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Unnecessary Roughness: Examining Terrain, Indiscriminate Violence, and Conflict Duration

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Abstract

During the past decade scholars have attempted to identify factors influence conflict onset, outcome and duration by using cross-national quantitative analysis, many of which utilize terrain roughness as a control variable or as an independent variable asserting that it provides an advantage in guerrilla warfare. However, despite the theoretical assumptions, these studies fail to reach consensus regarding how or if rough terrain contributes to conflict. One study in particular, Buhaug and Lujala (2005), found that higher levels of rough terrain in the conflict zone were associated, albeit insignificantly, with shorter conflicts, while higher levels of terrain roughness at the country level were associated with longer conflicts. This thesis seeks to explain this counterintuitive result by proposing a new theory about how terrain roughness impacts the way counterinsurgencies are fought. I argue that terrain roughness which conflict zones geographically separated from the capital experience higher levels of indiscriminate violence from the state which increases rebel resolve and prolongs the conflict. Using GIS analysis to construct terrain roughness measures of the country-level, conflict-zone-level and the area separating the conflict zone from the capital. This hypothesis, in two parts, was tested using Cox Proportional-hazards modeling to determine if increased terrain roughness in the area separating the conflict zone from the capital results in longer conflicts. The second part was tested using Seemingly Unrelated Regression Analysis to learn whether or not increased terrain roughness in the separation zone increases the number of casualties. I also use Coarsened Exact Matching to limit selection issues related to state power, conflict location, and the ability to inflict a large number of casualties. The results from these test do not provide direct support for the hypothesis. Rough terrain and spatial separation between the conflict zone and the capital correlates to both shorter conflicts and fewer casualties. However, several of the underlying assumptions of the theory do receive strong support, including the relationship between state power and conflict location, cost sensitivity, and the application of indiscriminate violence in areas away from the capital.

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Chapter I: Introduction

The notion that rough terrain provides an advantage in guerrilla warfare has become axiomatic in discussions of civil war and insurgency. While scholars rely on the presence of rough terrain to predict conflict onset or explain conflict duration, the results in quantitative studies fail to offer consensus on the value of these variables. Often they fail to control for battle field dynamics. Pooling data of conflicts where insurgency is the primary tactic with wars fought conventionally may account for why terrain roughness reaches statistical significance in some large-n studies (Collier and Hoeffler 2004, DeRouen and Sobek 2004, Fearon and Laitin 2003) and not others (Collier et al. 2008, Buhaug and Lujala 2005, Buhaug et al. 2009). Although it may be advantageous in guerrilla warfare, rough terrain may have adverse affects when states use conventional tactics.

Another potential explanation for the lack of consensus among large-n quantitative studies of civil war is the use of poor proxies for terrain roughness. While Lyall and Wilson III (2009) limit their case selection to wars in which the guerrilla warfare was the primary battlefield dynamic thus compiling a dataset in which the advantage of terrain roughness should be most apparent, their proxy for terrain roughness, an average of five measures of altitude from within the conflict zone, fails to reach significance for either period of their analysis.

Buhaug et al. (2005, 2009) seek to demonstrate the problems with country-level analysis for variable such as terrain roughness in examinations of intrastate conflicts, use GIS data to create measures of both country-level and conflict-zone-level terrain roughness. Interestingly, their results suggest that a higher terrain roughness level shortens conflict duration when measured where the conflict is fought (though failing to reach statistical significance), but lengthens conflict when measured at the country level. While intending to illustrate the value of sub-national variables in civil war, they arrive at a counterintuitive result. Others have emphasized the importance of rural bases for the feasibility of rebellion (Fearon and Laitin 2003, Collier and Hoeffler 2004). This may help explain the contradiction of Buhaug's empirical analysis from his theoretical framework if the rebel's rural base were in the mountains but the fighting itself took place in another location.

However, these perplexing results may have other implications. Rather than exclusively offering refuge to insurgency forces engaged in guerrilla warfare, terrain creates a barrier of separation between the state and rural constituency which gives the state a greater propensity to apply indiscriminant violence, which in turn increases rebel resolve and conflict duration. It does so in two ways: (1) when the fighting occurs in remote regions where the state has less developed infrastructure and fewer social and economic connections, it will have greater difficulty identifying insurgents, and (2) with a lower cost absorption, in terms of casualties, states will employ indiscriminant violence because of its lower monetary cost.

Outnumbering conventional wars by nearly three to one (Balch-Lindsay and Enterline 2000), lasting on average ten times longer (Collier, et al. 2008),[1] and with five times the number of deaths (Fearon and Laitin 2003), civil wars have, unsurprisingly, received an increasing amount of attention from scholars. However, disaggregation of data, such as by war type or rebel objective often provides better illustrations of how specific variables affect conflict. Lyall and Wilson III examine specifically insurgency wars, defined by "a strategy of armed resistance that (1) uses small, mobile groups to inflict punishment on the incumbent through hit-and-run strikes while avoiding direct battle when possible and (2) seeks to win

[1] This is an increase from Collier, et al. 2004a in which they suggest civil wars were six times longer.

the allegiance of at least some portion of the noncombatant population" (70). They argue that because a key element of counterinsurgency campaigns is the ability for the incumbent to distinguish between insurgent and non-combatant when applying violence, mechanization and a reduced dependence on the local population for supplies will lead to "identification problems." While their results fail to support the notion that terrain roughness contributes to incumbent defeats, rough terrain and distance are the sorts of obstacles mechanized forces were developed to overcome. Similarly, some have argued the development of military and communications technologies have reduced the relevance of distance and separation variables (Boulding 1960, Scott 2009). However, it seems counterintuitive to suggest that the reliance on these technologies results in a greater level of indiscriminant violence, while the geographic conditions which led states to depend on them is not also associate with indiscriminant violence. Examining the variables that lead states to apply indiscriminate violence in war may allow international organizations and third party states with humanitarian interests to identify and prevent occurrences of mass killings and unnecessary civilian casualties. Because the use of indiscriminate violence by one party may increase support for the opposing party (Kalyvas 2006), indiscriminate violence may lead to longer conflicts, which in addition to casualties will have higher material and economic costs as well.

In addition to explaining the counterintuitive results in Buhaug et al (2005; 2009) and the lack of consensus regarding the role of terrain roughness in intrastate conflicts, this study seeks to examine the relationship between states and their constituencies and how that relationship differs when that constituency is separated from the state geographically. To do so, I employ Cox Proportional-hazards Modeling to examine how terrain roughness as well as other measures controlling for different types of separation between the state and constituency affects conflict duration. Because of the potential for duration to influence the levels of violence and, concurrently, the level of violence to influence the will of both the incumbent and the rebels, I use Seemingly Unrelated Regression analysis to analyze the relationship between terrain roughness and casualties. Interestingly, the state strength, which allows states to control territory and fight conflicts effectively also impacts the location of conflicts. To address this selection problem, I use Coarsened Exact Matching to prune the dataset of outliers that might bias the result. To further understand the relationship between physical separation of the conflict zone from the capital, I run separate SUR analyses on each type of conflict to help determine if the nature of the conflict fought in remote regions truly differs from those in which some of the fighting takes place in the capital.

I find while many of the underlying assumptions are supported, rough terrain in the conflict zone and the areas separated the capital from the conflict zone is associated with shorter conflict, and in the case of the latter, fewer casualties. However, there is evidence to support that terrain roughness does influence how conflicts are fought, in terms of number of casualties, as well as a difference in nature between conflicts fought in proximity to the capital and those fought in remote regions.

The next chapter will examine the existing literature regarding the role of terrain roughness in conflict, the use of indiscriminate violence, and the cost sensitivity of states, rebels and non-combatants in terms of casualties. Chapter Three will outline the theory I propose regarding the role of terrain roughness in leading the incumbent to employ indiscriminate violence, leading to longer conflicts. The fourth chapter will discuss the methodology I use to test the effects of separation on both conflict duration and casualties, and control for selection issues. Chapter Five will describe the case selection criteria and data. The test results will be presented and explained in Chapter Six. Chapter Seven will describe the limitations of the study in terms of both the available data and the methodology, explain the results in terms of their relationship to the core hypotheses, the proposed theory and the relevance to existing literature within Political Science, as well as discuss avenues for further research. The final chapter will offer concluding remarks.

