Geography, Strategic Ambition, and the Duration of Civil Conflict

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Abstract: Both the control of territory possessing natural resources used to finance armed conflict and the distances an army must travel to project force affect how a civil war is fought and who will prevail. In this paper, a model based on a contest success function designed to explicitly account for distances is employed to model the ability to project force and sustain conflict. The strategic ambitions of the rebel group will determine whether the conflict is focused on territorial secession or conquest of the government. These goals, in turn, affect where the war is fought, how it is fought, and the likelihood of one of the parties succeeding militarily. Using both Cox regression and parametric survival analyses, specific propositions regarding the duration of conflicts derived from the formal model are analyzed. Using a precisely dated armed civil conflict duration data (Gates & Strand, 2004), which is based on the Uppsala Armed Conflict dataset (Eriksson & Wallensteen, 2004), and using data regarding the location of conflict (Buhaug & Gates, 2002) and natural resources (Buhaug & Lujala, 2004) we are able to assess the role geography has on the duration of armed civil conflict, especially in terms of the location of the conflict zone and location of lootable natural resources. We are also able to differentiate armed civil conflicts according to the strategic ambitions of the rebels.

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Knowledge about the potential impact of geography on conflicts is probably as old as the art of war. Geographers, as well as theorists of international relations have for long claimed climate, topography and location to be important determinants of state behavior (Sprout 1963). In an assessment of previous work on geography and war, Diehl (1991) discusses three theoretical frameworks of particular influence: Sprout & Sprout (1965) with the notion of 'environmental possibilism'; Boulding (1962) with the loss-of-strength gradient; and Starr (1978) with the concepts of opportunity and willingness. All three emphasize physical distance as the crucial geographic factor affecting the risk of conflict.

The theoretical link between geographic proximity and conflict has resulted in the development of the Correlates of War project's contiguity dataset (Gochman 1991) as well as Gleditsch & Ward's (2001) minimum distance dataset. But while the pioneering works by the Sprouts, Boulding and Starr still are considered highly influential - and later empirical studies have indeed revealed some convincing findings - they interpret geography merely as a concept of contiguity and distance. Accordingly, the geography concept acts more as a proxy of interstate interaction opportunities than measuring the impact of physical, geographic attributes of conflicting countries. Moreover, international borders and interstate distance as analytical concepts are mainly relevant when dealing with international conflicts.

To the extent that geography and conflict have been linked in other and more fashionable ways, they have been subject to either of two approaches. The first one deals with micro-level analyses of battlefield effectiveness, typically from a military point of view. In this respect, issues like weapon and soldier performance in varying topographic and climatic conditions, and how to exploit geographic advantages (ranging from hills and weather to tidal water) are central concerns, sometimes illustrated by certain well-selected historical battles (see Collins 1998). On the other hand, we have system-level discussions of geopolitics and structures of the (post-) Cold War. Here, spheres of ideological influence and strategies of nuclear deterrence are central themes (cf. Pepper & Jenkins (1985) for a discussion of Cold-War geopolitics). Neither of these approaches is suitable for a cross-national study for the entire post-WW II period; the first is inappropriately detailed, the latter allows little variation between cases.

Diehl (1991) points us in the right direction with his work on the geography of interstate war. His work emphasizes the importance of territory in war. The geographic aspects of territory significantly shape the incentives for going to war. Defending or conquering some land area may be valuable. A given territory may hold strategic or valuable resources (loot). The population residing there may maintain special significance (due to factors of ethnicity, religion, etc.). The geography of the land may also exhibit strategically desirable characteristics. Rough terrain, for example, may offer good defensive positions for an army. Or controlling a mountain pass or a sea passage (i.e. a straight) may offer strategic advantages with regard to transportation and movement of troops. Territory also may possess certain non-tangible qualities – symbolic value, identity & cohesion – all of which may play a critical role in recruitment and allegiance to an army. All aspects of territory as described here are relevant to either civil war or interstate war. The difference occurs with regard to theory and the way these characteristics are operationalized in large-N quantitative analyses.

Gates & Buhaug’s (2002) “The Geography of Civil War” demonstrates the endogenous relationship between the location and the scope of civil conflict. This work also features the special role national boundaries play in limiting a government's ability to project military force beyond its juridical boundaries. Rebel groups often position themselves near national borders, retreating into neighboring countries' territory if need be. Buhaug & Gates's (2002) three-stage-least-squares analysis is static cross-sectional. In this paper we extend this analysis to consider the dynamic aspects of civil war.

In this paper we feature the strategic ambitions of the rebel group vis-à-vis the government, geography (as it relates to natural resource wealth, population, and terrain), and the duration of civil wars. Whether a rebel group seeks to control government or to secede will significantly affect the manner in which they deploy their troops and engage the government in conflict. Geographic considerations will also affect the strategy of both the government and the rebel group. Together these strategic choices affect the dynamics and duration of conflict, critically affecting the decision to continue to fight or to lay down arms and pursue a peaceful solution to the conflict.

Geography and the Dynamics of Civil War

Few have analyzed the relationship between geography and the dynamics of civil war. One of the very few works that have analyzed the role of distance in the context of civil war is Gates (2002). In this theoretical paper on the microfoundations of rebellion, Gates identifies three factors determining military success and shaping rebel recruitment: geography, ideology and ethnicity. His central themes are how geography interacts with ethnicity and ideology, and how this interaction affects the distance between rebels and government, and how distance enables a rebel group to expand. In this paper, we explicitly draw on the contest success function that Gates developed to model the dynamics of civil war.

Although the resource curse has become a dominant theme in the analysis of the onset of civil war, only a few authors have theoretically modeled the role of natural resource rents in the dynamic context of civil conflict.[1] Gates (2002) models how rents from natural resources can be used to recruit rebel soldiers and how revenues from natural resources are distributed in a rebel organization to deter defection and to ensure compliance. Skaperdas (2002) models warlordism in a region where state control is weak. He shows that rents accruing from wealth generated from minerals, drugs, etc. lead to more intense competition between the warlords and thereby more soldiers are recruited in the various fighting groups. The Skaperdas model concludes that potential warlords should prefer an "armed peace" to an open conflict due to the destruction costs caused by warfare. However, due to incomplete information or long-term benefits of destroying the enemy (enemies) at once, negotiated settlement is not reached.

On the other hand, the rebels might not be the only side taking advantage of access to lootable resources, governments too often engage in appropriative activities. Indeed, conflict may be preferred to peace by one or both groups involved in a conflict. Addison et al. (2001) show that protracted low-intensity warfare may be beneficial for all fighting parties including the government since it provides economic opportunities that are not available during peacetime. They argue that groups that have both access to weapons and the opportunity to form armed groups to loot natural

[1] Snyder and Bhavnani (2005) develop a model to explain why lootable resources are linked to the onset of civil wars in some cases and not in others, but they do not explain the role of lootable resources during conflict.

resources or other rents (such as foreign aid), may prefer conflict to peace. Although conflict is detrimental to society at large and is extremely costly to the general citizenry, the participating armed groups may experience higher total revenues/utility during conflict than during peace.

