Insurgency and Inaccessibility

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A widely held belief within policy and practice contends that rough terrain and other physical obstacles to power projection hinder public surveillance, lower counterinsurgency capability, and generally constitute an important facilitator of rebellion. Likewise, sociocultural exclusion and alienation from the core are widely assumed to increase latent conflict risk through their influence on identity formation and perception of collective grievances. However, there is no scientific consensus on the empirical strength or significance of such a relationship, and many quantitative studies fail to find a robust link between a country’s geographical or ethno-demographic characteristics and its estimated conflict risk. This paper represents a first comprehensive evaluation of how physical and sociocultural inaccessibility relate to contemporary civil wars. Drawing on recent advances in geographic information systems and georeferenced indicators of terrain, settlement patterns, ethno-political status, and armed conflict, we put the purported causal relationship to empirical test. A statistical analysis of civil-conflict events across post-Cold War Africa gives considerable support to the proposed theoretical framework, revealing that the various dimensions of inaccessibility all exert significant and substantive effects on local conflict risk. We find weaker evidence for the notion of substitutability; the inaccessibility indicators largely retain their individual effects when included in the same regression model.

Provinces or districts peripheral to the national center […] create (or reinforce) systems of local power which tend to reach extremes of violent, personalistic rule—patrimonial, even sultanistic—open to all sorts of violent and arbitrary practices. (O’Donnell 1993:1358)

Throughout the history of warfare, political and military leaders have observed the importance of physical geography in determining the nature and fate of rebellion. In his manual on guerrilla warfare, the Argentine Marxist revolutionary Ernesto “Che” Guevara (1961:29) developed a doctrine of guerrilla

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war around the notion that rebels are favored by “zones difficult to reach, either because of dense forests, steep mountains, impassable deserts or marshes.” The role of human geography as a determinant of conflict dynamics has received less explicit attention. Yet, cultural cleavages shape participation and support in many contemporary conflicts, especially where ethnic lines overlap with deep economic and/or political cleavages (Cederman, Gleditsch, and Buhaug 2013a). Movements close to a regime rarely orchestrate civil wars; rather, the large majority of active insurgencies involve marginalized groups that enjoy strongholds in the remote countryside. Indeed, a notable feature of today’s armed conflicts—from Afghanistan to Ukraine—is their tendency to cluster along peripheral, often porous, state borders that cut across traditional ethnic minority homelands (Horowitz 1985; Brancati 2006; Walter 2006).

Rugged landscape, rural hinterlands, and distinct cultural traits are central to the notion of inaccessibility. The concept is best depicted as a center-periphery continuum, where inaccessibility increases with the extent of mountainous or forested terrain, distance from major population centers and government strongholds, and local dominance of distinct minority culture. Inaccessibility of any of these kinds is widely believed to reduce state capacity and counterinsurgency capability by obstructing tax collection and public surveillance, identification of local allies, and projection of police and military power (Fearon and Laitin 2003). Under a *ceteris paribus* assumption, countries shaped by one or more of these inaccessibility dimensions should have a higher latent risk of armed civil conflict.

Despite such intuitive reasoning, the role of inaccessibility (with its various facets affecting the subnational risk of violent conflict) has received relatively little attention, and to our knowledge, no study to date provides an explicit and rigorous comparative assessment of the inaccessibility-conflict nexus. This article seeks to fill this void. We begin by discussing some important dimensions of inaccessibility, generally meant to signal extent of state presence, before we develop a theoretical argument concerning how local opportunities and motives for civil unrest increase with (i) the distance from the capital city; (ii) the availability of latent safe havens; and (iii) the sociocultural distance to the central power holders. Aided by recent advances in geographic information systems (GIS) and georeferenced data, we then develop complementary indicators of inaccessibility as well as aggregated indices, which are then systematically compared with georeferenced data on local conflict outbreak and prevalence. Through a detailed analysis of post-Cold War civil-conflict occurrence across Africa, we find considerable empirical evidence to support expectations: Civil-conflict events tend to concentrate in remote parts of countries, in locations characterized by substantial rugged terrain, and in areas inhabited by politically excluded ethnic groups. The analysis further corroborates earlier findings that local conflict risk is higher in more densely populated areas (especially those with minority populations), close to regional population centers, in relatively poor areas, and in areas surrounded by violent activity.

**Inaccessibility**

Accessibility, put simply, reflects the potential for interaction (Song 1996). It is a relational concept that concerns the nature of association between two entities, be they geographic locations or social actors. Extent of accessibility can be understood as a function of the interaction opportunity between two locations, discounted by a negative exponential function of distance (and other causes of friction) between them. The concept of accessibility thus is closely linked to the notion of social inclusion (Farrington and Farrington 2005). For a society to
become socially included, a certain level of accessibility must be offered. Accessibility in this sense is fundamentally related to life opportunities; a central government’s ability to deliver public goods such as health and education—but also law and order—depends upon its ability, and willingness, to access the population.

The term inaccessibility as used in this article is best understood by considering the concept of state penetration, that is, the extent to which a central government manages to project political and military authority throughout its territory. State penetration is not uniform across space: Where inaccessibility is high, state penetration is low and vice versa. Yet, much of the contemporary literature on state capacity and civil war tends to treat capacity in a uniform, state-level manner with little consideration of subnational variation in the state’s ability to monitor and control the population (Fjelde and de Soysa 2009; Besley and Persson 2010; Braithwaite 2010; Sobek 2010; Hendrix 2011).