Chapter II: Literature Review

Prior studies of conflict have tested terrain roughness as an explanatory variable, assuming its importance with respect to guerrilla warfare without disaggregating based on battlefield dynamic. Despite the overwhelming theoretical importance, empirical studies find mixed results due to case selection issues and use of poor proxies for terrain roughness. While some studies discuss guerrilla warfare specifically, their emphasis on identity problems and the indiscriminate use of force provide further support to the idea that rough terrain, as a spatial barrier between the state and rural constituency, may influence the duration of counterinsurgency campaigns. Past studies have examined duration as a dependent variable, but often with other motives. Those studies that do explore the effects of terrain roughness often attempt to apply the theory to cases in which guerrilla warfare is not the primary battlefield dynamic or use inappropriate proxies. This review will demonstrate a gap in existing literature and identify the theoretical underpinnings for the role of terrain in exacerbating identity problems and increasing the resolve of the warring parties.

1. The role of terrain

While many scholars test the effects of rough terrain as a contributor to conflict onset, duration or outcomes with varying results, the theoretical underpinnings as well as its consistent use as a control variable suggest it has some influence. Conventional wisdom suggests that rough terrain provides refuge to fighters engaging in guerrilla warfare. However, studies often fail to differentiate between wars fought using guerrilla tactics and wars fought conventionally with a clearly defined front-line in which refuge, such as rough terrain, provides no advantage. Fearon and Laitin (2003) and Collier and Hoeffler (2004) suggest mountainous terrain contributes significantly to civil war onset. However, after adjusting their model, Collier and Hoeffler (2008) find geographic variables fail to reach statistical significance in predicting onset. Each study restricts itself to civil wars while pooling conflicts of different battle field dynamics. Such pooling is unsurprising given that a post-World War II conflict rarely consisted of a single battlefield dynamic in its entirety. However, the theoretical underpinning of the value of terrain roughness in a) creating opportunity for civil war onset by making conflict feasible for weaker parties in the face of stronger adversaries, b) prolonging conflict by allowing rebels to hide, c) increasing the likelihood of incumbent defeats by providing guerrillas with an advantage does not hold as equally valid for wars fought primarily with conventional tactics.

Other studies, when restricted to insurgencies, defined as war in which guerrilla warfare is the primary tactic, counterintuitively find that terrain roughness fails to achieve significance. Lyall and Wilson III (2009), when testing the effects of mechanization on the outcome of counterinsurgency campaigns, find that both terrain roughness and distance of the conflict zone from the capital were not significant predictors of rebel victory in the mechanized era (post-1918). However, in pooling interstate and intrastate conflicts based on battlefield dynamic the dataset includes cases in which the distances variable represents the separation of the colonial or foreign capital from the conflict zone. As a result, anti-colonial and interstate conflicts dwarf the variation in the distance variable among intrastate civil wars. Their variable for terrain roughness, measured by taking the average of altitude measurements from the corners and center of the conflict zone, failed to reach statistical significance. This poorly approximates terrain "roughness" since a high plateau may be relatively flat and thus fail to provide refuge for rebels engaged in guerrilla warfare. Johnston and Urlacher (2010) have similar findings in their study of counterinsurgency duration with a similar case-selection criteria and identical variables for geography. Geographic and distance variables failed to reach significance in either the pre- or post-mechanized era, though they were more salient in pre-mechanized era (14). Their variables suffer the same flaws as Lyall and Wilson III's study. However, using Lyall and Wilson III's case selection and terrain roughness measure, Schutte (2012) finds elevation and forest cover weak predictors of higher casualties with the latter being highly significant. This coincides with DeRouen and Sobek's finding that mountainous terrain increases the probability of rebel victory while the probability decreases with flat terrain.

Other examinations of the role of terrain in conflict explore its effects on duration but do so with civil wars without respect to battlefield dynamic (pooling insurgencies with wars fought conventionally). Collier et al. (2004) find that neither mountains nor forest cover were significant predictors of duration using terrain data which measures the percentage of mountain and forest cover of the country. Buhaug and Lujala (2005) and Buhaug et al. (2009) have the opposite finding for mountain and forest cover for country-level measures. However, their examination of mountain-cover within the area where the fighting occurred correlates to shorter conflicts, though failing to reach statistical significance. Similarly, DeRouen and Sobek (2004) when examining outcome and duration found that forest cover and mountainous terrain increased conflict duration. Despite the varied outcomes, most of these studies examined terrain roughness and applied the theoretical advantages of guerrilla warfare to wars fought using conventional tactics by examining exclusively civil wars. These results might be tied to case selection rather than an indicator of the effects of terrain roughness. Lyall (2010) when examining the duration of counterinsurgency campaigns, found neither distance nor altitude significantly associated with conflict duration.

Beyond terrain roughness, distance also contributes to conflict onset, duration, and outcome. Buhaug and Lujala (2005) that find the distance between the conflict zone and capital significantly increases the duration, while Weidmann (2009) found it significantly associated with conflict onset. Conversely, Johnston and Urlacher (2012 unpublished) test a similar variable in a study of counterinsurgency campaigns and find distance fails to reach statistical significance. However, in Johnston and Urlacher's study, the variance among intrastate wars was dwarfed by the presence of anti-colonial wars and wars of foreign interventions where the distance between the incumbent's capital and conflict zone was often several thousand miles. Lyall and Wilson III (2009) and Schutte (2010) have similar findings when applying the same variable to insurgency outcomes when pooling intrastate and extrastate conflicts.

Although scholars routinely assert the importance of rough terrain and other factors of geographic differentiation, empirical evidence offers a mixed assessment potentially due to case selection which ignores the underlying assumptions or masks the effects through high levels of variance, or due to poor proxies for terrain roughness.

2. Insurgency and battlefield dynamics

The significance of terrain roughness as a variable in conflict rests on the notion that it provides an advantage in guerrilla warfare. Mao explains the tactic of guerrilla warfare, "In guerrilla warfare, select the tactic of seeming to come from the east and attacking from the west; avoid the solid, attack; withdraw; deliver a lightning blow, seek a lightning decision. When guerrillas engage a stronger enemy, they withdraw when he advances; harass him when he stops; strike him when he is weary; pursue him when he withdraws. In guerrilla strategy, the enemy's rear, flanks, and other vulnerable spots are his vital points, and there he must be harassed, attacked, dispersed, exhausted and annihilated" (1937, 7). In other words, employing this strategy of attacking an enemy and retreating before the enemy has a chance to retaliate allows one opponent to exhaust the will of another. He further discusses the importance of refuge for the guerrillas offered by terrain or a large non-combatant population with which to blend in. These elements which provide cover to insurgents make the attack-and-retreat method of guerrilla warfare more feasible.

While several scholars draw on the importance of this battlefield dynamic with respect to the costs and outcomes, such considerations are rarely made in quantitative studies of civil war. Most notably, Mack (1975) asserted that utilizing guerrilla warfare tactics, small powers can exhaust the will of their opponent whose cost sensitivity may outweigh their interests in continuing to fight. He suggests that through this strategy smaller powers whose survival depends on success can defeat larger powers based on what he describes as "interest asymmetry" in which the larger power will be only minimally harmed by the defeat and therefore less willing to continue a prolonged conflict. Interjecting in this discussion, Arreguin-Toft (2001, 2005) suggests the ability of weaker powers to defeat stronger powers rests on a choice of strategies by each actor. Engaging in guerrilla warfare strategies while a stronger opponent attempts to engage in conventional tactics allows a weaker power to gain an advantage (and subsequent victory). However, engaging in barbarism, which Arreguin-Toft describes as the application of indiscriminate violence against civilians, when the rebels utilize guerrilla warfare tactics will allow for the successful defeat of the rebels. The problem with Arreguin-Toft's theory is that it relies upon the assumption that the stronger actor is necessarily fighting a war of aggression (in which it selects its strategy first) against the weaker actor. While this may be true of the cases examined in Arreguin-Toft's (2005) study, such underlying assumptions become problematic when applied to cases of rebellion. Furthermore, in the context of a rise in rebel victories over time, his theory would suggests that incumbents have become increasingly poor decisions makers over time.

Lyall and Wilson III (2009), also seeking to explain the rise in incumbent defeats, argue that battlefield dynamic cannot be predicted *ex ante* (81), and for this reason mechanization, measured by the ratio of troops to vehicles, provides a better predictor of outcomes. They suggest powerful states with standing armies are better equipped to fight against other armies in conventional battles (78). Advancements in technology better allowed armies to fight conventional wars in remote regions by allowing them to operate farther from the source of their supplies without having to rely on potentially hostile local sources.

Unlike many other studies they restrict their selection to cases which utilize guerrilla warfare as the predominate battlefield dynamic. They illustrate how mechanized forces equipped to fight conventional wars struggle to overcome guerrilla warfare strategy from weaker forces due to "information starvation," or the inability to distinguish insurgents from the non-combatant population.