According to Addison et al., conflicts centered around and motivated by natural resource looting are characterized by low intensity warfare to maximize profits and minimize costs. Furthermore, in some cases looting may only be possible during the conflict since peace would increase the competition from other groups to extract the resources. Therefore, to exploit the wartime opportunities the fighting groups have an incentive to continue the conflict instead of pursuing peace. The low commitment and few incentives to restore the peace are likely to result in prolonged conflict duration.

Modeling Geography and the Dynamics of Civil War

This section presents a model of military conflict between a rebel group and governmental forces. The model developed follows from Gates (2002) and follows from a general class of contest success functions first developed by Tullock (1980) and applied to conflict by Hirshleifer (1989; 2000) and others. An axiomatic derivation of a general class of contest success functions is provided by Skaperdas (1996). As applied to military conflict, the contest success function relates to the relative capabilities of two competing sides of a conflict, such that:

1) $\pi\ (K_l, K_g) = f(K_l)\ /\ [f(K_l) + f(K_g)]$,

where $f(K_l)$ is a non-negative, increasing function of military capabilities, and π is the probability of military success.

Military capability, ε_l, depends on some unspecified combination of troop size, military budget, etc. As such, military capability can be represented as, $K_l(x_a; \varepsilon_l, x_l)$, which basically can be interpreted to mean that the capability of a rebel group is a function of the distance to the site of conflict, x_a, and the rebel headquarters, x_l, and the military effectiveness of the rebel army, ε_l. The closer one is to one's own base compared to the enemy's distance from its base, the higher one's own probability of victory even if one is fielding a smaller force. Geographical distance thus affects the ability to project force. This is similar to Gates' (2002) model of a contest success function to model recruitment and geographical distances in the context of principal-agent relationships.[2]

Formalizing $K_l(\cdot)$, military capability is assumed to take the following form:

2) $$K_l(x_a; \varepsilon_l, x_l) = a + ln(\varepsilon_l) - (x_a - x_l)^2 + \eta_l,$$

where η_l is a stochastic element and a is a constant. Since there are so many unforeseen or even unseen factors that determine victory or defeat, military success is assumed to be stochastic in nature.

By setting the respective capabilities of the two armies against one another, their relative strengths can be compared such that: $K_l(x_a; \varepsilon_l, x_l) = a + ln(\varepsilon_l) - (x_a - x_l)^2 + \eta_l, = a + ln(\varepsilon_g) - (x_a - x_g)^2 + \eta_g, = K_g(x_a; \varepsilon_g, x_g)$. For the rebel group to have an advantage in terms of capability, $K_l(x_a; \varepsilon_l, x_l) > K_g(x_a; \varepsilon_g, x_g)$, such that: $ln(\varepsilon_l) - (x_a - x_l)^2 - ln(\varepsilon_g) + (x_a - x_g)^2 > \eta_g - \eta_l$. To obtain the success function we follow Gates (2002) and utilize a subclass of the contest success function, the <u>logit success function</u>

[2] The model presented here does not consider the organizational factors that Gates (2002) features through his principal-agent model.

(Hirshleifer 1989; 2000), such that the cumulative density function of the difference between the two stochastic elements, F(η_g - η_l) is assumed to be logistic:

3) $$F(\eta_g - \eta_l) = \frac{e^{(\eta_g - \eta_l)}}{1 + e^{(\eta_g - \eta_l)}}$$

Thus, the probability of success is expressed in this logistic fashion, directly accounting for the geographic location of the two sides; such that the probability of success, π_l, depends on the proximity of x_a and x_l with respect to x_g (the location of the government's forces). More specifically:[3]

4) $$\pi_l = \frac{\varepsilon_l / \varepsilon_g}{e^{-(2x_a - x_l - x_g)(x_l - x_g)} + \varepsilon_l / \varepsilon_g}.$$

This functional form of a conflict success function allows us to explicitly incorporate distance into our analysis.[4] The closer x_g and x_l are together, the flatter the function of the probability of success and the more the ratio of military effectiveness alone matters. If $x_l = x_g$, such that rebel headquarters were located in the country's capital, equation 7 will be the same as the generalized success function, $\pi_l = f(\varepsilon_l) / [f(\varepsilon_l) + f(\varepsilon_g)]$, since the distance term equals zero, making $e^0 = 1$.

Where a rebel group chooses to locate is a product of a strategic choice. Locating near a population that serves as a recruitment base is one such strategic

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[3] Please note that there was a typographical error in Gates (2002); the minus sign in the exponent in the denominator was missing.

[4] See Butler, Gates, and Leiby (2005) for another functional form of a contest success function that directly accounts for geographical distance. Their contest success function takes on a ratio format rather than a logistic form as developed here.

decision. A group may also choose to focus their activities near a lootable resource in order to control this valuable territory. Groups also often base themselves near an international border, which offers an opportunity to retreat to a “safe haven” in another country. A particular region’s terrain may also offer a defensive advantage for a rebel group, leading them to establish a base camp there. All of these factors shape the decision of location. Each factor, in turn, affects the military capability of the rebel army relative to the government. In terms of our contest success function, these factors affect military effectiveness, ε_l.

The relative distance to the combat zone will be determined by the location decision (shaped by the factors discussed above) and the strategic ambitions of the group. If the group’s aim is to secede, the group is more likely to be in a favorable position vis-à-vis the government (presuming that the seceding province is relatively remote from the capital – as it typically is). If the group aims to capture the apparatus of the state, it will aim at the capital, and in general this will give the government the advantage with regard to distance. These distance considerations modeled in our contest success function exhibit a conceptual similarity to Boulding’s loss-of-strength gradient (1962).

Contest success function models are particularly useful for explaining why belligerents in an armed civil conflict continue to fight and do not negotiate a bargained settlement (even when a bargain seems to be mutually advantageous).[5] In this regard they serve as a useful model for understanding why some civil wars last longer than others. To empirically analyze this question we employ duration analysis.

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[5] Butler, Gates, and Leiby (2005) focus their paper on this aspect of contest success functions.

But before turning to our analysis, we review previous attempts to model the duration of civil conflict.

Empirical Studies of Geography and the Duration of Civil War

There are strong theoretical arguments that rough terrain favors rebels, making them harder to detect and defeat by government forces. Among the first empirical studies to include variables on terrain, Fearon & Laitin's (1999) unpublished paper uses a simple dummy variable of mountain-based rebel groups in Eastern European countries. In a more recent paper (2003), they use a more refined measure – identical to the one used by Collier & Hoeffler (2004) – that gives the percentage of the country covered by mountainous terrain. These papers only consider the association between mountain and risk of civil war, though. Within the context of duration of conflict, Collier, Hoeffler & Söderbom (2004) include proxies for both mountainous and forested terrain. They find that the length of internal conflicts is positively associated with the amount of forest cover in the country whereas the share of mountainous terrain is irrelevant. In contrast, Buhaug & Lujala's (2005) comparison between country- and conflict-specific measures of terrain shows that forest is consistently negatively related to duration of intrastate conflict while mountains produce inconclusive findings. The generally ambiguous relationship between terrain and civil war is further corroborated by DeRouen & Sobek's (2004) investigation of civil war outcome. Their analysis suggests that mountains are favorable to rebels while forest cover reduces the likelihood of rebel victory.