Writing within the context of international relations and interstate conflict, Boulding’s (1962) seminal loss-of-strength gradient (LSG) model postulates that a state’s strength peaks at its home base and declines as power is projected across distance (see also Hegre 2008; Pickering 2012). The amount of power at disposal depends not only on the total state capacity (“home strength”) and the distance across which power is projected but also on the cost of power projection, determined by the LSG. Whether a conflict of interest between a pair of actors is likely to escalate to the use of military force then depends on the distribution of available power. Where the projected power of state A is substantially higher than the local power of state B, state B should give in without resistance. Only where the actors appear to be near parity, or where there is uncertainty about their relative strength, should we expect a military contest to materialize. In reality, most states lack the capability to overcome the LSG and fight distant adversaries, and the large majority of modern militarized interstate disputes and wars involve land-contiguous neighbor states (Starr 1978; Lemke 1995).

Adapted to a domestic setting, the LSG model can be taken to express extent of projected state capacity, or local state control. As indicated in the left panel of Figure 1, a weak rebel group (R) that is located close to the government’s (G) core should be defeated quickly, or decide not to rebel, because projected state power (the slope from line GH) is higher at the rebel’s headquarters (R) than home strength (RK). On the right, however, the equally weak but peripheral rebels are able to withstand the central government given the latter’s inability to project sufficient amount of military force to location R. At a more general level, this is akin to Lichbach’s (1995:84) assertion that “if the dissidents’ strength approaches that of the regime, the regime usually falls.” See Buhaug (2010) for a more extensive elaboration of this model.

In empirical civil war research, the notion of inaccessibility has been restricted to imply physical remoteness, with country-aggregated statistics of mountainous terrain and (in a smaller set of disaggregated studies) distance to the capital provided as the main indicators of state penetration. While important, these factors reveal only half of the story. In this article, we also consider the human and social terrain, which captures central dimensions of sociocultural inaccessibility. This includes aspects of ethnicity and its political configuration. Where physical inaccessibility can be seen as especially relevant in providing opportunities for rebellion, cultural inaccessibility may be equally important in shaping people’s motivation for engaging in a conflict against the state. The following sections expand on the two dimensions of inaccessibility—before we discuss, in more detail, how they relate to armed conflict.
There are two general determinants of physical accessibility: distance from the point of origin and the terrain that has to be traversed. Grundy (1971:45) provides a model of guerrilla confrontation where:

\[ MS = M_i^2 + Ob + San - CT, \]

where \( MS \) = Military space; \( M_i^2 \) = Square mileage; \( Ob \) = Obstacles; \( San \) = Access to a sanctuary in a neighboring state; \( CT \) = Effective and defensible communications and transport networks. In this way a few square miles of mountainous jungle may be as strategically invulnerable as, let us say, a hundred square miles of prairie or, perhaps, a thousand square miles of flat plain crisscrossed by roads and telephone wires and dotted with airstrips and radio transmitters.

Absolute distance pertains to the geographical distance between points of interest, one of which is typically the capital city or another government stronghold. Because power diminishes as it is projected across distance, it follows that areas further away from state presence are less accessible, or can only be accessed with higher costs. The linear (or logarithmic) distance to the capital gives some indication of \textit{de facto} periphery, but it is clearly a crude approximation of state penetration. For instance, a straight-line distance measure ignores geographic features such the type of terrain, the political landscape along the way (for example, whether the shortest distance crosses the ocean or a foreign country), and also the extent of available infrastructure.

It is not difficult to imagine more nuanced and theoretically appropriate quantifications of local inaccessibility. One such factor is the prevalence or absence of developed roads and other infrastructure. As detailed by Herbst (2000), roads can serve as proxies for broadcasting of authority, and nowhere more so than in poor, developing societies. The importance of communication networks is especially prominent in countries with challenging political geographies. Herbst’s typology of African countries contains two such kinds: the first includes very populous countries with uneven, scattered settlement patterns whereas the second group contains countries with small, densely populated areas and large, scarcely populated hinterlands. It is in the vast areas \textit{between} the main settlement clusters that the regimes struggle to exert authority, making these countries “seem almost impossible to govern” (Herbst 2000:152; see also Zhukov 2012).
A second and complementary physical determinant of inaccessibility is terrain. High mountain ranges and dense forests are fundamental determinants of interaction, migration, and development (and constitute natural barriers of nation-states). It is no coincidence that some of the most backward human communities today are found in inescapable parts of Borneo and the Amazonas rain forest.

The unevenness of statehood often bears a strong legacy to a historical state-building, wherein certain areas are consciously privileged by the core at the expense of what then becomes the periphery. Boone (2012:625) calls such dynamic “unevenness by design,” which she argues is the result of three conditions that affect the cost/benefit calculation of power projection: (i) difficult-to-access regions; (ii) zones of low population density; and (iii) poor resource bases (see also Herbst 2000; Thies 2009). Modern technology, notably telecommunication, is less affected by physical obstacles than traditional modes of transport and communication, but it is not immune to geographic friction. However, while the notion of cyberwarfare—in which geographical distance may be truly irrelevant—has inspired science fiction for decades, its manifestation belongs to the future.

A third aspect of physical inaccessibility concerns proximity to an international border. Following the Peace of Westphalia in 1648, an international principle of nonintervention was established, whereby states were prohibited from interference with the internal affairs of any other state. Accordingly, regardless of the local terrain and the proximity to urban centers and other areas of government presence, having access to a neighboring country implies jurisdictional immunity and thereby increased inaccessibility.