3. The role of identification, control, and spatial separation

Because the success of guerrilla warfare rests on the ability to retreat before the opposing party can retaliate, a successful counterinsurgency requires distinguishing the insurgents from the noncombatant population. Returning to Mao's discussion of guerrilla warfare, his description of the rebels' goals of winning the allegiance of noncombatant population while hiding from retaliation from the opponent lay the ground for many contemporary discussions of insurgency. Kalyvas (2006) demonstrates that these objectives of hiding from state retaliation and winning the allegiance of the population are closely tied.

The noncombatant population has the power to either protect or denounce the rebels to the incumbent. Their penchant for denunciation relates closely to whichever group can best provide protection (118). For this reason, Kalyvas argues, indiscriminate violence is counterproductive in COIN campaigns. When then incumbent administers indiscriminate violence, the noncombatants will aid the rebels, either materially, through not denouncing them to the incumbent, or through participation. Conversely, selective violence allows incumbents to eliminate insurgency forces without making the noncombatant population feel they are at risk of violence and reducing their incentive to collaborate with the rebels.

Lyall and Wilson (2009) define insurgency, in part, by the goal of winning the support of some portion of the non-combatant population (70). They attribute the diminishing ability for states to win this support (and decreasing ability to achieve victory in COIN campaigns) to "mechanization" or the dependence of the counterinsurgency forces on the supply line. Subsequently, states have experienced lower levels of interaction with the local populations as technology increased and they became less dependent on "foraging" for supplies in conflict zones. This dynamic exacerbates "identity problems" counterinsurgency forces face in distinguishing the non-combatant population, whose allegiance they seek, from the insurgents whom they seek to defeat. One obvious goal of technological advancement was to make obstacles such as distance, rough terrain and other geographic factors less salient. However, following Lyall and Wilson's (2009) logic that the ability to operate independent of the local population in remote regions diminishes the ability to effective fight COIN wars, this strategy may have effectively backfired.

Kalyvas (2006) argues that in civil war, either side is more likely to use indiscriminate violence in areas in which they do not control or in which they have less control relative to their opponent (223). Administering selective violence requires information which can be obtained more easily when in control of the territory in question. The non-combatant population is more likely to lend their allegiance to whichever side can best provide them with security or protection from violence (117). Having said allegiance from the population makes the controlling party less inclined to administer indiscriminate violence since this may induce collaboration with their rival who may be capable of shielding the non-combatants from the seemingly random violence. Conversely, the controlling parties use of selective violence to ensure the noncombatant populations in the territories they control do not defect.

Using Lyall and Wilson's (2009) dataset Schutte (2012) examines the effects of geography on casualties and outcomes finds that mechanization is associated with higher levels of casualties. This supports Lyall and Wilson's hypothesis that troops tied to "the umbilical cord of the supply line" (75) will apply force with less discrimination. The strongest and most significant indicator of both rebel victory and high casualties was a "territorial balance indicator" which measured the dispersion level of the population from the capital. In other words a greater percentage of the population living away from the capital increases both the level of violence and probability of incumbent defeat. Weidmann (2009) finds groups residing in mountainous areas are more likely to engage in rebellions against the state.

Others suggest geography influences conflict by ascribing loyalty to a geographic region. Toft (2005) describes an increased resolve based on loyalty to a specific territory as a homeland, particularly if parties have fought to preserve the land from foreign invasion. Buhuag (2006) suggests that stronger states are more likely to be subject to secessionist conflicts rather than conflicts with revolutionary aims (705). Similarly, Mason and Fett (1996) explain that the indivisible nature of territory makes civil wars more difficult to end and as a results, territorial based conflicts are more likely to end in settlement, rather than victory. This is consistent with Balch-Lindsay and Enterline's (2000) finding that separatist conflicts are more highly resolute and last longer. Fearon claims that longer conflicts necessarily occur in remote regions of states where ethnic minorities have been displaced and marginalized in his "sons of the soil" argument (2004). Scott (2009) makes a similar point, suggesting that groups evading the state by taking up residence in mountainous regions develop distinctly different identities and ethnicities from the urban and lowland based populations the state claims to represent. These studies demonstrate the value of territory and a geographically based kinship that can affect the resolve of warring parties and thus increase the duration. This supports Weidmann's finding that mountain-based groups are more likely to engage the state in rebellion.

DeRouen and Sobek (2004) find that military strength does not correlate to government victories. "In civil wars, a large army capacity may act as a detriment in that its use incurs more grievance against the government" (314). Though military strength does not necessarily correspond to mechanization, their results lead to a conclusion similar to that of Lyall and Wilson III (2009). The dependence of these forces on supply lines and military transport inhibited their ability to establish relationships with the local population in counterinsurgency campaigns. Subsequently, insurgents, defined as those employing guerrilla warfare tactics, benefit from the force's inability to distinguish rebels from those in the general population. These incumbent forces are also more likely to employ indiscriminate violence as a measure of counterinsurgency which can increase support for the rebels from the noncombatant population. While these factors hinder incumbent abilities to effectively fight counterinsurgency wars, these factors become much more problematic in conflicts that occur in areas further from the incumbent's reach..

4. The Significance of Duration and Cost Sensitivity

Examining outcomes or onset exclusively ignores the true costs of war, in terms of both monetary costs and casualties. Mao's writings on guerrilla warfare emphasize exhausting the will of one's opponent. "While these units function as guerrillas, they may be compared to innumerable gnats, which, by biting giant a giant both in front and in rear, ultimately exhaust him. They make themselves as unendurable as a group of cruel and hateful devils, and as they grow and attain gigantic proportions, they will find their victim is not only exhausted but practically perishing" (1937, 14). In addition to an assessment of the cost, duration also measures the level of resolve of the fighting parties. Mack (1975) and Merom (2003) both emphasize the impact of duration in weakening the resolve of stronger parties who might not necessary face existential threats from defeat.

DeRouen and Sobek (2004) similarly suggest the length of a conflict measures the resolve of each party and that both the incumbent and the rebels make decisions based on the likelihood of victory and how long each expects the conflict to continue. Furthermore, they find duration correlates to the likelihood of certain types of outcomes. For example, if rebels can survive the first several months of conflict their chance of victory increases, though remains relatively low (316). Similarly, incumbent victories are most likely close to the onset of conflict but diminishes over time in favor of settlements or treaties, or in other words, "rebels appear to be the beneficiaries of prolonged war" (316).

Collier, Hoeffler, and Soderbom (2004) suggest rebels will continue fighting as long as funding and cover are available, or, in other words, as long as conflict is feasible. In this regard, rebels may have a vested interest in prolonging the war. However, the interests of the incumbent and rebels are not the only considerations for whether a conflict continues.

The importance of winning the support of the non-combatant population in guerrilla warfare provides a certain level of veto power to the populace. Though it is not his primary focus, Kalyvas (2006) also discusses the differing reasons for allegiance and involvement beyond the political objectives of the civil war. He suggests that non-combatants will go to great lengths to avoid violence including "fence-sitting," remaining neutral or attempting to curry favor with both groups (245). The historical evidence he uses in developing his theory suggests that often non-combatants act strategically to prevent violence. And in some instances, the desire for security and stability leads to support for the actor most likely to win than that which they agree with ideologically. "Survival and desire for war to end trumps ideological allegiances for most people" (117). This illustrates that beyond the will of the state and rebels to fight, the non-combatant population has its own cost sensitivity which can influence conflict duration. Similarly, Mason, Weingarten, and Fett (1999) illustrate this sort of domestic cost sensitivity with the correlation between high casualty levels and the likelihood that civil wars will end in a treaty. While they do not specifically address which side inflicts the casualties or how, as such variables are difficult to capture in cross-national studies, they do illustrate that cost absorption influences an actor's will to continue fighting.

For these reasons, duration provides an important variable of interest. Because incumbents rarely have a vested interest in prolonging conflict rather than achieving victory, understanding the factors that influence insurgents' resolve and prolong fighting capabilities may help induce negotiations rather than protracted conflict.

Chapter III: Theoretical Framework and Hypotheses

While terrain may offer refuge to rebels engaging in guerrilla warfare, it also shapes how states project power and influences where and to what extent states maintain control of their territory. As a results, rough terrain will also affect how states address rebellion when it arises. I argue that spatial separation created by rough terrain influences how conflicts are fought by making the incumbent more likely to administer indiscriminate violence due to lower cost absorption and limited information, this will in turn increases the rebel's resolve. In conflicts located in areas geographically separated from the capital, the state's decision makers are less likely to absorb cost or experience the same risks of violence. Similarly, they are less likely to have resources that will allow them to identify the insurgents that would allow them to employ selective violence. Without the ability to determine who is responsible for insurgent attacks and with the ability to administer violence without sharing the risks, incumbents will use indiscriminate violence.