The potentially adverse consequences of natural resource abundance on political stability have received much attention in the civil war literature in recent years, largely inspired by contributions in Economics, including Berdal & Malone

(2000) and Collier & Hoeffler (1998, 2004) and the introduction of the greed-grievance typology. Among the empirical studies of civil war dynamics, Collier, Hoeffler & Söderbom find little evidence that resource wealth affects the estimated duration (contrary to their finding regarding onset of conflict, see Collier & Hoeffler 2004). This contrasts Ross (2004a), whose evaluation of the underlying causalities between resource abundance and civil war in 13 selected cases indicates that abundance makes a conflict more likely as well as leading to longer duration. Further, Ross (2004b) shows that lootable natural resources in particular have a tendency to lengthen conflicts since they appear to benefit the rebel groups more than the government, and since they are associated with lower moral in armies that have opportunity to exploit them. Fearon's (2004) duration analysis also suggests that valuable contrabands, such as cocaine, opium, and gemstones, increase the length of the war, though the robustness of this judgment is questionable due to very limited resource data. Finally, Buhaug & Lujala find that gemstones contribute to lengthening a conflict, but only when they are located in the conflict zone.

Another aspect of geography that has been tested in relation to civil war duration is size of the conflict-ridden country, measured as country area (Balch-Lindsay & Enterline 2000), population size (Collier, Hoeffler & Söderbom; Elbadawi & Sambanis 2000; Fearon 2004), or both (Buhaug & Lujala). Again, the findings appear to be mixed across studies. While the Collier, Hoeffler & Söderbom piece indicates a positive relationship between size and duration, the other papers find less evidence of a systematic co-variation.

Finally, some studies have considered the relative location of the rebellion. Buhaug & Gates (2002), for example, show that conflicts with a larger geographic scope last longer on average (although there is certainly some degree of endogeneity in that relationship). There is also ample evidence that more remote conflicts are harder to put to an end than conflicts located in the center of the state (Buhaug & Lujala). Moreover, Balch-Lindsay & Enterline report that separatist conflicts – which presumably occur mostly in peripheral areas – last longer, and a similar behavior is uncovered for the so-called ‘sons-of-the-soil’ conflicts (Fearon).

Other Possible Determinants of Conflict Duration

Most armed intrastate conflicts occur in failed states. A recent report of the World Bank concludes that the factor most consistently linked to civil war is poverty (Collier et al. 2003). Large-scale domestic violence is also largely a characteristic of non-democracies. The empirical relationship (if any) between quality of economic and political institutions and duration of conflict is substantially weaker. Collier, Hoeffler & Söderbom’s (2004) analysis gives strong indications of an inverse link between development and duration, and shows a strong positive association between inequality (which is correlated with political institutions) and duration of civil war, even though a separate measure of democracy fails to be significant. In contrast, Fearon (2004) finds a weak but insignificant positive effect of GDP per capita (and democracy) on civil war duration, and DeRouen & Sobek (2004) find an even stronger positive effect of democracy and wealth on expected conflict duration.

Second, several empirical studies suggest a positive (but possibly non-linear) relationship between ethnic diversity and duration. Collier, Hoeffler & Söderbom, DeRouen & Sobek, Elbadawi & Sambanis (2000), and Regan (2002) all report a positive effect of ethnic fractionalization, and Fearon’s (2004) positive estimate for the ‘sons-of-the-soil’ dummy provides additional, if indirect, support.

Most studies that distinguish between various forms of civil conflict find that type matters. Balch-Lindsay & Enterline (2000), for example, conclude that among the internal factors the type of conflict has the largest impact, where separatism is associated with considerably longer civil wars. Fearon, too, finds that coups and revolutions are shorter on average than conflicts over issues of self-determination. The relevance of type of the ambition of the rebel group is further supported by Buhaug & Lujala and DeRouen & Sobek.

Finally, Balch-Lindsay & Enterline's study suggests that international aspects are just as important as the domestic environment in determining the length of civil wars, where support by foreign actors in favor of either side increases the duration of the conflict. This finding counters their prediction since biased interventions are expected to alter the balance of power in favor of the supported party, thus increasing the probability of rapid military success. Regan (2002) reconfirms these findings by showing that both economic and military interventions increase the expected duration of civil conflict (see also Elbadawi & Sambanis 2000). In contrast, Collier, Hoeffler & Söderbom find no effect of interventions, regardless of type or direction.

Shortcomings of Previous Studies

As is evident from the short review above, most factors theorized to influence the duration of civil war have produced mixed results. To some extent, this is because different investigations use different sources of conflict data. Whether one chooses to study large-scale conflicts only (typically relying on the Correlates of War project's requirement of at least 1,000 deaths in total) or decides to investigate a more comprehensive sample of conflicts (for example all conflicts with at least 25 annual battle-deaths) may ultimately have a substantial impact on one's findings. Similarly, some conflict data come with precise start and end dates while others only denote the first and final year in which the death threshold was reached. Different conflict datasets also treat lulls between periods of fighting differently. Moreover, the quality of the conflict data is likely to influence the research design. More finely grained data facilitate sophisticated statistical estimation techniques, which may affect the end product of the empirical analysis. See Gates & Strand (2005) for more on this subject matter.

Another cause for deviations across studies is poor operationalizations of key explanatory variables. One of the most controversial measures in this regard is Sachs & Warner's (1995) indicator of a country's dependence on primary commodity exports, which is used by e.g. Collier and colleagues. Among other things, this measure is not exogenous to the unit of observation: conflict. The denominator in the expression, GDP, is almost without exceptions negatively affected by civil conflicts, thus inflating the values of the resource proxy. This problem is normally addressed by applying time lags to the regressor, but many civil wars are preceded by significant internal unrest or previous armed conflicts (spirals of violence).[6] Accordingly, a country in conflict may have a high ratio of primary commodity export to GDP less because of abundance of natural resources than due to a collapse in the national economy. A second problem is that this statistic does not discriminate between different resource types -- some of which we have no reason to expect to be linked to rebellion. Abundance of natural resources should not per se be viewed as a conflict-

[6] 54% of the civil wars in Collier & Hoeffler's sample (2001) occur in countries that have experienced previous conflicts since 1945, a figure that undoubtedly will be much larger if one also includes armed intrastate conflicts below the 1,000 fatalities threshold.

promoting factor – it depends on the type and availability of the commodity. See Fearon (2005) for a more extended discussion of this.