Sociocultural Inaccessibility

Complementing its analysis of physical factors, this article considers key aspects of human geography, in particular ethnic diversity and characteristics of the local population, as well as their political status. In heterogeneous societies, the political elite tends to originate from (and represent) the dominant ethnic group(s), populated in core areas of the state. Depending on the nature of the regime, the elite may attempt to impose its preferences and ideologies on the rest of the population, and exploit marginal groups (see, for example, Hechter's 1975 work on internal colonization). These transactions are fraught with costs, the extent of which is dependent on the sociocultural distance between the core and the periphery. Areas inhabited by people with deviating traditions and preferences regarding language, minority rights, wealth redistribution, local autonomy, etc., will be harder to penetrate by the central government. For this reason, rulers with less extensive territorial ambitions (and those anticipating political contenders in the periphery) may decide to leave backward zones alone: not investing in infrastructure or bureaucratic and socioeconomic institutions, and refraining from providing costly public goods that serve no greater political purpose (Boone 2003; Raleigh 2014). Such areas can best be described as cultural peripheries (Rokkan 1999), which are liable to produce distinct identities through a process of “othering” (Cresswell 1996). Higher degrees of “othering” imply higher political, economic, and cultural barriers to internal structuring of the peripheral population.

Ethnicity is certainly not the only sociocultural determinant of inaccessibility; language and religion are other obvious (and often overlapping) features. Class, caste, and political ideology, too, may generate notable friction on projected state authority, although these traits tend to be less geographically clustered among the population. The political configuration of social cleavages is important in this context. While areas inhabited by minority groups are harder to monitor and control as a general rule, this is especially true when identity cleav-
ages overlap with inequalities in basic political and/or economic opportunities and privileges in the society (for example, where certain minority groups are subject to overt discrimination by the core). In accordance with our inclusive understanding of inaccessibility, it follows that the most socioculturally isolated areas are those hosting politically excluded and economically marginalized minority populations.

**Linking Inaccessibility to Conflict Risk**

Now that we have outlined some basic dimensions of inaccessibility, the next task is to explain how these dimensions relate to intrastate armed conflict. In doing so, it may be useful to consider: first, how inaccessibility affects opportunities for rebellion; and then, secondly, how it influences peoples’ motivation to stage or join a rebellion.

**Opportunity**

The opportunity aspect of the inaccessibility-conflict link is probably the most intuitive one. While we are certainly not subscribing to a deterministic understanding of the role of geography, it is clear that physical obstacles to the exercise of state control in themselves create space for competing authorities, and poor monitoring and counterinsurgency capabilities imply that such contenders may rise to local power with little warning. Beyond facilitating clandestine mobilization and taxation by local elites, physical inaccessibility may be relevant to rebellion in at least two ways. First, rough terrain provides opportunities for establishing safe havens, undetectable and unreachable by governmental forces. Likewise, seeking refuge across the border—and/or enjoying tacit or direct support from a sympathetic neighboring government—facilitates training, regrouping, rearming, and trade (Salehyan 2009). This dynamic, which is analogous to Cunningham, Gleditsch, and Salehyan’s (2009) notion of capability to resist, is especially efficient in the early phase of a conflict, when rebels tend to be vastly outnumbered by governmental troops. It does not follow that proximity to a neighboring state always comes with tactical and material opportunities to the nonstate actor, however. While the separatist insurgencies in South Ossetia (Georgia) and Eastern Ukraine undoubtedly have benefitted from strong ties to Russia, transnational Kurdish independence movements have been fighting the governments of Iran, Iraq, Syria, and Turkey for decades (Cederman et al. 2013b).

Second, insurgents may take advantage of terrain to inflict disproportionate damage to the regime, employing what Cunningham et al. (2009) refer to as power to target. The effectiveness of a regular army is restricted in rugged landscapes; swamps, jungles, and mountain ranges present major obstacles to armored vehicles and other heavy equipment as well as putting a strain on supply lines, and dense forest canopies hinder aerial detection. Moreover, rebels often have greater local knowledge, which further amplifies the asymmetrical nature of insurgency (Arreguin-Toft 2005; Fuhrmann and Tir 2009). A relevant example can be seen in the inability of Western forces to defeat the Taliban and al-Qaeda in Afghanistan (and before that, the Soviet’s unsuccessful battle against the Mujahideen) in spite of overwhelming firepower and technology. The failure of the US engagement in the Vietnam War is also partly attributable to a military doctrine poorly suited to the physical environment, and the US Army’s use of Agent Orange for defoliation operations was a deliberate (but failed) attempt to deprive the insurgents of cover and make them more vulnerable to conventional military attacks.
Remote or hostile terrain should not, however, have a substantive influence on local conflict risk in all societies. In developed countries with extensive and well-functioning local administration (for example, taxing authorities, police) and up-to-date infrastructure, physical inaccessibility may have little relevance for national security. However, in weaker states, physical obstacles to interaction are conducive to “unauthorized sequestering of resources by violent specialists as well as to seizure or damage of persons and property along the edges of authorized political claim making” (Tilly 2003:134).

Motivation

Beyond facilitating rebellion, physical and sociocultural periphery can also affect individuals’ and groups’ willingness to challenge the central government by violent means. Recall that inaccessibility implies costly interaction. This is relevant not only for the exercise of military control but for all kinds of center–periphery interaction, including provision of health care, schooling, and other public services. As outlined above, isolated areas may be associated with higher latent opportunities for anti-regime movements, but they also tend to enjoy fewer privileges than—or be targets of explicit discrimination by—the power holders.

Peripheral location and sociocultural alienation are important also in shaping unique identities and preferences and may contribute to a collective perception of unjust treatment by the core, which may provide motivation to mobilize against the state. Although preferences are affected by individuals’ unique experiences, they will also be influenced by a score of common background factors, such as religion, language, economic welfare, and level of education. For this reason, there is a positive relationship between geographic and ideological proximity, whereby the physical distance between two points often serves as a good indicator of distance of preferences (Alesina and Spolaore 2003). Applying the same logic from the rebels’ perspective, Gates’ (2002:118) formal model shows that rebel leaders have to offer a “higher benefit stream [to distant rebels] to compensate the lower ability to punish defection.”