Despite the overwhelming assumption in existing literature that terrain roughness affects intrastate war by offering refuge to fighters engaging in guerrilla warfare, the numerous studies that have tested it have failed to reach consensus suggesting that it may influence conflict in other ways. In particular, this study seeks to address the counterintuitive results in Buhaug et al. (2005, 2009) in which country-level measures of terrain significantly increase conflict duration, while the measures of terrain roughness taken in the area where fighting occurred does not. While there is little doubt that the ability to conceal themselves from counterinsurgency forces is essential to rebels employing guerrilla warfare tactics, they can do so in other ways such as in cross-border sanctuaries in neighboring countries or among a large non-combatant population. The ability to conceal themselves from counterinsurgency forces allows guerrillas to overcome the power differential when fighting against a stronger incumbent force. Without knowing who participated in the insurgent attacks, counterinsurgency forces are faced with the dilemma of administering violence against non-combatants which may exacerbate discontent and increase sympathy for the insurgents.

Lyall and Wilson III's (2009) findings on the effects of mechanization suggest that states have attempted to overcome the obstacles of distance and rough terrain when exerting control in remote regions by relying more heavily on technology rather than developing strong local infrastructure. This strategy may have backfired by creating a new problem: "information starvation" leading counterinsurgency forces to administer violence indiscriminately since they have no local information network to help identify the insurgents. In addition to quantitative analysis, Lyall and Wilson III also offer a case study comparison of two U.S. forces in Iraq, the 4th Infantry Division and the 101st Air Assault Division, in 2003-2004. While the former relied heavily on mechanization with only a fraction of the daily patrols of the 101st, who relied more heavily on "dismounted" patrols that allowed for greater levels of interaction with the local population (2009, 96), the 4th Infantry Division faced difficulties identifying insurgents with fewer interactions and more limited information of the local population (99). Although their findings indicate that distance and terrain roughness have become less salient in the mechanized era (Urlacher and Johnston (2011) have similar findings for conflict duration), this appears counterintuitive from a theoretical standpoint. The technology that allows states to maintain control of remote regions and areas with difficult terrain, also limits the interactions and social connections between the urban-based states and their rural constituency.

1. Alternative Explanations

While the logic behind Lyall and Wilson III's mechanization theory suggests that how battles are fought heavily influences the success of counterinsurgency campaigns and the ability of either party to gain the support of the noncombatant population, terrain roughness and spatial separation may influence conflicts in other ways.

a. Increased salience of ethnic identities, via settlement pattern or state-evading

Terrain may coincide with settlement patterns of ethnic groups, or in some cases, might create more salient ethnic identities due to diminished levels of interaction with other groups. This coincides with Scott's (2009) theory that rough terrain and altitude allow groups to avoid the state's reach in Southeast Asia. Similarly, he explains other mechanisms of spatial separation exacerbate ethnic divisions such as with the Berber nomads in North Africa in which nomadism offers similar state-evading refuge (101). The ethnic segregation, either by chance in the case of settlement pattern or by choice in the case of evading the state as Scott describes, can contribute to conflict by leaving the minority group with limited or no representation in the state or by exacerbating deep seated ethnic hatreds. Licklider (1995) finds that ethnic/religious-based conflicts are not longer or more intense than political- or economic-based conflicts. He suggests that, from a theoretical standpoint, this is counterintuitive since these wars provoke deeper levels of commitment they are likely to be more intense. However, he does not disaggregate between geographic-based ethnicities and conflicts in which conflicting parties live side by side in the same cities and neighborhoods, and thus share the risks associated with conflict.

b. Distribution of resources and representation

Similarly, terrain roughness and distance can influence how states distribute resources and benefits among their constituency. In many cases, residence of urban areas have different economic interest and social values than those in rural areas. For example, in Afghanistan during the late 1970s, the Taraki and Amin governments each attempted to institute land reforms in rural areas from urban-based governments of Kabul. However, these redistributions of land were not well received by the rural tribal leaders and as a result, under these regimes the state failed to project power beyond the capital (Rubin, B., 2002: 122). In his examination of the Sendero Luminoso, Weinstein (2006) explains that the heavier concentration of state benefits along the coast where the capital is located brought about grievance among the inland peasant population. Furthermore, when the economy declined and resources became more scarce, the state's provision further diminished for the inland residents along with the state's capacity to provide security (Weinstein 2006: 82-83).

While two alternative explanations relate to terrain roughness shaping the social and political ties between the state and its constituents, I argue that the strategies and means by which the state attempts to end a rebellion will vary based on the proximity to the capital. The strategies states often adopt in remote regions will facilitate longer, more violent conflicts. Because each explanation might increase the duration of conflict by increasing the rebels will to fight, examining the level of violence in the conflict allows the final explanation to be disaggregated from the exacerbated social and political disconnect.

2. Causal mechanisms and theory outline:

While in reality, the difference between rural conflicts and those fought in proximity to the capital is likely informed by each of these three factors, by differentiating an increase in resolve from a conflict with limited information from reduced cost absorption from increased resolved due to social and political disconnect we can measure the effect terrains influence on how conflicts are fought. To do this I will incorporate the rational choice framework developed by Mason and Fett (1996):

$$E(U_C) = P_V(U_V) + (1 - P_V)(U_D) - \sum_{t_V=0}^{t_V} C_{ti}$$

In their framework, $E(U_C)$ is the party's expected utility of continuing to fight, P_V is the probability of victory, U_V and U_D are the utility of victory and defeat respectively. $\sum_{t_V=0}^{t_V} C_{ti}$ is the accumulation of cost if fighting continues, where C is the rate at which the party absorbs the cost of the conflict, assumed to be constant, and t is time. It is assumed that for both parties that $U_V > U_S > U_D$, where U_S is the utility of a settlement. Although Mason and Fett (1996) seek to explain why some conflicts end in settlement rather than until one party has achieved victory, their framework can also be used to compare resolve and cost sensitivity in different types of conflicts.

If each party in the conflict has Mason and Fett's utility function, a conflict adjacent to the capital would have high costs ($\sum_{t_V=0}^{t_V} C_{ti}$) for both the incumbent and the rebels. However, if the conflict zone is geographically separated from the capital the costs are lower for the incumbent, increasing their $E(U_C)$, their utility of continuing to fight. The incumbent's use of indiscriminate violence also influences the rebels and non-combatant population within the conflict zone. As Kalyvas (2006) suggests, because non-combatants can do little to ensure they do not become victims of indiscriminate violence, they will support the opposing side for the sake of protection. As rebels and non-combatants continue to experience indiscriminate violence at the hand of the incumbent, the greater the perceived burden of continuing to live under the incumbents rule, U_D decreases for the rebels. Furthermore, because this incumbent strategy leads the noncombatants to support the rebels, it eventually leads to an increase in the probability of rebel victory, P_V increases for the incumbent and P_V decreases for the rebels. Though the probability of rebel victory is always low, a small increase will not only strengthen resolve but also provide incentive for other noncombatants to support their cause, increasing conflict duration.

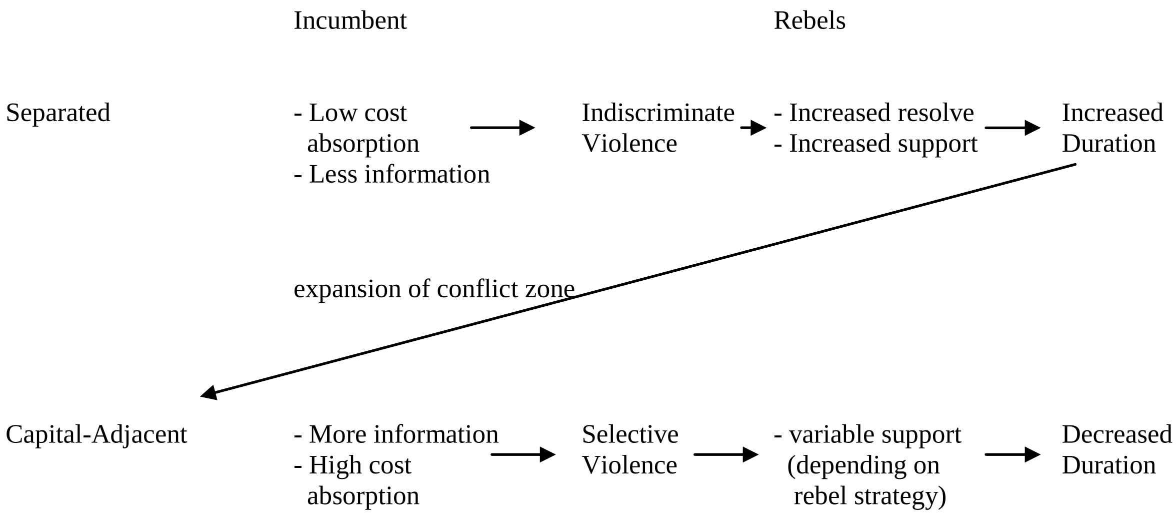
H1: Physical separation between the incumbent's decision makers and the conflict zone will increase conflict duration

Conversely, if the incumbent chooses to administer indiscriminate violence in urban areas, particularly their own capital, the rate of cost absorption increases substantially. Furthermore, if the rebellion takes places in and around the capital, the incumbent is more likely to have an information network in place that will allow them to more effectively identify rebels as well as a large number of noncombatants with a vested interest in the state's continued stability and are thus willing to provide information to the incumbent.