This leads to what we view as a fundamental flaw with several contributions to the literature, namely the procedure to use aggregated country-level measures of features that in reality have substantial sub-national variation. Civil wars are by definition sub-national event and they rarely span throughout the territories of the conflict-ridden countries. More typically, rebel groups operate in specific areas of the country – often along the peripheral edges – while other parts of the country may be virtually unaffected by the conflict. Several theories about civil war also speak of local conditions. For example, the rough terrain proposition maintains that rebel groups are favored by inaccessible land that may provide shelter from government forces. If this is true and the rebels are aware of the advantages that e.g. mountains constitute, we would expect these groups to operate from such terrain. Yet, empirical tests of this proposition almost exclusively use country-level aggregates. However, unless we can assume that country statistics are representative of the conflict zones, it is not clear to us how to interpret the results. The same argument goes for natural resources. When analyzing the prospects for peace in a resource-rich, war-torn country, we would probably want to know whether the valuable resources are located within the conflict zone. If not, they are less likely to play a prominent role in the conflict. As the first large-N study to handle this problem, Buhaug & Gates (2002) used a preliminary version of the Armed Conflicts Dataset (Gleditsch et al. 2002)[7] as well as maps of the location of natural resources to construct a resource dummy that indicated whether or not there were lootable natural resources in the conflict zone at

[7] The Armed Conflicts Dataset includes information on the location of the conflicts; see Buhaug & Gates (2002).

the time of the conflict. With the aid of Geographic Information Systems, the work on collecting geo-referenced resource data has expanded considerably (see Lujala, Gleditsch & Gilmore 2005). Systematic comparison between country-level variables of terrain, population, and resources and more appropriate measures at the scale of the conflict shows significant differences (Buhaug & Lujala 2005). This suggests that the traditional aggregated variables may be poor indicators of the real thing, be it resources, terrain, population density, or other features that are likely to vary across space. Our paper is a continuation along this line, where the emphasis is placed on local conditions and the relation between the rebel group and the center of state power.

Hypotheses

Remote regions are more difficult to control by the government. Hence, Boulding's (1962) "loss-of-strength gradient" may be applicable for explaining the duration of civil conflicts. Governments often face significant logistical obstacles when involved in a conflict in distant areas. These include physical barriers for transportation of troops and equipment (such as mountains, lack of transport network), higher costs associated with longer distance, and limited knowledge of the local environment. In sum, we predict a positive linkage between the relative location of the conflict and its duration.

H 1. Conflicts located further from the capital city last longer.

Physical geography such as forested and mountainous terrain provides the setting where the conflict takes place. As the geography varies from country to country, the fighting groups face different advantages and limitations determined by the geography. A rebel group that has knowledge of terrain and knows how to benefit from it is better equipped to succeed on the battlefield. A group that can retreat to areas where it is protected from the enemy can more easily regroup, rearm, and train, and is therefore able to continue fighting for prolonged periods. Generally it is argued that mountain areas and forested terrain are beneficial for the rebels since rough terrain is hard to access and provides protection against aerial detection. Similarly, rebels that operate along the international boundaries may avoid government forces by seeking refuge behind the border.

H 1. Conflicts located in mountainous areas last longer.

H 2. Conflicts located in forested areas last longer.

H 4. Conflicts located at the international border last longer.

Extraction of many resources requires significant investment in technology and/or in skilled workforce. In addition, some resources require special transport facilities while others have low value-to-weight ratio, which make transportation costly and smuggling more difficult. These types of resources can be called non-lootable, since the revenues from the resources are not available to rebels during conflict. The latent value of non-lootable resource may, however, trigger conflicts by serving as a motivation for groups to take control of these resources either by ousting the present government or by secession. Lootable resources, in contrast, can be exploited during conflict by the rebel forces whereby the associated revenues contribute to financing the ongoing conflict. Classification of natural resources into lootable and non-lootable resources allows us to estimate more precisely the circumstances a rebel group can profit from natural resources – be it during the conflict or after the peace is restored.

Lootable resources provide a source to finance an ongoing conflict. Therefore, a conflict in which one side or more can benefit from resource exploitation, prolonged conflict is financially viable. Lootable resources also make rebel movements more independent from outside forces since they do not depend on foreign support to finance the fighting. This leaves less leverage for foreign institutions to influence rebel movements' decisions to enter into peace negotiations and eventually establish peace. As Addison, Le Billon & Murshed (2001) argue, a conflict situation may be preferred by one or more fighting groups over the peace since the conflict may not decrease the overall revenues accruing to participants. Thus, a conflict can provide economic opportunities that otherwise would not be present and consequently the fighting factions have an incentive to continue the fighting instead of pursuing peace.

H 5. Conflicts located in areas with lootable resources last longer.

Data and Research Design

The conflicts under study are taken from the Armed Conflicts 1946-2001 dataset, version 2.0 (Gleditsch et al. 2002). In this dataset, each conflict may have several observations, due to varying severity levels and change of combatants. Further, a conflict is only coded for years during which it reached the minimum severity level of 25 battle-deaths, resulting in two or more units if the threshold is not met for all years during the temporal span of the conflict. Obviously, we cannot treat observations as unique conflicts if they in fact compose one civil war. Consequently, we merged units that had identical ID codes, incompatibility, location, main actors, and were separated by less than 24 months of ‘peace’.[8]

Applying GIS to Generate Spatial Variables

In order to generate data that are able to incorporate spatial attributes, we relied on desktop geographical information systems (GIS). A GIS tool, such as ArcView or ArcInfo, combines digital maps with relational databases that have statistical functions, and enables the researcher to map and analyze variables that have a spatial dimension. Several of our variables were generated this way, mapping the distribution of specific regressors and intersecting the resulting theme layers with the conflict map. In order to pursue this task we first needed spatial information on the relevant variables. For the geographic distribution of conflicts, we mapped the units in the Armed Conflicts in accordance with the latitude, longitude, and radius variables (c.f. Buhaug & Gates 2002 or Gleditsch et al. 2002).

Dependent Variable: Duration of Internal Conflicts

The dependent variable is the duration of internal conflicts. Although the Armed Conflicts dataset includes start-dates of the conflicts, it does not contain detailed information on the termination of conflicts. Consequently, we used the Gates & Strand (2005) dataset, which more precisely dates war start and termination. This dataset offers a number of advantages. First as with all data that are part of the Armed

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[8] Deciding where to place the cut-off point between ongoing and new conflicts is not trivial and may have a substantial impact on the results. Cut-offs less than 24 months seem to be more problematic than longer cut-offs. Moreover the 24 month criterion possesses a certain prima facie validity. See Gates & Strand (2005) for a more detailed discussion of coding civil wars involving intermittent fighting.

Conflict Database family (PRIO/Uppsala), the battle casualty threshold is much lower than other datasets – twenty-five as opposed to one thousand. Second, the unit of analysis is the conflict not the country. The data thereby can differentiate between several contemporaneous conflicts occurring in the same country. This allows us to account for unmeasured heterogeneity. Third, the more precise dating of duration in the Gates-Strand dataset allows us to account for the large number of conflicts that last less than a month. Indeed, as Gates & Strand show, there are a number of conflicts, particularly coups that last only days.

Independent Variables

Location and Distance

To control for the relative location of the conflict, we include the natural logarithm of the distance between the conflict center and the capital, similar to Buhaug & Gates (2002). We also include a dummy variable to mark off conflict zones that abut the border of a neighboring state. In addition, since rebel groups that operate from distant regions may not need to cross the border in order to avoid government forces, and groups that have access to safe havens in a neighboring country are less dependent on having peripheral bases in their home country, we add an interaction term between location and border.