Lastly, at a more general level, inaccessibility—manifested through a scarcity of interaction—reduces information flow, thereby increasing uncertainty about the relative distribution of preferences, capability, and resolve between state and nonstate actor dyads. Hence, civil unrest and military state response can in some cases also be the result of bargaining failure, due to misinterpretation and miscalculation of the opponent (Morrow 1989; Walter 2006).

Empirical Evidence

A glimpse at today’s insurgencies provides many examples of conflicts that are fought in rural and peripheral areas where the state has limited reach: the Afar and Ogaden rebellions in remote parts of Ethiopia, the Nagaland and Manipur insurgencies in northeastern India, the separatist conflicts in Patani (Thailand) and Mindanao (the Philippines), and more recently, the retreat of al-Qaeda in the Islamic Maghreb to the Ifoghas Mountains in Mali, the separatist uprising in Eastern Ukraine, and the terrorist activities of ISIS in peripheral parts of Syria and Iraq. The relationship between a country’s share of mountainous or forested terrain and the risk of civil war has also been subject to systematic scientific scrutiny—if normally only as a control variable. The findings from these studies are generally weak and inconsistent (Hegre and Sambanis 2006). The conflicting results might be ascribed to data and methodology issues; different studies cover different time periods and apply diverging operational definitions of conflict and terrain. A more serious concern is that studies using country-level aggregates often suffer from a mismatch between data and the hypothesized causal mecha-
nism, which may result in ecological fallacy. Country-averaged indicators do not contain information about the local variance of geographic features. Empirical evidence shows that most civil wars, especially separatist conflicts, are restricted to limited areas of the host countries (Hallberg 2012), and these conflict zones rarely cover a representative subset of the countries’ terrain (Buhaug and Lujala 2005). Perhaps somewhat surprisingly, spatially disaggregated studies to date have been unsuccessful in establishing a robust and unambiguous terrain-conflict link (Buhaug and Rød 2006; Rustad et al. 2008).

There is more systematic evidence in favor of the distance indicators. Several recent studies report that subnational conflict risk is higher in locations at some distance from the capital city (Buhaug and Rød 2006; Clayton 2013), but proximate to regional population centers (Raleigh and Hegre 2009). Available empirical evidence further suggests that conflict events are more likely close to borders (O’Loughlin et al. 2012; Wischnath and Buhaug 2014), often involve transnational ethnic groups (Salehyan 2009; Cederman et al. 2013b), and conflicts that abut or cross borders also last longer on average (Buhaug, Gates, and Lujala 2009; Raleigh and Kniveton 2012). Moreover, it has been shown that civil conflicts and instability have a number of negative spillover effects, well beyond increased conflict risk, which may provide additional opportunities for armed challenges to the state (Gleditsch 2008; Iqbal and Starr 2008).

The notion that grievances related to social/cultural marginalization might affect the risk of conflict is not new (Gurr 1970) but, due to data limitations, it is only quite recently that this proposition has been subject to systematic large-N testing at the theoretically appropriate subnational (group) level. For example, Buhaug, Cederman and Rød (2008) postulate, and find, that ethnic groups settled in remote locations more often engage in conflict against the center. Later studies have reported a similar pattern for economic activity and spatial inequality, where the poorest parts of countries are, ceteris paribus, more conflict prone (Østby 2008; Buhaug et al. 2011; Cederman, Weidmann, and Gleditsch 2011). Moreover, using statistics on international telecommunication, Weidmann (forthcoming) shows that the conflict-inducing effect of shared ethnic ties extends beyond contiguous countries. Broadening the scope beyond traditional conflict, Raleigh (2014) shows how local political hierarchies across Africa have resulted in distinct conflict landscapes, whereby different forms of political violence co-occur within states, but with little spatial overlap. With the exception of Weidmann (2009), few studies have attempted to evaluate the relative importance of opportunity and motivation in explaining the purported geography-conflict association.

**Propositions**

Based on the reasoning outlined above, the general expectation to be tested in this article can be expressed as follows: Local civil war risk increases with extent of inaccessibility. From this, we formulate a set of testable hypotheses that refer to specific aspects of physical and sociocultural inaccessibility. The first concerns the relative location of an area:

**Hypothesis 1**: Local civil war risk increases with physical distance from the government.

Next, we consider the notion that availability of safe havens, by means of rough terrain or neighboring territory, increases conflict risk by making prospective rebels harder to detect and defeat through conventional military means:

**Hypothesis 2**: Local civil war risk increases with proximity to potential safe havens.
Finally, sociocultural inaccessibility should increase conflict risk by obstructing state monitoring of the local population, generating grievances related to lack of political and material privileges, favoring creation (and manipulation) of distinct local identities, and making defection less likely:

**Hypothesis 3**: Local civil war risk increases with sociocultural distance from the government.

There is no reason to expect all aspects of inaccessibility to be equally important in all contexts. For example, having access to safe havens across the border may well compensate for lack of rugged terrain, whereas proximate but culturally distinct groups may in effect be less penetrable by the state than ethnic peer settlements located far from the core. For this reason, we anticipate that distance, terrain, and identity profiles are best viewed as substitutable drivers of local conflict risk.

**Data and Research Design**

In order to test these propositions, we make use of version 1.01 of PRIO-GRID (Tollefsen, Strand, and Buhaug 2012). PRIO-GRID provides a global grid network with a resolution of $0.5 \times 0.5$ decimal degrees, comprising 64,818 unique terrestrial cells in a single cross section, excluding oceans and unpopulated areas (notably Greenland and the poles). In contrast to administrative entities, grid cells are inherently apolitical units that are fully exogenous to the phenomena of interest to this study. Furthermore, the grid framework is consistent in space and time, making it ideal for statistical analysis of spatiotemporal processes.