H2: Conflicts adjacent to the capital will be less violent than conflicts that occur in remote regions.

Armed conflicts of any kind are not as simple as having a single battlefield dynamic and are often not limited to a single battlefield. A conflict may arise from a remote region and later spread to the capital, other large cities or the entire country. When all constituents as well as the state decision makers must share the cost of the conflict, they will have a greater willingness to bring about an end to the conflict.

FIGURE 3.1. Linking Violence, Rebel Resolve, and Duration by Conflict Type



By re-examining the role of terrain in counterinsurgency campaigns, this project seeks to explain the counterintuitive results in Buhaug et al. (2005, 2009) as well as the lack of consensus among civil war studies whose results do not support their theoretical assumption that it influences wars by providing refuge for insurgents. Measuring the duration of conflicts offers a measure of both rebels' resolve and incumbents' willingness to absorb cost, while examining casualty data allows for the disaggregation between battlefield dynamics and use of violence and other mechanisms by which terrain roughness might influence resolve. The method by which these variables will be examined will be further explored in the next chapter.

Chapter IV: Methodology

1. Matching to compare levels of violence

When testing the effects of separation on the levels of violence in counterinsurgency campaigns one encounters selection effects when stronger states are more likely to engage in conflicts in remote regions (Buhaug 2010) and these states also often possess more effective means of administering violence in terms of their military power (Merom 2003). These effects are closely related, the same power that allows a state to administer violence effectively also allows it to contain the rebellion to specific geographic areas. This confounding variable may limit the ability to obtain accurate causal inferences from the sample. In other words the treatment, separation between the capital and conflict zone, is applied non-randomly. For this reason, non-parametric processing must occur in an attempt to achieve near-random or as good as random treatment.

By matching, an approach developed by Rubin (1973) as a means of "pruning," the dataset of cases which allows for equal distribution of both control and treatment groups in terms of confounding variable, X, in this study state strength. Matching treated cases with control cases based on X, the confounding pre-treatment variables allows researchers to calculate the Average Treatment Effects (ATE).

$$ATE = \frac{1}{n}\sum_{i=1}^{n} E[Y_i\,(1) - Y_i(0)|\, X_i]$$

$$= \frac{1}{n}\sum_{i=1}^{n} \mu_1\,(X_i) - \mu_0(X_i)$$

Let Y_i indicate a given the casualty level for an observation of conflict, where $Y_i(1)$ the dependent variable when treated (in this instance, a conflict separated from the capital) observation and $Y_i(0)$ is the result for the same observation, i, when left untreated. For the matching procedure, separation will be transformed into a binary variable, while the continuous distance variable will be used during the regression analysis. Because a conflict cannot be both treated and untreated, nor can a research perfectly replicate a conflict as in a laboratory setting, one measure is left as a counterfactual. A simple comparison of treated to control cases risks attributing incorrect causal inference when X influence both the application of treatment and the dependent variable. However, pairing cases based on the confounding variable or variable(s) X allows researcher to measure the effects of treatment against similar treated and control groups.

Coarsened Exact Matching (CEM) involves coarsening the covariates as much as reasonably possible, in other words, cutpoints are identified to assign individual continues values to a range. This allows continuous variables to be matched as though they have the same value if the values are fall within the range. For example, a researcher may choose to coarsen education data into "8th grade or less," "some high school," and "high school graduate" with the idea that someone who has completed ninth grade might have more in common with someone who has completed eleventh grade than with someone who has completed seventh grade. Because there is no *a priori* reason to believe that an observation with, for example, a *state power* value of .05 would have more in common with an observation in which it is .02 than an observation with .08, I use the algorithm in the CEM, developed by King et al. 2009. Observations with exact matches on each of the coarsened variables, in this case, power, are placed into a single stratum which is then weighted based on the number of treated units. If strata do not have at least one treated and one control observation then they are pruned from the dataset by setting the weight to zero (King et al.

2011, 4). While pruning the dataset by removing observation may seem counterintuitive, reducing can, when it removes extreme counterfactuals, increase the efficiency of estimates (Ho et al. 2007, 215). Removing these observations that fall outside of the shared "support space" in the distributions of the control and treated groups in terms of X allows for obtaining causal inference estimates with less sensitivity to assumptions of functional form (211). Other approaches to matching include exact matching, Propensity Score Matching and Mahalanobis Distance Matching. Exact matching requires observations be identical on the matched covariates. While this may be feasible when using discretely measure or dichotomous variables, continuous data can effectively prune all observations from the dataset. Propensity Score Matching involves summarizing all matching covariates in a single measure of the probability that unit *i* receives treatment, given the covariates X_i, $e(X_i) = p(T_i = 1|\ X_i)$ then usually estimate with a regression of T_i on a constant term and X_i without regard to Y_i (Ho et al. 2007, 218). After calculating the propensity scores, matching using methods such as "nearest-neighbor" to match treated and control observations until groups with identical propensity score distributions are obtained. Similarly, Mahalaoanobis Distance Matching employs a similar strategy measuring the distance between observations X_i and X_j with the measure $M(X_i, X_j) - \sqrt{(X_i - X_j)^T S^{-1}(X_i - X_j)}$ in which S is the sample covariance matrix of X (King, et al. 2011, 4, unpublished). With each of these methods a support space, usually based on "calipers" or maximum allowed distance, is established to prune outliers that may bias the results.

The primary difference between these methods and Coarsened Exact Matching is that MDM and PSM chose a fixed number of observations while hoping the method will provide an adequate level of balance, while CEM sets a fixed level of imbalance assuming the remaining number of observations will be sufficiently large (King et al, 2011, 2, unpublished). Because the number of observations in this study, 120, is fairly large, I choose to use Coarsened Exact Matching to alleviate the selection issues with separated conflicts being fought more frequently in more powerful states since the number of observations remaining after matching, without attempting to set *ex ante* would likely still be sufficiently large.

2. Duration

Matching itself does not estimate causal inference, but offers a means of preprocessing the data to achieve comparable treatment and control groups. To test the influence of spatial separation on conflict duration, I use Cox Proportional-hazards Modeling. This method falls under a larger family of statistical approaches commonly referred to as event history modeling or survival analysis. The primary advantage of event history models is the ability to incorporate right-censored cases, or cases which survive beyond the end of the period of interest. Excluding these cases may introduce selection bias since these cases may share other characteristics that influence duration (Fearon 2004).

This model measures the probability that a hazard, in this case conflict termination, will occur given that it has survived until time, t.

$$h(t) = \lim_{\Delta t \to 0} \frac{P(t + \Delta t > T \geq t | T \geq t)}{\Delta t}$$

T is the duration of a conflict. This equation is the rate at which conflict ends within a given interval, $[\mathrm{t}, \mathrm{t} + \Delta\mathrm{t}]$. While, like many researchers, I am interested in conflict termination as a continuous hazard rather than a hazard that can occur in discrete intervals, data for continuous processes must still be collected at discrete intervals (Box-Steffensmeier and Jones 1997). For this study duration will be measured in weeks.