Lootable resources

Diamonds are classified into two types according to the nature of the deposit. Primary deposits are called kimberlite pipes, which are deep subterranean rock-formations. Mining of kimberlite diamonds requires high investment in exploration, capital-intensive equipment and underground tunneling and are therefore often mined by large international companies (Smillie et al. 2000). Thus, kimberlite diamonds are not classified as lootable natural resource. Diamonds in Botswana, for example, come from kimberlite deposits. Alluvial diamond deposits are eroded diamondiferous kimberlite that has been carried away by running water. These deposits can be found in vast areas and can be mined by a single person; the mining method is simple and only requires removal of topsoil to expose the diamondiferous gravel. This gravel is centrifuged and washed, and the resulting mix is searched by hand for the diamonds. The end product has an extremely high value-to-weight ratio and smuggling of diamonds is easy. Consequently, alluvial diamonds are often referred as the ultimate loot for armed groups. Diamonds in Sierra Leone, Angola and Congo (Zaire) are mainly mined from alluvial deposits.

Other gemstones than diamonds such as rubies, sapphires and emeralds occur both in alluvial and primary deposits. However, the lootability of the two types of deposit does not differ significantly. Although alluvial gem deposits are extracted easier and faster, extraction of primary deposits does not require special skills or equipment. The end product has high value-to-weight ratio and as in the case of diamonds, they are smuggled easily. Therefore, gems from both alluvial and primary deposits can be considered lootable

In the empirical analysis below, we include measures of alluvial diamonds, other gemstones, and narcotics cultivation (coca, opium, cannabis). These variables are dichotomous and take on the value 1 whenever the given resource is located within the conflict zone (as defined by the Armed Conflict Dataset) at the time of the conflict. See Lujala, Gleditsch & Gilmore (2005) for further information on the resource data.

Terrain

The variables for mountainous and forested terrain are based on Buhaug & Lujala (2005). With the aid of GIS, we calculated the share of the two-dimensional area of each conflict zone that is covered by the given type of terrain. Geo-referenced data on mountains were drawn from UNEP (2002) while gridded forest data are from FAO (2002).

Intervention

Following the findings of e.g. Balch-Lindsay & Enterline (2000) and Regan (2002), we include measures of third-party interventions. Our indicators are constructed from the Armed Conflicts dataset, where any foreign state that intervened on the part of the government or opposition is identified. Only 10.5% or 27 of the 257 civil conflicts in our sample are coded as internationalized – i.e. included foreign intervention on one or both sides of the conflict. This figure strongly contrasts those of Elbadawi & Sambanis (2000) and Regan (2000, 2002), who report interventions in 64.5% and 67% of the cases, respectively.[9] The reason is that the Armed Conflicts data only record events of direct military engagement by third parties whereas Regan additionally counts economic and indirect military assistance, such as aid, intelligence, and sanctions.[10] Regan also only includes cases of civil war as defined by the Correlates of War project whereby a civil war is defined by 1000 battle deaths in a year. The Armed Conflict Dataset uses a lower threshold of 25 annual battle-deaths.

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[9] Elbadawi & Sambanis and Regan use the same intervention data.

[10] Regan (2000: 10) defines intervention as "convention-breaking military and / or economic activities in the internal affairs of a foreign country … with the aim of affecting the balance of power between the government and opposition forces."

Territory

This is essentially a dummy-coded version of the incompatibility variable in the Armed Conflicts dataset, and distinguishes between conflicts over territory (secessionism) and governance.

Methodology

A standard model to capture the duration dependence of civil conflict is the Weibull model. In this model, the "hazard" of war termination is either high immediately after the initiation of conflict, and then decreases at a steady rate, or it starts low and increases. To test whether the duration dependence of armed civil conflict is monotonic in this way, we also employ a log-logistic survival function and employ two variants of the Cox proportional hazards model. We run a Cox model with clustering and with frailty.

The data for this analysis are structured as multiple-record data with multiple events with censoring. Given that civil wars frequently occur in the same country at different points in time, and indeed with the Uppsala data, more than one armed civil conflict can occur contemporaneously. The data structured in this way allows for clustering on country COW code, which, in turn, is used in the calculation of the robust standard errors. A number of wars were still on-going in 2001 (the last year of our data); we censored to account for this. The multiple-record per subject survival data structure allows us to account for time varying parameters. This is a big problem for most other duration analyses of civil war.

Results and Discussion

In order to evaluate the hypothesized relationships, we explored the effect of the explanatory variables across multiple models with different specifications and assumptions. Table 1 presents the results for four initial models, using slightly different estimation techniques. The two first models are estimated through Cox proportional hazard (with clustered observations and shared frailty, respectively), the third model reports Weibull accelerated failure-time (AFT) coefficients, while the final column present estimates from a log-logistic model. The same set of covariates is applied to all models: two indicators of relative location plus an interaction term, two dummies for lootable resources in the conflict zone, two rough terrain measures, a dichotomous intervention variable, an indicator of type of conflict, and a control for population density. Our proxy for level of economic development – (log) GDP per capita – is not included to avoid missing observations. The interpretation of the results differs between the semi-parametric Cox and the fully parametric Weibull and log-logistic models. In the former case, the coefficient indicates the hazard of 'failure' (i.e. the conflict ending) within a short time interval (t, $t+\Delta t$), given that the unit has survived until time t. Accordingly, a negatively signed coefficient implies that the factor contributes to lengthening the conflict. In contrast, negative AFT and log-logistic estimates indicate that the given covariate is negatively associated with the expected conflict duration. With few exceptions (which we will discuss in more detail below), the various models produced largely similar results.

All models in Table 1 provide strong evidence that location matters. Disregarding for now the possibly endogenous relationship, (which is probably not a huge problem given the crude nature of the location variables), civil wars that occur on (or beyond) the boundaries of neighbor states last significantly longer than other conflicts. This supports Hypothesis 4 and the notion that neighbor territory provides rebel sanctuaries, although it is also consistent with the assumption that access to foreign soil facilitates arms trade and smuggling, which might have an independent effect on the sustainability of the rebel group. In addition, we find that strong support for Hypothesis 1 in that conflicts that occur in the periphery is less likely to be resolved within a short period of time. In part, this might be because a ruling elite may view events in distant parts of the country less critical to their political survival and thus allocate fever resources than is needed to strangle the unrest quickly. But we believe this finding also reflects the inability of governments to project sufficient force and maintain full authority over peripheral regions, in particular if the rebellion is supported by the local population. As expected, the interaction term shows that the joint impact of the two factors is less than their combined individual effects. This suggests that access to foreign soil may act as a substitute for not having a peripheral base of operation and vice versa.

Aside from the location of the rebellion, access to some lootable natural resources seems to affect the dynamics of intrastate conflicts. The dummy representing secondary diamonds and other precious stones exerts a significant estimate in all models, and the direction of the effect is in accordance with Hypothesis 5. Civil wars in countries with easily exploitable gems last considerably longer, on average, than conflicts in less valuable terrain. The variable for drug production, however, shows no systematic relationship to the duration of conflict. The different behavior of these variables clearly illustrates the need to differentiate between types of resources; some resources are likely to have a larger influence on characteristics of conflict than others, and they may in fact be associated with different forms of domestic conflict (see Le Billon 2001b).