PRIO-GRID contains one realization per calendar year. Each cell is assigned to the country to which the majority of its land area belonged at the outset of the year, thereby allowing combining spatial data on, for example, population and terrain with country-level information on political system and economic growth rates. For this analysis, we cover all years between 1989 and 2010 for which high-resolution georeferenced conflict event data are available. Since the inaccessibility indicators are largely time-invariant, we use a simple cross-sectional data structure for the main models; factors that do change over time are set to represent the beginning of the period. Moreover, the analysis is limited to the African continent, which is the spatial coverage of the conflict data.

The outcome of interest to the empirical analysis is civil conflict. We use spatial data capturing the dynamics of civil conflict, based on Uppsala Conflict Data Program Georeferenced Event Data (UCDP GED; Sundberg and Melander 2013). The UCDP GED contains spatial and temporal information on fatal violent events, derived from the UCDP Armed Conflict Dataset (Gleditsch et al. 2002; Themnér and Wallensteen 2013). These data provide details on the precise location of specific civil-conflict events (we excluded intergroup and one-sided violence), aggregated over time to give the total cell-specific count of the number of reported conflict events since 1989. Given the highly skewed cell-specific count distribution, we use a log-transformed count as the dependent variable in the regression models.

A generous selection of measures of inaccessibility is used to capture the concept’s various dimensions. Hypothesis 1, on distance to the government’s core areas, is represented by the straight-line distance (log km) to the national capital, measured from the centroid of each cell. While intuitive and simple, this variable ignores the type of terrain that has to be traversed, the quality of the infrastructure, and the fact that governmental strongholds extend beyond the capital city. Two complementary measures of rough terrain are used to test Hypothesis 2, on the availability of safe havens. The first gives the share of the
cell covered by dense forests, whereas the second is an index of mountainous terrain. The forest-cover indicator is derived from 2009 GlobCover satellite imagery (Bontemps, Defourny, and Van Bogaert 2010), while the mountain data are computed using the United Nations Environment Programme’s (UNEP) World Conservation Monitoring Center (WCMC) definition of mountainous terrain (UNEP-WCMC 2002). The fourth and final measure of physical inaccessibility, which also relates to Hypothesis 2, gives the straight-line distance (log km) from the cell centroid to the nearest neighboring country, inversed to let higher values denote greater extent of remoteness. All four indicators were normalized (that is, bounded within the interval [0, 1] to facilitate direct comparison and the construction of joint inaccessibility indices).2

The operationalization of sociocultural inaccessibility (Hypothesis 3) is less straightforward, in part because this concept is decidedly more fluid than its physical counterpart, and also because it gives intangible connotations that may be hard to quantify. Our admittedly crude approximation gives preference to the ethno-political status of the local population. In short, we measure extent of sociocultural inaccessibility as the normalized product of local population density and political status; that is, whether the population is denied representation and participation in national politics. In other words, all areas inhabited by an “included” ethnic group are considered fully accessible on this dimension whereas the inaccessibility of “excluded” areas is a function of local population size, with higher concentrations assumed to provide greater resistance to governmental authority (Buhaug et al. 2008). This variable is created by first combining local demographic statistics (CIESIN, Columbia University, and CIAT 2005) with the GeoEPR dataset (Wucherpfennig et al. 2011), which maps all politically relevant ethnic groups around the world since 1946, and then accounting for the groups’ political status from the EPR dataset (Cederman, Wimmer, and Min 2010). Because ethno-political status is subject to changes over time (in part as a result of violent conflict), our strictly cross-sectional analysis captures the situation at the outset of the sample period (1989).

Ideally, we would want to account for sociocultural periphery and cleavages beyond the political configuration of ethnicity. Linguistic distance and religious differences would be natural candidates, although data on these factors are, to our knowledge, not available in a suitable, georeferenced format. The same limitation obviously applies to less tangible dimensions, including political ideologies, social class and networks, etc.

Table 1 lists the inaccessibility indicators. Further details on the spatial distribution and descriptive statistics of these variables are found in the Supporting information.

In the interest of parsimony, the models presented here include a limited set of controls. Previous research suggests a positive relationship between population size and local conflict risk (Hegre, Østby, and Raleigh 2009). Hence, we include an indicator of (log) cell population, derived from the Gridded Population of the World v. 3.0 dataset (CIESIN, Columbia University, and CIAT 2005). Population estimates represent the year 1990.

A second, robust predictor of civil conflict is low economic development (Hegre and Sambanis 2006). At a subnational scale, Buhaug et al. (2011) observed that relatively impoverished areas have a higher risk of conflict outbreak, whereas other

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2In principle, it would be preferable to also account for the nature and salience of borders, as those that follow mountain ranges impose different restrictions and opportunities than non-topographical boundaries that cut across waters or flat lands or contain points of strategic importance (Starr 2002; Starr and Thomas 2002). At the same time, the characteristics of the terrain that must be traversed in order to reach the border will often be of much greater significance than the border in itself, not the least when considering areas (grid cells) in the vast interior of countries, far from the nearest neighboring state. Accounting for this in a satisfactory manner is a highly demanding task that we defer to future research.
studies have found intergroup inequalities to increase local civil war risk (Østby 2008; Cederman et al. 2011). Data on local income levels were obtained from the G-Econ dataset (Nordhaus 2006), which provides estimates of economic output at a 1 × 1 degree resolution for the year 1990. Disaggregated to PRIO-GRID, we constructed a measure of (logged) gross cell product (GCP) per capita, analogous to the country-level GDP per capita measure.