The Cox Model, developed in 1972, belongs to a larger family of proportional hazards models. Proportional Hazards assumption means that a covariate has the same effect on duration at any point prior to the conflict terminating. Among various models in event history analysis the Cox Proportional-hazards Model, as a semi-parametric model allows the researcher to make no assumption about the shape of the hazard function. Because the baseline hazard function, $h_0(t)$, has no specified functional form it has no intercept, in other words the intercept is absorbed into baseline hazard function (Box-Steffensmeier & Jones 2004, 49).

$$h_i(t) = \exp\left(\beta_1 x_{1i} + \beta_2 x_{2i} + \ldots + \beta_k x_{ki}\right) h_0(t)$$

$$\log\left\{\frac{h_i(t)}{h_0(t)}\right\} = \beta_1 x_{1i} + \beta_2 x_{2i} + \ldots + \beta_k x_{ki}$$

Previous literature is fairly split with respect to model specification between Proportional Hazard Models (Balch-Lindsay and Enterline 2000; Collier 2004; DeRouen and Sobek 2004; Urlacher and Johnston 2011) and Weibull Models (Buhaug et al. 2005, 2009, Lyall 2010), with the former being particularly popular among scholars who wish to test time-varying covariates. Selecting Weibull regression for survival analysis requires the researcher to make assumptions about the shape of the hazard model, specifically monotonicity. In other words, the hazard rate must either increase or decrease exclusively over time. With a Cox model, the researcher allows for the possibility that the hazard rate, or probability of the conflict will terminate, may decrease and increase over time. DeRouen and Sobek's (2004) findings suggest this may be true of the hazard rate for intrastate wars, when they find that wars surviving the first few months when incumbent victory is most likely are likely to continue (316). Similarly, to follow Mason and Fett's (1996) logic, both incumbents and rebels choose to continue fighting based on their own perceptions of how long the fighting will continue and their perceived likelihood of success (549). If after several months, the fighting continues without a clear winner or resolution, more time may elapse before the incumbent or rebels have adjusted their expectations about the future cost and likelihood of victory, during which time the likelihood of conflict termination may decreases but later increase when incumbent's and rebel's expectations have been adjusted. Others (Lyall 2010, Buhaug 2009) suggest that the probability of conflict increases over time. While I do not explicitly seek to make claims about the shape of the hazard function, it is worth noting that there is sufficient reason to suspect it may be non-monotonic.

One potential disadvantage of the Cox model is that if the hazard function does take a known functional form, such as the Weibull distribution for conflict duration if the assumptionsof Lyall 2010 and Buhaug 2009 are correct, the Cox model will be less efficient. If the standard errors for a Weibull model are smaller, the efficiency would justify using it over the Cox model. However, if the standard errors are similar between the two models, the Cox model would be preferred because less restrictive assumptions (Box-Steffensmeier and Jones 1997).

3. Casualty analysis

Because of the potential for duration and casualties to influence one another, I employ Seemingly Unrelated Regression Analysis. First developed by Zellner (1962), this method follows the same notion as with serial autocorrelation for a single equation in which the error terms are correlated. As the name implies the two equations may not appear to be related, but a relationships might emerge. If the two error terms are uncorrelated, the procedure will yield the same results as if they were estimated separately through Ordinary Least Squares regression, if they are related, using a system of Seemingly Unrelated Regression will provide a more efficient estimation.

Chapter V: Case Selection and Data

1. Research Scope

Testing the effects spatial separation on the duration of insurgency wars, I have chosen to limit the study to conflicts started between 1945 and 2005 in which guerrilla warfare was the primary battlefield dynamic. Lyall and Wilson III's (2009) dataset provides a comprehensive list of insurgency wars fought between 1800 and 2005. However, unlike their study which seeks to illustrate the differences in outcomes in the pre- versus the post-mechanized era, limiting the study to conflicts fought after WWII removes the influence of conflict norms which most scholars believe to be different prior to WWII (Merom 2003, Fearon and Laitin 2003). Restricting the case selection to insurgencies provides a better indicator of whether terrain within the conflict zone functions as an area of refuge for guerrillas while excluding any countervailing may have on conventional wars. For this study, I define insurgency as Lyall and Wilson III do, as "protracted violent struggle by non-state actors to obtain their political objectives - often independence, greater autonomy, or subversion of existing authorities - against the current political authority (the incumbent)" (70). They further distinguish their case selection by requiring the conflicts have a minimum of 1,000 battle deaths with at least 100 on each side, and the non-state actor utilize guerrilla warfare strategy. The define guerrilla warfare as "a strategy of armed resistance that (1) uses small, mobile groups to inflict punishment on the incumbent through hit-and-run strikes while avoiding direct battle when possible and (2) seeks to win the allegiance of at least some portion of the noncombatant population" (70).

Because the theoretical claims apply to cases in which states administer violence against their own constituency, I further restrict the case selection to exclude anti-colonial wars, and cases of foreign intervention in which the intervening incumbent is non-contiguous to the state in which they intervene. I distinguish anti-colonial wars from separatist conflicts not by outcome (particularly since right-censored cases do not yet have outcomes) but by certain characteristics. Colonization typically involves less social and political integration of the colony to the homeland. Conversely, a separatist war involves residents of a state's home territory who share similar levels of representation as those in other areas of the state's territory. Similarly, I chose to include wars of conquest and irredentism in which the territory in question is contiguous to the incumbent state. Failing to include such cases would exclude the conflicts between North and South Yemen that eventually led to a unified state. As Fearon (2004) explains, case selection based on outcome can potentially lead to selection bias, for this reason I include cases in which one contiguous state attempts to acquire territory of another.

Finally, because the theory rests on an incumbent's willingness to apply violence against its constituency and the incumbent's own cost sensitivity, I also exclude cases where a third party contributed directly to the violence through intervention on behalf of either party. This should not be confused with other types of support such as providing incumbents or rebels with weapons, financial support or refuge in which the receiving party still decides how to administer violence. For example, while the Vietnam War, as fought between North and South Vietnam is included in Lyall and Wilson III's (2009) dataset (with the United States intervention conflict coded separately though they overlap), I have chosen to exclude it since the United States, as non-contiguous foreign power, intervened and administered violence against people who do not fall within its constituency, scholars have suggested the willingness of states to apply violence against foreign populations differs considerably from the manner in which they would apply violence domestically (Meron 2003).

2. Independent Variable: Spatial Separation/Terrain Roughness Measures

To measure terrain roughness, I used ArcGIS 10.1 and data created by the UN Environment Programme (UNEP 2002) which divides the land area into 10 by 10 kilometer cells with each mountainous cell assigned a value 1-7 based on the difference between highest and lowest point within that cell. Unlike altitude-based measures of roughness, this data provides a more effective means of distinguishing rough low-lying areas or higher flat plateaus which would otherwise be unaccounted for in the data. Up to four measures of terrain roughness were taken for each conflict. The first, *Country-level Roughness* is an average of the values of all cells within the territory, cells without a UNEP value are given a value of zero. Additional GIS analysis was performed to create a polygon file for each conflict zone from the Armed Conflict Dataset (Gleditsch et al. 2002) which provides the coordinates of a center point and radius for each conflict. The centerpoint was plotted and a the radius was used to create a circular buffer which was then clipped to the borders of the territory (the state boundaries or outer boundaries of two or more contiguous states involved in the conflict) to provide a measurable area for the conflict zone. To measure *Conflict Zone Roughness*, an average of the values of all cells within the conflict zone was taken. If cells did not have a UNEP value, they were given a value of zero.

To provide a measure of *Separation Zone Roughness*, the roughness for the area between the capital and the conflict zone in which conflict, in which some of the fighting takes place in the capital can be given a meaningful value, each of the UNEP values for terrain roughness has been weighted. Cells with the UNEP value of 1 were given a weight of .7, with the weight of each successive value increasing by .1. Cells with no value were given a weight of .5. Tangent lines are drawn from each side of the circular conflict zone to the capital (plotted from CIA World Factbook Coordinates) to capture the area the incumbent would need to cross to reach the conflict zone from the capital. Within this field the weighted values are summed. Conflicts in which some or all the fighting took place in the capital were given a value of 1. These values are logged. In observations in which the conflict took place in one or more contiguous states

To provide an alternative measure of separation, *Separation Zone Roughness (Alternate),* similar to the first two measures of terrain roughness, the average of the UNEP values was taken for the area separating the capital from the conflict zone. However, this value does not incorporate distance and thus, does not differentiate between a conflict zone separated by hundreds of kilometers of mountainous terrain and one separated by shorter distance of equally mountainous terrain. It is included only as an alternative.

As an additional measure of separation, *Distance* was also included as the distance in logged kilometers between the capital and the conflict zone. In cases where the conflict took place in one or more contiguous states, the capital of the incumbent (as defined by Lyall, the "counterinsurgency force") was used for this measure.

A dichotomous variable, *Separation,* was added, taking the value of 1 if the conflict zone was a measurable distance from the capital and 0 if the conflict was fought in an area adjacent to the capital. This variable was used in the Coursened Exact Matching process as the "treatment" which I argue is applied non-randomly with a bias toward more powerful states.