The proxies for rough terrain generally fail to influence the duration of conflict, and Hypotheses 2 and 3 are thus not supported. This might imply that the so-called rough terrain argument is not applicable to civil wars in general, but it could also mean that inaccessible bases are most crucial in the early phase of the conflict, before the rebel group is strong enough to conduct a more open warfare (as indeed was the case for Castro's guerrilla war in Cuba, see Pérez-Stable 1999). Therefore, in the most protracted of conflicts, the balance of power between the government and the opposition side is close to equal, and rough mountains become less crucial from a military-strategic point of view.[11] In addition, even though our variables give the proportion of mountains and forest in the conflict zone, rather than in the country as a whole, we cannot rule out that the lack of support for the hypotheses are due to poor data.

Table 1 is generally in line with other studies that report a negative effect of outside intervention on the prospects for peace. Even though the statistical significance of this finding is sensitive to model specification, the models are consistent with respect to the direction of the effect. We also see that territorial (or separatist) conflicts are likely to last longer than conflicts over state authority, but again, the models differ on the significance of the effect. Finally, only the log-logistics model suggests that densely populated countries are associated with different conflict dynamics than other countries.

In Table II we include a measure of national wealth (the log GDP per capita in time, t-1, prior to the conflict onset and a number of interactive terms. The analyses run in parallel to those in Table I. The findings are largely robust with those reported

[11] Yet, there are several cases to the contrary; long-lasting conflicts occur in jungles and mountainous areas in, e.g. Myanmar.

in Table I. The signs and hazards rates change only marginally. The pattern across estimations is for the most part similar across the estimations reported in Tables I and II. For the Weibull AFT estimation, however, the statistical significance of intervention and population density both improve with these estimations. The interactive terms are also statistically significant at the .05 or borderline ($0.05 < p < 0.10$). This pattern is somewhat reflected in both the Cox estimations. Wealth itself is not statistically significant in any of the estimations.

In Table III we compare Weibull AFT estimations with and without outliers. Figure I plots the outliers. We also identify the specific outlier cases. Whether the estimations are run with or without the outliers, it makes little difference; further demonstrating robustness across estimations.

The results demonstrate extremely strong support for the role of geography in understanding the duration of civil war.

Conclusions

Drawing on the PRIO/Uppsala Armed Conflict dataset for the 1946-2001 period (Gleditsch et al., 2002), we have identified the location of all battle-zones for all conflicts in this period and thereby identified the location and geographic extent of the conflict. Using information regarding these battle-zones we have determined whether lootable resources were accessible to rebel groups. We hypothesized that access to lootable resources will allow a rebel group to prolong the conflict, thereby resulting in longer duration of civil war. We found that alluvial diamonds and gemstones were strongly associated with longer wars. These lootable resources allowed the rebel groups associated with their exploitation to sustain the conflict. We did not find that drugs were associated with longer wars.

We also determined whether the conflict zone exhibited geographical factors that favor a rebel army based in the area. The location of the conflict is strongly associated with duration. Indeed all variables that deal with relative distance are statistically and substantively significant. Proximity to an international border also prolongs civil conflict.

We still have some work to do. In an effort to further explore the capacity of a rebel army to sustain conflict, we need to further examine the factors that affect rebel recruitment and retention. We also plan to further examine how the strategic goals of rebel groups affect the duration of armed conflict. Simply using a simple dummy variable indicating whether the conflict was secessionist does not provide enough information about a rebel group's strategic ambitions with regard to territory. Further examination of specific factors associated with rebel-held territory should be especially fruitful.

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Table I.
Event History Analysis for Civil War Duration data using Base Model (Excluding GDP)

Cofactor Name	**Weibull A.F.T Estimate (s.e.)**	**Log-logistic Estimate(s.e.)**	**Cox (clustering) Estimate(s.e.)**	**Cox (frailty) Estimate(s.e.)**
Conflict Zone at Border	1.021(.298)***	1.495(.384)***	-.548(.178)***	-.648(.174)***
Log conflict-capital distance	.680(.121)***	.753(.134)***	-.343(.068)***	-.352(.063)***
Confl. Zone*log Conflict-Capital dist.	-.744 (.205)***	-.704(.187)***	.384(.117)***	.390(.103)***
Log GDP per cap. in t-1 prior to conf. onset	-	-	-	-
Gemstones or sec. dia. prod. in conf. zone	.765 (.273)***	1.179(.354)***	-.469(.156)***	-.481(.211)**
Drug prod. in conf. zone	.348(.378)	-.030(.406)	-.234(.241)	-.125(.247)
Log %mountain in conf. zone	-.176(.098)*	-.085(.124)	.082(.051)	.082(.054)
Log %forest in conf. zone	-.099(.080)	-.127 (.085)	.060(.046)	.068(.048)
Intervention	.734(.423)*	1.189(.448)***	-.362(.230)	-.426(.244)*
Population Density	.002 (.002)	.004(.002)**	-.001(.001)	-.001(.001)
Territorial Conflict	.564(.290)*	.666(.346)*	-.344(.169)**	-.316(.194)
Constant	-3.055(.570)***	-5.005(.619)***	-	-
Shape Parameter (σ)	.546 (.032)	1.269(.085)	-	-
Variance of the θ (Random Effect)	-	-	-	3.09 (p<.039)
Log Likelihood	-529.08101	-533.74582	-1016.2741	-1014.7289
N	1483	1483	1483	1483

Note: 1) Robust standard errors are reported. 2) Two tailed hypothesis tests; * = p<.10; ** = p<.05; *** = p<.001.

Table II.

Event History Analysis for Civil War Duration Data, using Base Model plus Drug*Mountains, GDP, GDP*Mountains and GDP*Forest variables

Cofactor Name	Weibull A.F.T Estimate (s.e.)	Log-logistic Estimate(s.e.)	Cox (clustering) Estimate(s.e.)	Cox (frailty) Estimate(s.e.)
Conflict Zone at Border	1.032(.288)***	1.567(.425)***	-.592(.172)***	-.592(.176)***
Log conflict-capital distance	.730(.117)***	.777(.142)***	-.390(.075)***	-.390(.065)***
Confl. Zone*log Conflict-Capital dist.	-.579 (.180)***	-.618(.221)***	.265(.108)**	.266(.111)**
Gemstones or sec. dia. prod. in conf. zone	.916 (.269)***	1.354(.389)***	-.616(.170)***	-.616(.214)**
Drug prod. in conf. zone	-.183(.512)	-.337(.535)	-.162(.267)	-.162(.323)
Log %mountain in conf. zone	-.272(.133)**	-.110(.152)	.123(.066)*	.123(.066)*
Log %forest in conf. zone	-.034(.100)	-.106 (.123)	.048(.049)	.048(.048)
Intervention	1.199(.417)***	1.663(.435)***	-.658(.233)***	-.658(.258)*
Population Density	.004 (.002)**	.005(.002)***	-.002(.001)***	-.002(.001)*
Territorial Conflict	.288(.269)	.540(.326)*	-.164(.170)	-.164(.194)
Log GDP per cap. in t-1 prior to conf. onset	-.058 (.159)	-.024(.201)	.075(.087)	.075(.084)
GDP*Mountains	.089 (.054)*	.066(.074)	-.037(.030)	-.037(.035)
GDP*Forest	-.136(.067)**	-.099(.083)	.078(.040)*	.078(.045)*
Drug*Mountains	1.334 (.806)*	.969(.969)	-1.309(.556)**	-1.309(.593)**
Constant	-2.904(1.377)**	-5.150(1.463)***	-	-
Shape Parameter (σ)	.569 (.039)	1.248(.098)	-	-
Variance of the θ (Random Effect)	-	-	-	1.8e-05 (*p*<.498)
Log Likelihood	-474.27563	-481.79445	-889.3642	-889.36419
N	1226	1226	1226	1226

Note: 1) Robust standard errors are reported. 2) Two tailed hypothesis tests; * = p<.10; ** = p<.05; *** = p<.001.