As a third control, we include a measure of the average travel time (in logged minutes) from the cell centroid to the nearest city of at least 50,000 people (Nelson 2008). These estimates are based on information on land transportation networks, such as roads, railroads, and navigable rivers; the environmental context, including elevation, slope, and forest cover; and political factors (that is, national boundaries). The original travel-time data come in a very high resolution, 0.01 × 0.01 decimal degrees; our indicator gives the mean cell value. The data are from the year 2000, although we assume that they are reasonably representative for the entire post-1989 period. Accounting for proximity to regional urban centers is probably important, as rebel attacks necessarily occur where government forces and representatives are present (radio and police stations, army barracks, etc.). Accordingly, while the inaccessibility argument assumes better opportunities for insurgent activities in remote hinterlands, tactical considerations (and possible bias in media reporting) imply that we should expect most violent activities to occur in the vicinity of population centers.

A final set of controls is included to account for spatial dependencies in the data, as well as countrywide drivers of latent conflict risk. Conflict in one unit often affects the risk of conflict in neighboring units, and failing to account for such spatial dependence violates the assumption of unit independence (Bivand, Pebesma, and Gómez-Rubio 2008; Schutte and Weidmann 2011). Hence, we include a spatial lag of conflict that measures the (logged) mean conflict rate (number of events) among adjacent cells in the same country in the sample period. Moreover, all models are specified with country fixed effects to account for unobserved differences between countries. We exclude observations that are considered highly unlikely to host conflict events; that is, coastal grid cells with only a small sliver of land territory (<100 km²) and cells with extremely low population density, such as deserts and high mountain ranges (<1 per km²). This returns a valid sample of 7,465 grid cells across Africa.

### Results

As a preliminary test of how our physical inaccessibility indicators relate to each other and to violent conflict events, we generated a set of bivariate scatter plots (Figure 2). With a possible exception for population, we see no clear pattern whereby an increase in an exogenous variable is associated with an increase (or decrease) in the density of conflict events. Equally interesting in this context, however, we also note that there is no strong covariation pattern among the

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<tr>
<td>Sociocultural distance (H3)</td>
<td>Population-weighted ethno-political exclusion, normalized [0, 1]</td>
</tr>
</tbody>
</table>
inaccessibility indicators—except for the juxtaposition of population size and exclusion (the latter indicator contains population-weighted estimates). This is an important observation as it implies that the various measures capture complementary dimensions of remoteness.

Next, we put our propositions to test in a more appropriate multivariate regression framework (Table 2). We first introduce the inaccessibility factors in sequential models (Models 1–5) and then estimate a model that includes all parameters simultaneously (Model 6).

As evidenced across all models, the control variables behave much as expected and in accordance with previous literature. On average, conflict events tend to cluster in relatively populated and poor areas of countries, and the models also confirm the distinctly contagious nature of armed conflicts. Units with one or more neighboring units experiencing conflict are themselves significantly more exposed to violence.

Focusing on the five complementary inaccessibility measures, we find much support for our notion that conflicts tend to cluster in areas at the margins of state control: The frequency of battle events increases with the distance from the capital city; it increases with the extent of local mountainous and forested terrain, and it increases with the size of the excluded local population. Only the proximity to border indicator fails to produce a statistically reliable effect,

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3The two most overlapping physical inaccessibility indicators are forest and distance to the capital ($r = 0.12$). Sociocultural inaccessibility (exclusion) relates most strongly to mountains ($r = 0.24$). The overall most powerful bivariate correlation in Figure 2 is between population and distance to major city ($r = -0.62$). Although this could raise concerns about multicollinearity bias, regression diagnostic tests show it to be unlikely.

4An inherent challenge with using time-varying information in a static analysis is accounting for reverse causality. Part of the very powerful effect of neighboring violence on the estimated frequency of conflict events may be caused by nearby events having occurred as a consequence of earlier violence in a given location. See the discussion on sensitivity tests for further details.
<table>
<thead>
<tr>
<th></th>
<th>(1) lnGED</th>
<th>(2) lnGED</th>
<th>(3) lnGED</th>
<th>(4) lnGED</th>
<th>(5) lnGED</th>
<th>(6) lnGED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital distance</td>
<td>0.144 (0.046)**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.123 (0.047)**</td>
</tr>
<tr>
<td>Mountains</td>
<td>0.113 (0.025)**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.099 (0.025)**</td>
</tr>
<tr>
<td>Forest</td>
<td></td>
<td>0.090 (0.031)**</td>
<td></td>
<td></td>
<td>0.052 (0.046)</td>
<td>0.022 (0.047)</td>
</tr>
<tr>
<td>Proximity to border</td>
<td></td>
<td></td>
<td>0.052 (0.046)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exclusion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.230 (0.047)**</td>
</tr>
<tr>
<td>Distance to city</td>
<td>-0.109 (0.015)**</td>
<td>-0.107 (0.015)**</td>
<td>-0.110 (0.015)**</td>
<td>-0.106 (0.015)**</td>
<td>-0.107 (0.015)**</td>
<td>-0.118 (0.015)**</td>
</tr>
<tr>
<td>Population</td>
<td>0.071 (0.008)**</td>
<td>0.058 (0.007)**</td>
<td>0.061 (0.007)**</td>
<td>0.064 (0.007)**</td>
<td>0.050 (0.008)**</td>
<td>0.051 (0.008)**</td>
</tr>
<tr>
<td>Income</td>
<td>-0.056 (0.021)**</td>
<td>-0.067 (0.021)**</td>
<td>-0.063 (0.021)**</td>
<td>-0.067 (0.021)**</td>
<td>-0.069 (0.021)**</td>
<td>-0.053 (0.021)**</td>
</tr>
<tr>
<td>Neighbor violence</td>
<td>0.477 (0.011)**</td>
<td>0.473 (0.011)**</td>
<td>0.474 (0.011)**</td>
<td>0.477 (0.011)**</td>
<td>0.474 (0.011)**</td>
<td>0.467 (0.011)**</td>
</tr>
<tr>
<td>Constant</td>
<td>0.699 (0.456)</td>
<td>0.831 (0.454)*</td>
<td>0.776 (0.455)*</td>
<td>0.796 (0.455)*</td>
<td>0.890 (0.454)*</td>
<td>0.768 (0.455)*</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.457</td>
<td>0.458</td>
<td>0.457</td>
<td>0.456</td>
<td>0.458</td>
<td>0.460</td>
</tr>
</tbody>
</table>

