 1 × 1 degree pixels.

[b] Stars indicate significance levels at 10%(*), 5%(**) and 1%(***).

[c] Standard errors (in paranetheses) are clustered at the pixel-level and robust to heteroscedasticity.

Table 10: BORDER CHANGES AND POLITICAL ATTITUDES: EVIDENCE FROM AFROBAROMETER

	(Trust in president)	(Support democracy)	(Satisfied with democracy)	(Understand government)	(Interest in politics)
Split	0.163***	0.052***	0.105***	0.036	-0.162***
	(0.046)	(0.020)	(0.040)	(0.035)	(0.024)
Merger	-0.075	0.008	0.014	-0.145***	0.042
	(0.082)	(0.027)	(0.033)	(0.019)	(0.030)
Pixel FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Regions	986	1065	1065	799	1065
N	59858	76495	77070	28561	85412
F	7.052	1187.925	17.094	57.721	220.041

[a] This table collects difference-in-difference regressions that relate border changes in Africa (splits or mergers) to survey evidence on political attitudes from the Afrobarometer. The unit of observation are individual survey respondents.
[b] Stars indicate significance levels at 10%(*), 5%(**) and 1%(***).
[c] Standard errors (in paranetheses) are clustered at the pixel-level and robust to heteroscedasticity.

Table 11: BORDER CHANGES AND SERVICE DELIVERY: EVIDENCE FROM AFROBAROMETER

	(Without healthcare)	(Without water)	(Without food)
Split	-0.060**	-0.076**	-0.068**
	(0.029)	(0.032)	(0.028)
Merger	-0.006	0.039	-0.121***
	(0.044)	(0.060)	(0.033)
Pixel FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Regions	1065	1045	1065
N	83050	77641	83247
F	19.656	158.614	23.186

[a] This table collects difference-in-difference regressions that relate border changes in Africa (splits or mergers) to survey evidence on service delivery from the Afrobarometer. The unit of observation are individual survey respondents.
[b] Stars indicate significance levels at 10%(*), 5%(**) and 1%(***).
[c] Standard errors (in paranetheses) are clustered at the pixel-level and robust to heteroscedasticity.

Table 12: BORDER CHANGES AND ECONOMIC GROWTH IN AFRICA: CROSS-COUNTRY DIFFERENCES FROM GOVERNMENT QUALITY

	(1)	(2)	(3)
Split	0.102		0.098
	(0.066)		(0.068)
Split × Bureaucratic quality	0.459**		0.159
	(0.214)		(0.232)
Merger		0.296**	0.269**
		(0.120)	(0.123)
Merger × Bureaucratic quality		0.822**	0.750*
		(0.369)	(0.402)
Bureaucratic quality	-0.152	-0.146	-0.161
	(0.175)	(0.171)	(0.174)
Region FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Regions	2438	2438	2438
N	50148	50148	50148

[a] This table depicts the interaction effects of border changes in Africa (splits or mergers) with a measure of country-level institutions, notably its bureaucratic quality. The outcome variable is log of night light output at the 1×1 degree pixel-level. Column (1) considers the interaction effects of splits with a continuous variable (bound between 0 and 1) of government effectiveness from the International Country Risk Guide. Column (2) shows similar interactions for mergers. Column (3) considers the interactions of both mergers and splits.

[b] Stars indicate significance levels at 10%(*), 5%(**) and 1%(***).

[c] Standard errors (in paranetheses) are clustered at the pixel-level and robust to heteroscedasticity.

Online appendix

A.1 Fractal dimension of regional borders in Africa

The idea of Alesina et al. (2011) to measure the arbitrariness of borders is to divide a figure of the (non-coastal) border of a jurisdiction (in their case a country) into boxes of different sizes and to count how many boxes are crossed by the border. If the number of boxes crossed by a border increases linearly as the size of the boxes declines, the border is a straight line. In contrast, the more the number of boxes increases disproportionally as the size of the boxes declines, the more squiggly the underlying border.

More formally, the slope coefficient of a log-log plot of the number of boxes that are crossed by a border and the total number of boxes into which the figure is divided assumes a value between 1 (linear line) and 2 (the line crosses every box in the figure and is thus effectively a plane). The specific value is called the fractal dimension, with higher values indicating more complex borders. When we apply this method to the (non-coastal) borders of regions in Africa (See subfigure (a) of Appendix Figure A.1), we obtain a fractal dimension of 1,5268.[35] This value in itself is not particularly meaningful. However, we can compare it with the fractal dimension of first-order regions in other continents such as Europe (subfigure (b) of Appendix Figure A.1). For the borders of European regions, we obtain a value of 1,5805. Accordingly, the borders of African regions are less squiggly than those of European regions, suggesting in line with intuition that the borders in Africa are more arbitrary.

For reference, we have also compared the fractional dimensions of African and European country borders. We obtain a value of 1,2783 for Africa and 1,3811 for Europe. These values are consistent with the intuition that African national borders are more arbitrary than European borders. Note that the magnitudes of these values cannot be easily interpreted and arguably have no cardinality. Hence, we cannot make statements about whether national borders are more or less arbitrary than regional borders.

[35] Following Alesina et al. (2011), we use the software program ImageJ, which is available at `https://imagej.nih.gov/ij/`, to calculate the fractal dimensions after few adjustments from the defaults.

(a) AFRICA **(b)** EUROPE

Figure A.1: Non-coastal regional borders in Africa and Europe, 1992

A.2 Data Appendix for regional elections in Africa

Table A.1: SUBNATIONAL ELECTIONS IN AFRICA IN SAMPLE PERIOD

Country	Regional elections (Years of elections)
Algeria	Yes (1997,2002,2007,2012)
Angola	No
Botswana	Yes (1994,1999,2004,2009)
Cameroon	No
Central African Republic	No
Chad	No
Congo	Yes (2002,2008)
Cote d'Ivoire	No
Democratic Republic of the Congo	Yes (2007)
Equatorial Guinea	No
Eritrea	Yes (1993,1997,2002,2004)
Gabon	No
Gambia	Yes (2002,2008,2013)
Ghana	Yes (1996,2000,2004,2008,2012)
Guinea-Bissau	No
Lesotho	Yes (2005,2011)
Liberia	No
Libya	No
Malawi	No
Mali	Yes (1999,2004,2009)
Mauritania	No
Morocco	No
Mozambique	Yes (1998,2003,2009)
Namibia	Yes (1992,1998,2004,2010)
Niger	No
Nigeria	Yes (1992,1999,2003,2007,2011)
Rwanda	No
Senegal	Yes (1996,2002,2009)
Sierra Leone	No
Somalia	No
South Africa	Yes (1994,1999,2004,2009)
Sudan	Yes (2010)
Swaziland	No
Togo	No
Tunisia	No
Uganda	Yes (1997,2001,2002)
Western Sahara	No
Zambia	No
Zimbabwe	Yes (2013)
Burkina Faso	Yes (2012)
Burundi	No
Guinea	No
Madagascar	Yes (2008)
United Republic of Tanzania	No
Kenya	No
Egypt	Yes (2002,2008)
Ethiopia	Yes (2000,2005,2010)
Benin	Yes (2002,2008)

This table collects information on whether African countries had elections at the regional level in the 1992–2013 period (election years in parentheses). The sources for this data are available on request.