Table III.

Event History Analysis for Civil War Duration Data, using Base Model with Drug*Mountains, GDP, GDP*Mountains and GDP*Forest variables

Cofactor Name	Weibull A.F.T Estimate(s.e.)	Weibull A.F.T After Dropping the Outliers Estimate(s.e.)

Conflict Zone at Border	1.032(.288)***	1.005(.306)***
Log conflict-capital distance	.730(.117)***	.810(.132)***
Confl. Zone*log Conflict-Capital dist.	-.579 (.180)***	-.644(.179)***
Gemstones or sec. dia. prod. in conf. zone	.916 (.269)***	.900(.278)***
Drug prod. in conf. zone	-.183(.512)	-.006(.607)
Log %mountain in conf. zone	-.272(.133)**	-.312(.137)**
Log %forest in conf. zone	-.034(.100)	-.073 (.104)
Intervention	1.199(.417)***	1.294(.444)***
Population Density	.004 (.002)**	.004(.002)**
Territorial Conflict	.288(.269)	.264(.277)
Log GDP per cap. in t-1 prior to conf. onset	-.058 (.159)	-.111(.182)
GDP*Mountains	.089 (.054)*	.107(.054)**
GDP*Forest	-.136(.067)**	-.122(.068)*
Drug*Mountains	1.334 (.806)*	1.092(.885)
Constant	-2.904(1.377)**	-2.787(1.594)*
Shape Parameter (σ)	.569 (.039)	.563(.041)
Variance of the θ (Random Effect)	-	-
Log Likelihood	-474.27563	-469.24901
N	1226	1219

Note: 1) Robust standard errors are reported. 2) Two tailed hypothesis tests; * = p<.10; ** = p<.05; *** = p<.001.

Table IV.
Efficient Score Residual Analysis for Cox Proportional Hazard Model

Variable	Obs	Mean	Std. Dev.	Min	Max
Confbord	1226	-1.09e-18	.1710565	-.7074644	1.201734
lndistx	1226	-3.08e-17	.674641	-3.683614	6.514269
borddist	1226	-6.88e-18	.3667695	-3.695487	2.215432
allgems	1226	7.19e-18	.1442937	-.3827357	.8265945
alldrugs	1226	1.12e-17	.1264603	-.5766388	.9052037
Lnmt	1226	1.61e-16	.598164	-2.918337	4.995954
lnfrst	1226	-3.98e-17	.6417699	-2.548883	4.46737
interven	1226	2.61e-18	.1092812	-.9447767	.8769241
popdcntry	1226	-1.36e-15	35.25886	-145.5632	681.6089
terr	1226	1.29e-17	.1794729	-.5339436	.8020931
Lgdp96x	1226	-1.42e-16	.3401965	-2.221149	2.445117
gdpmnt	1226	1.46e-16	1.065303	-8.811657	6.552158
gdpfrst	1226	3.33e-17	.8379015	-4.522243	5.486199
drugmnt	1226	1.51e-18	.0669784	-.2524446	.9242502

Figure I. Boulding's (1962) Loss-of Strength Gradient (Hegre 2005: 5)

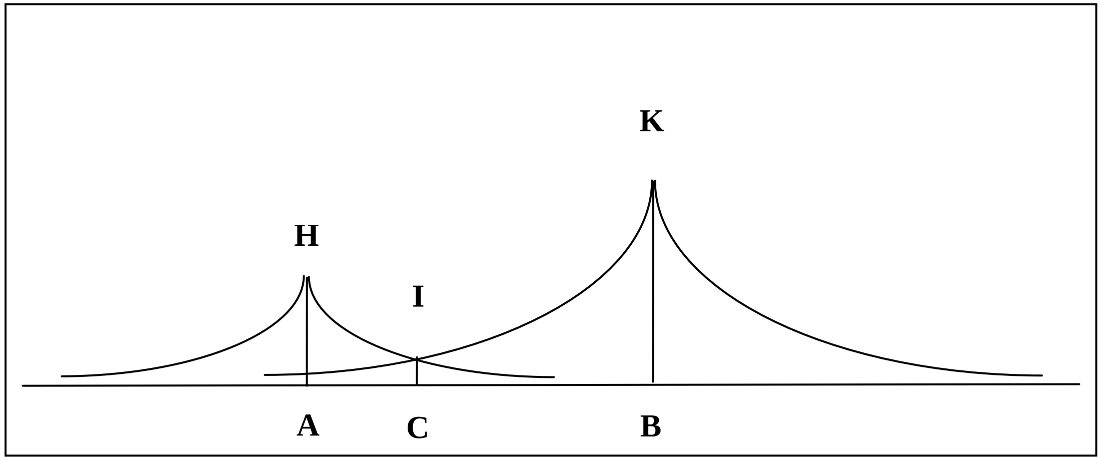


Figure II. Battle Distance (Butler, Gates, Leiby 2005: 19)

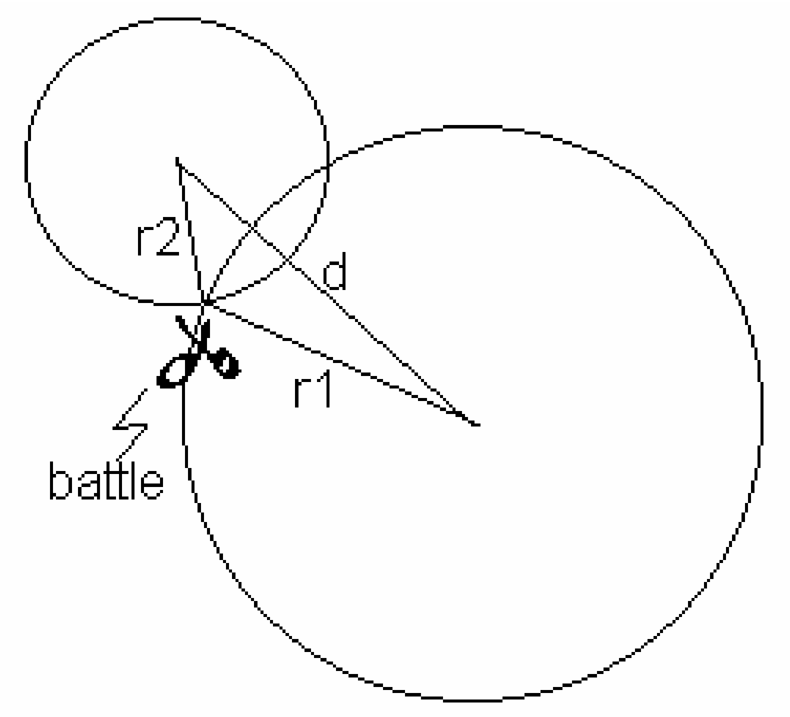


Figure III. Distance and Probability of Success (Butler, Gates, Leiby 2005: 20)