(Notes: OLS with country fixed effects; standard errors in parentheses; **p < .05, *p < .1.)
although the positive sign of the coefficient, indicating more events closer to the border, is consistent with the theoretical model outlined above. Model 6 shows that the effects of our key explanatory variables are robust to controlling for alternative dimensions of inaccessibility, thereby providing further evidence in support of all three hypotheses. The fact that the estimated effects of the individual indicators drop only moderately (15–30%) when all dimensions are considered jointly also suggests that our expectation of substitutability is at most only partially true; inaccessibility along several dimensions makes for especially conflict-prone environments.

Given the encouraging findings from Table 2, we next evaluate simple indices that combine the inaccessibility measures. In doing so, two issues must be considered: first, the assignment of weights (if any) to the individual components in the index; and second, the nature of the index, that is, whether it should represent the most extreme value (maximum or minimum value) or some aggregate measure (mean, product). These are fundamentally theoretical questions with no simple, preferred solution. We believe the relative importance of the inaccessibility dimensions is likely to vary between cases. Yet, the salience of ethnicity (Esteban and Ray 2008) and the notion of indivisibility of territory (Toft 2003) might suggest that ethnic exclusion plays a particularly central role. That being said, any particular weighting scheme would be highly speculative at this stage, and we acknowledge that more rigorous theorizing is necessary in order to make further progress along these lines. As such, for an exploratory empirical evaluation, we assign equal weight to all components in this analysis. Regarding the second issue, we take the pragmatic approach and construct two alternative indicators. The first index, $a_1$, is founded on the logic of substitution, whereby high inaccessibility on one dimension may compensate for lack of inaccessibility on other dimensions. The index thus takes the maximum cell value among the five normalized indicators of physical and sociocultural inaccessibility. The second index reflects a different logic, where the various dimensions are considered complementary and additive rather than substitutable. Accordingly, the $a_2$ index represents the mean cell value across all inaccessibility variables. Figure 3 provides a visual comparison of the two composite indices, with darker shades denoting more remote areas.

For this reason, two of the four indices do not include sociocultural inaccessibility, allowing the importance of ethno-political exclusion to be assessed through a separate indicator.
Table 3 shows the results from the regression analysis, using similar models to those reported above, but replacing the individual inaccessibility components with the two alternative aggregate indices. As expected, both indicators are positive and highly significant. The notable difference in coefficient size is largely due to the different distributions of values within the bounded [0, 1] interval; a1 has a smaller coefficient to compensate for significantly larger values. At the same time, Model 8 appears marginally better fit to the data, as measured by the slightly higher $R^2$ parameter, although the difference is not statistically significant. Calculations of marginal effects also show that the mean-based a2 index performs better than the winner-takes-all a1, if not by a huge margin. We further see that the improvement in model fit over Models 1–5 is marginal, suggesting that there is also an element of substitutability at play.

Taken together, the empirical models offer strong evidence in support of all three hypotheses. We found that battle events tend to cluster in areas far from the national capital, in areas characterized by mountains and dense forests, and in areas hosting large, politically excluded populations. This pattern is robust in accounting for local population density, proximity to major cities, and local economic activity, as well as the conflict frequency in adjacent locations. One indicator that did not perform as expected is proximity to border. This may be due to the uniqueness of the African continent, encompassing many sizable and heterogeneous countries (for example, Central African Republic, the Democratic Republic of the Congo, Mali, and Sudan) whose weak or fragile central governments may give rise to local challengers even in the vast interior of the state. In some contrast, contemporary civil conflicts in South and South-East Asia and Europe are predominantly ethno-nationalist separatist insurgencies, located along national boundaries. At the same time, it is clear that not all borders offer equal opportunities for safe havens, military support, and illicit trade. A natural next step, in order to shed more light on border-conflict dynamics, would be to incorporate existing efforts to quantify international borders on these dimensions (Starr and Thomas 2002).

A limited number of sensitivity tests were carried out. First, we considered how our inaccessibility proxies behave in a time-varying set-up. Using a temporal analytical design might seem odd, as our focus variables are static, but it has some value in that it addresses a potential bias in the models reported above. Civil conflicts are not randomly distributed across space, and conflict events much less so. A common way to handle spatial autocorrelation is to introduce the so-called spatial lags of the dependent variable, represented by the neighbor conflict indicator in the models above. However, in the strictly cross-sectional design with

<table>
<thead>
<tr>
<th>(7)</th>
<th>(8)</th>
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<tbody>
<tr>
<td>lnGED</td>
<td>lnGED</td>
</tr>
<tr>
<td>a1 Max inaccessibility</td>
<td>0.245 (0.054)**</td>
</tr>
<tr>
<td>a2 Mean inaccessibility</td>
<td>0.206 (0.048)**</td>
</tr>
<tr>
<td>Exclusion</td>
<td>−0.119 (0.015)**</td>
</tr>
<tr>
<td>Distance to city</td>
<td>0.052 (0.008)**</td>
</tr>
<tr>
<td>Population</td>
<td>−0.060 (0.021)**</td>
</tr>
<tr>
<td>Income</td>
<td>0.471 (0.011)**</td>
</tr>
<tr>
<td>Neighbor violence</td>
<td>0.790 (0.455)*</td>
</tr>
<tr>
<td>Constant</td>
<td>7,465</td>
</tr>
<tr>
<td>Number of observations</td>
<td>459</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.459</td>
</tr>
</tbody>
</table>