FIGURE 5.1. Conflict and Separation Zones of Pakistan v. Baluchistan, 1973-1977

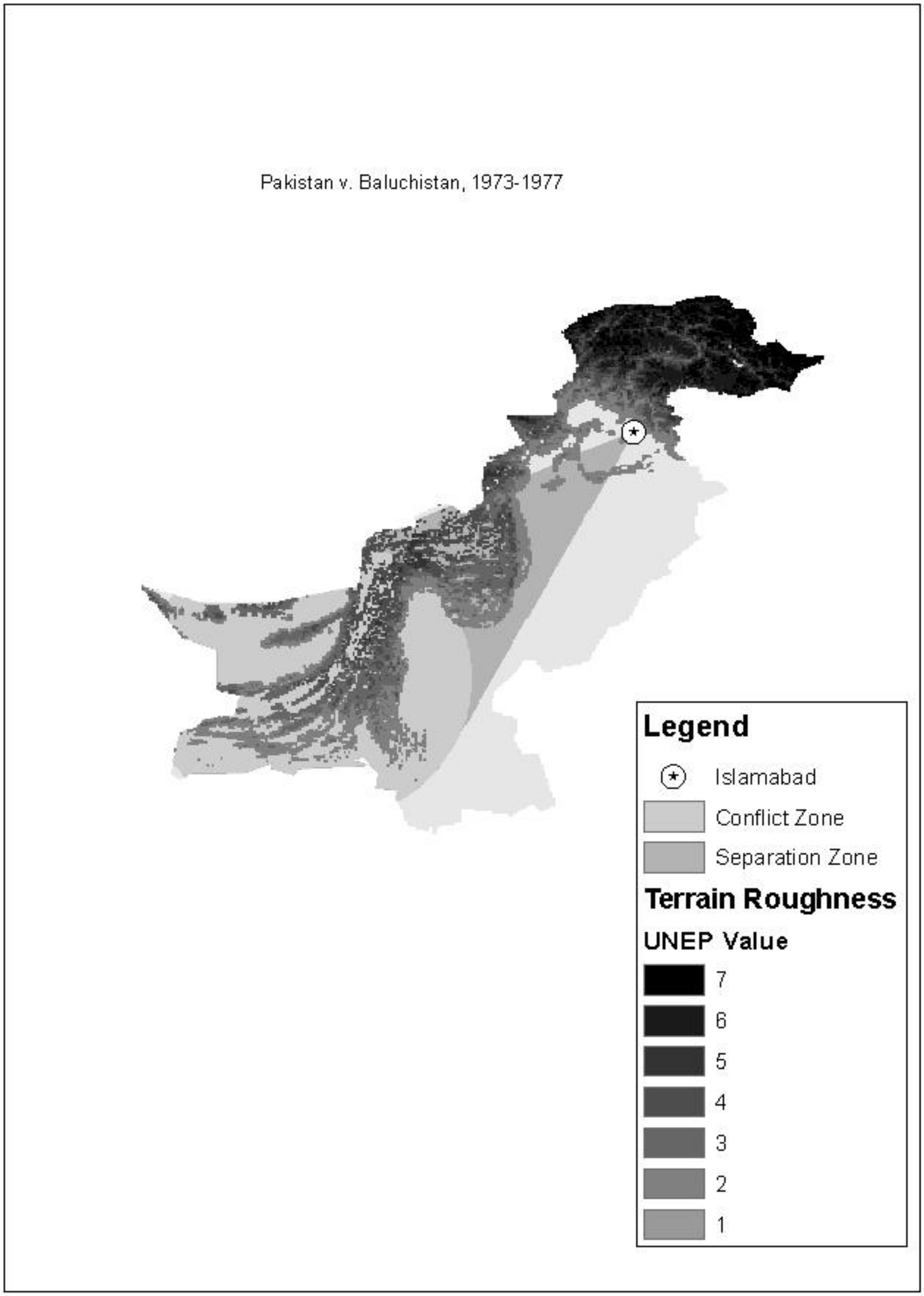
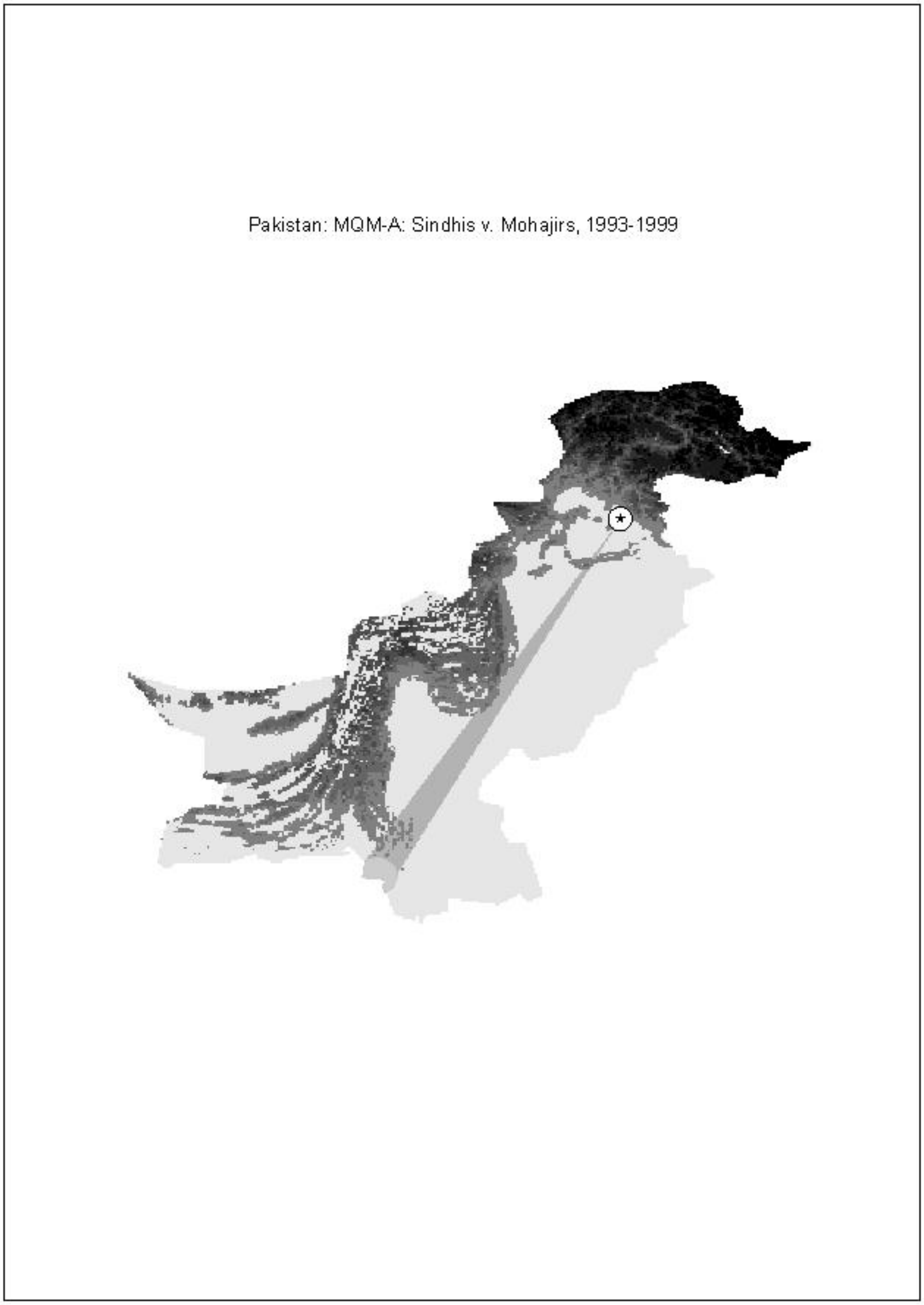


FIGURE 5.2. Conflict and Separation Zones of Sindhis v. Mohajirs, 1993-1999



3. Dependent variables

Because Cox Proportional-hazards model requires discrete intervals rather a continuous measure of time, conflicts were measured in a rounded number of *Weeks* based on the start and end dates in Lyall and Wilson III (2009).

The measure of casualties, *Average Battle Deaths per Year* includes both military and civilian casualties within the country over the duration of the conflict from the years the conflict took place. Data was taken from UCDP/PRIO's Battle Death Dataset (Lacina and Gleditsch 2005) to construct measures for a yearly average. Within their dataset, Lacina and Gleditch describe a low, high, and best estimate. For observation years for which it was available, the "best" estimate was used, for observation years in which it was not, the high estimate was used as the high estimate correlated most strongly with the best estimate for observations for which all three measures were available. This measure of casualties is also used as a control variable in the duration analysis.

4. Control Variables

Having the strongest theoretical influence on a state's ability to fight conflicts as well as where and to what extent they are able to project control, *State Power* provides an indicator for the incumbent's military and economic power. A measure of the incumbent's strength was taken from the Correlates of War's Composite Index of Material Capabilities dataset. This coincides with Merom's (2003) claim that stronger, more powerful states have more effective means of administering violence on a large scale. The measure is taken for the year prior to conflict onset and logged.