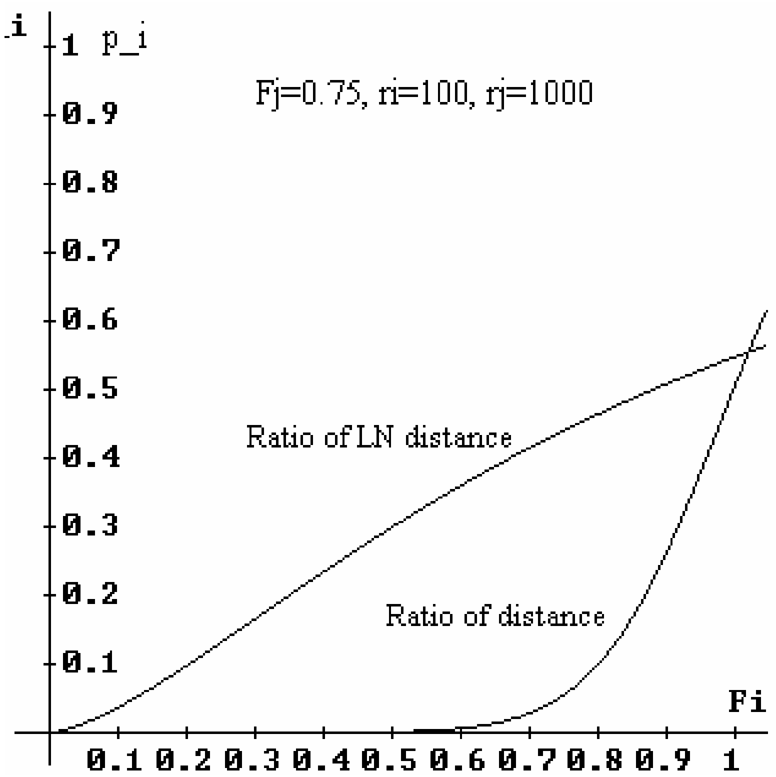
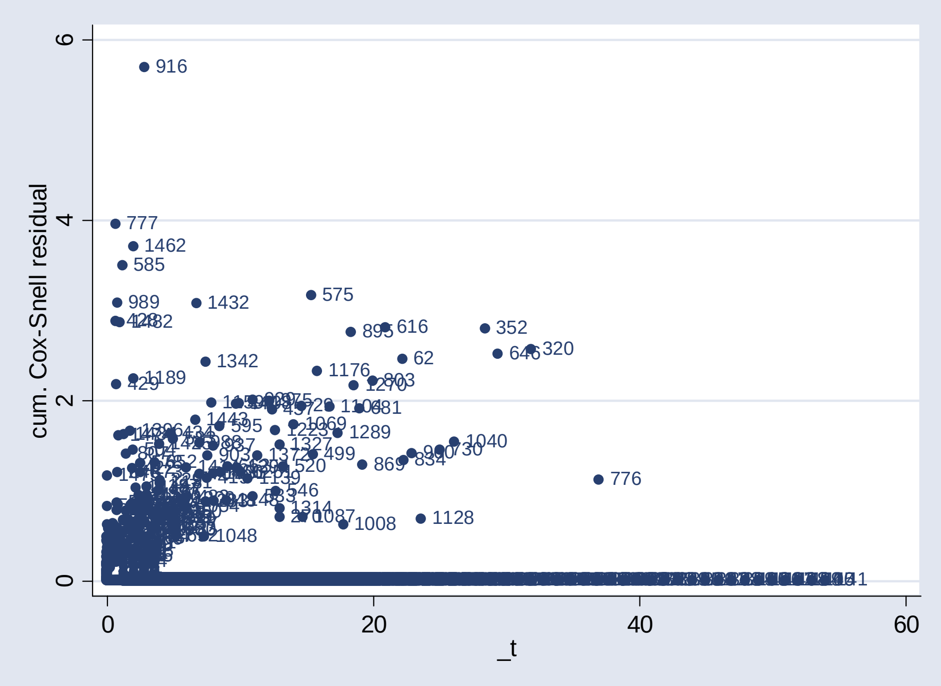


Figure IV.
Outlier Analysis, using Base Model plus Drug*Mountains, GDP, GDP*Mountains and GDP*Forest variables



Outliers in the Weibull estimation of Base Model

1. Ethiopia 1991
2. France 1962
3. Dominican Republic 1965
4. Uganda 1977
5. Uruguay 1972
6. Egypt 1998
7. Pakistan 1996

Figure V.
Kaplan-Meier Survival Estimates for Intervention as Estimated in Base Model

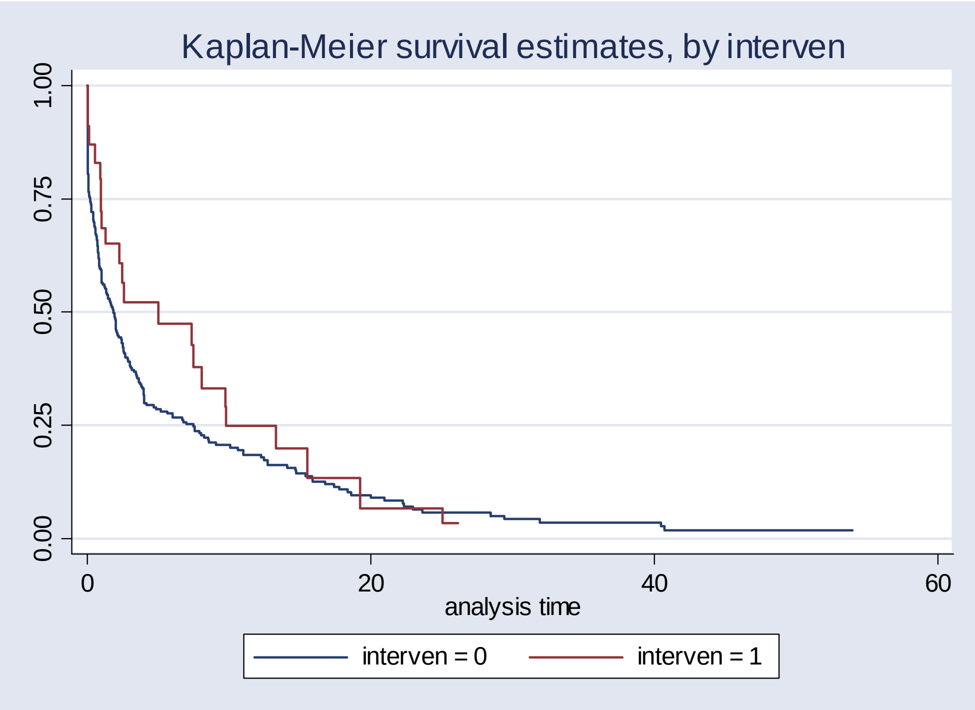


Figure VI.
Kaplan-Meier Survival Estimates for Territory as Estimated in Base Model