(Notes. OLS with country fixed effects; standard errors in parentheses; **$p < .05$, *$p < .1$.)
spatial lags, one risks adding right-hand-side information that could be the result, rather than a cause, of the observed outcome. Accordingly, the very powerful effect of neighboring events in the models above is partly explained by correlations that reflect a reverse causality. By running time-series models and applying a temporal lag to the neighborhood indicator, we have better control over the spatial correlation pattern, even though it comes at the expense of inflating the number of observations, with very little new information added.6 Reassuringly, replications of Models 1–8 with annual grid data did not produce findings that deviate markedly from those reported here. Given that our variables of key interest are (largely) time invariant, and thus not susceptible to endogeneity, we find the static design more appropriate. See Schutte and Donnay (2014) for a more comprehensive treatment of causal inference with spatiotemporal event data.

Second, we considered an alternative measure of sociocultural inaccessibility by simply flagging whether the local population belongs to the national majority ethnic group or not, based on the GeoEPR data. This approach remedies the potentially very significant endogeneity problem in the models above, whereby the reported correlation between exclusion and conflict may reflect a causal effect that runs opposite to the theorized direction. History is not short of examples of minority groups that become targets of exclusionary and discriminatory policies as a consequence of past protest or in anticipation of future mobilization—neither of which processes would be picked up in our analytical design. At the same time, ignoring the political configuration of ethnicity comes with its own limitations and tacitly prescribes a deterministic socio-demographic effect that we are not willing to subscribe to. We also note that our exclusion index upholds its powerful effect even if we also include the crude minority dummy.

Moreover, we considered some explicitly data-driven aggregate indices by means of factor analysis, constructing up to three new variables from the five inaccessibility components. This test provided further details on the extent of overlap and uniqueness of individual variables but failed to reveal new constellations of conditions with increased conflict risk.

Lastly, we replaced the GED events data with point data (on the location of the initial battle event) for each civil conflict recorded in the UCDP/PRIO Armed Conflict Dataset, because local explanations for why and where conflicts break out can differ from reasons for conflict diffusion. Probably due to the rareness of onset events in our sample, this test resulted in considerably weaker findings, although the general patterns were consistent with the inaccessibility argument.

Conclusions

This article has shed light on how peripheries can shape space for action and mobilization by shifting focus from the country to the subnational local scale. More specifically, we investigated the extent to which determinants of physical and sociocultural inaccessibility—distance to the capital, proximity to the border, rough terrain, and ethno-political exclusion—increase local civil-conflict risk.

The findings demonstrate that inaccessibility is a central factor affecting local conflict risk, as remote areas are shown to be significantly more conflict prone than more accessible parts of a country. We interpret these results as supportive evidence that physical inaccessibility—notably, remote location and rough

6Another significant benefit of adopting a time-series cross-sectional design is that it permits capturing important shifts in the ethno-political status of the local population (sociocultural inaccessibility), which are set to represent the world anno 1989 in the analysis above.
terrain—proves conducive to rebellion. In addition, areas hosting sizable politically excluded ethnic populations, on average, show more conflict events than areas inhabited by ethnic groups in power, even after controlling for other dimensions of inaccessibility and local demographic and economic conditions. Lastly, the analysis suggests that physical and sociocultural inaccessibility can to some extent be considered substitutable, as the combined indices that capture all inaccessibility dimensions fail to improve significantly on the simpler models that contain only one dimension at a time.

Where do we go from here? We have already indicated a central theoretical challenge with respect to determining the relative importance of various dimensions of inaccessibility, as well as technical challenges with respect to accounting for type and salience of the terrain separating the state and the local population. In addition, future research should investigate the mediating role of telecommunications. In particular, how does telecommunication infrastructure affect the level of inaccessibility, and how does this relate to conflict? Emerging research investigates how such types of infrastructure relate to conflict (Shapiro and Weidmann forthcoming) but it remains unclear who benefits more from new technology—the state (surveillance, propaganda) or opposition movements (mobilization).

A separate, natural next step is to use models like the ones developed in this study to improve on our ability to forecast new events or important changes in the dynamics of ongoing conflicts (notably escalation and diffusion). Extant attempts to develop general conflict forecasting models (Goldstone et al. 2010; Hegre et al. 2013) are exclusively constructed around country-aggregated input data. This makes sense as a first step; but, in order to offer more precise and policy-relevant early warning, we need to account for local conditions and developments.

One issue that remains to be determined is whether the patterns described here are applicable to other corners of the world, and at other time periods. The fact that the notion of inaccessibility draws heavily on guerrilla doctrine and is inspired by contemporary ethno-national separatist insurgencies—which are much more frequent in South and South-East Asia—suggests that our findings indeed can be generalized beyond Africa. Likewise, it remains to be determined whether physical and sociocultural inaccessibility exert similar effects on the spatial distribution of political violence outside the scope of civil war (for example, communal conflict and one-sided violence). This is the topic of a future paper.

References


**Supporting Information**

Additional Supporting Information may be found in the online version of this article:

**Figure S1.** Frequency of GED events, 1989–2010.

**Figure S2.** Distance to the capital city, 1989.

**Figure S3.** Mountainous terrain.

**Figure S4.** Forested terrain.

**Figure S5.** Proximity to borders, 1989.

**Table S1.** Descriptive statistics.