Similarly, because *Mechanization*, defined in Lyall and Wilson III (2009), separates the military personnel administering violence from the non-combatant population, Lyall's theory suggests more mechanized forces will engage in longer conflicts with a greater degree of indiscriminate violence. This measures an incumbent's soldier-to-mechanized-vehicle ratio. These ratios are lagged for the year prior to conflict onset and collapsed into quartiles with the highest value, 4, representing the highest level of mechanization, and 1 representing the lowest. The presence of *Minority Groups* may also influence how states apply violence particularly if they are highly concentrated rather than dispersed among other groups. A higher concentration of a minority population might allow incumbents to administer indiscriminate violence against identity-based rebel groups with minimal cost absorption and also coincide with stronger resolve. The measure of highly concentrated minority groups based on the Minorities at Risk (2009) dataset indicates the presence and number of groups identified as being concentrated in one region within a county in which a conflict occurs. The level of *Urbanization* within the territory where the conflict is fought can influence a state's ability to project control over a population or a larger share of the population outside of urban areas might results in greater alienation from the central government, increasing resolve. Similarly of the finding of Schutte (2011) that a large percentage of the population living far away from the capital is associated with higher casualties, a large percentage living outside urban areas might similarly allow the state to inflict a high number of casualties by focusing their efforts outside the cities. To measure urbanization, the percentage of the population living in urban areas was calculated from the Correlates of War dataset one year prior to conflict onset.

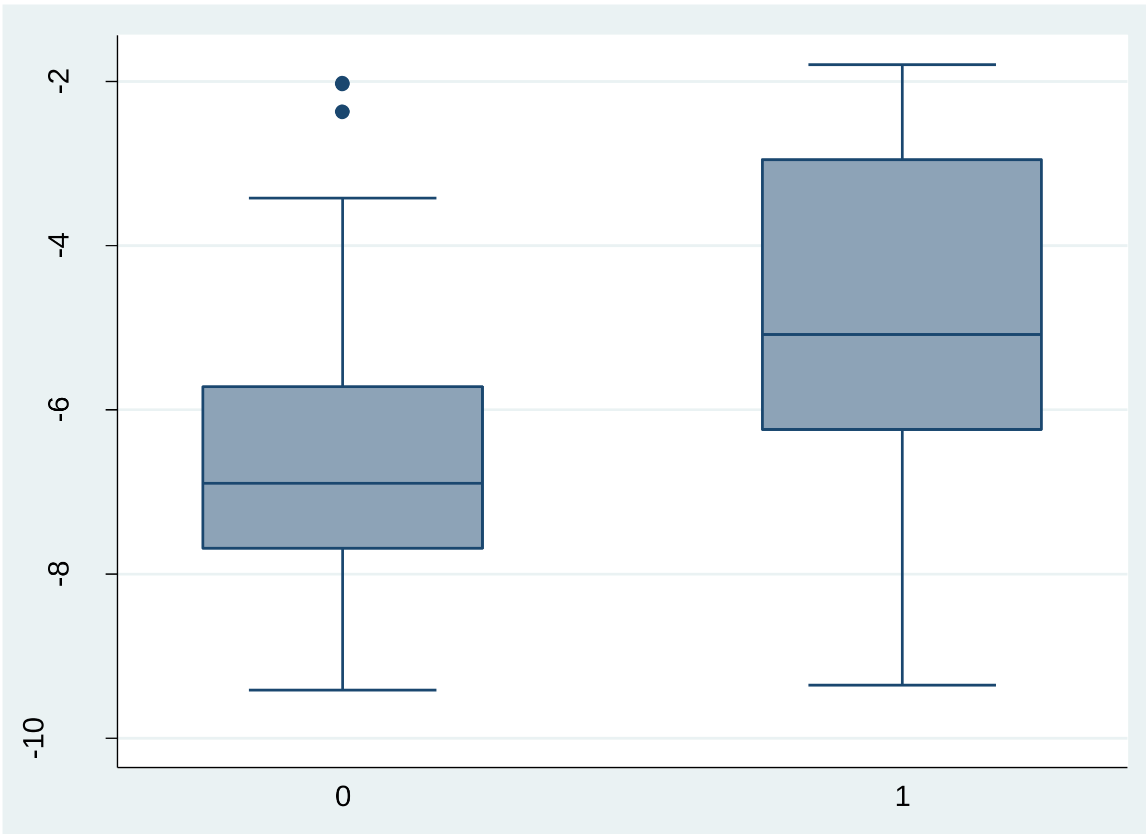
While conventional wisdom suggests terrain roughness provides a sanctuary for insurgents engaging in guerilla warfare, this does not rule out the potential for other types of sanctuaries such as those beyond the borders of neighboring states. *Cross-border Sanctuary,* taken from Lyall and Wilson III (2009), indicates whether the insurgents had access to refuge in a neighboring state. The territory throughout which the incumbent must project control can influence both the incumbent's ability to fight and the rebel's ability to evade the incumbent, potentially prolonging the conflict. *Area* includes all contiguous territory over which the incumbent attempts to control during the conflict. This variable, logged, was taken from the CIA World Factbook 2013 and was only be included in the duration analysis. To ensure temporal trends in conflict don't heavily influence the *Start Year* was included as a control variable. It was measured as the number of years after 1945.

Chapter VI: Results

In separating remote conflicts from those in which some or all of the fighting occurred in and around the capital, I tested a new theory, outlined in chapter three, intended to explain the counterintuitive results in Buhaug et al. (2005, 2009) and offer new insight into why terrain roughness is associated with conflict in some studies but not others. Using Cox Proportional-hazards Modeling, Coarsened Exact Matching and Seemingly Unrelated Regression (SUR) modeling, I tested the theory that states are more willing to administer higher levels of violence in remote regions and, in doing so, they prolong conflicts.

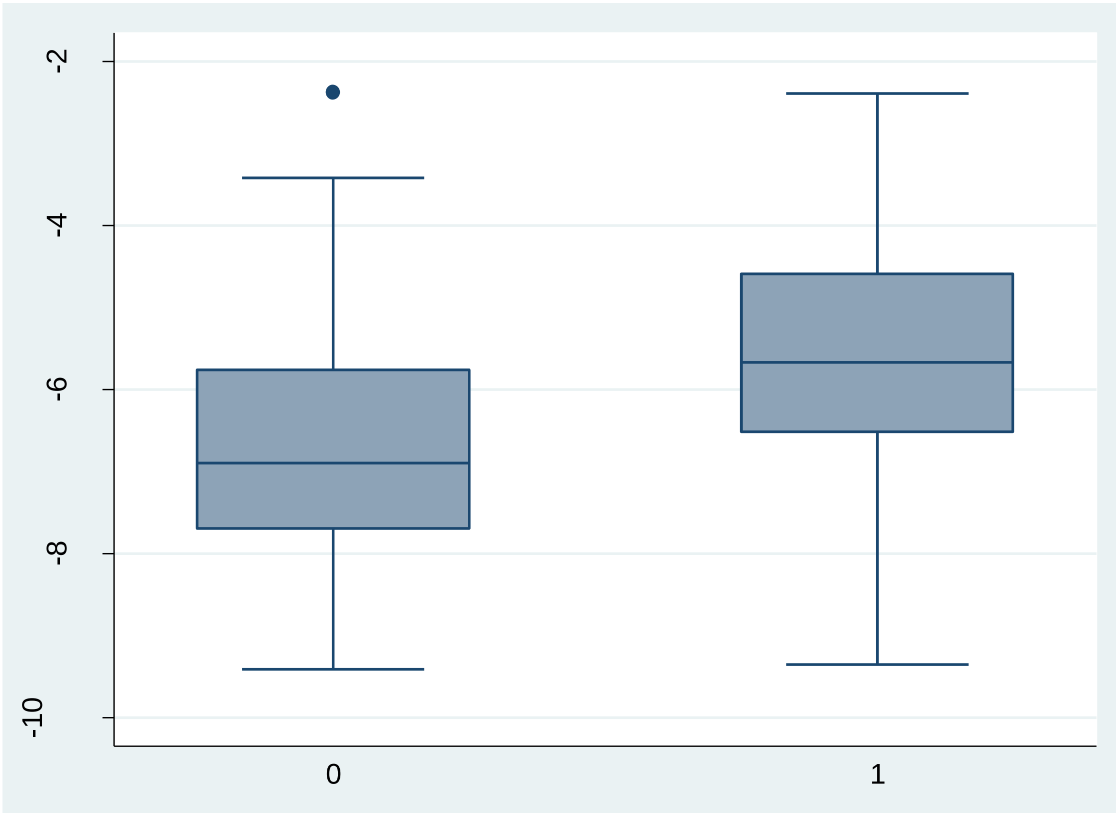
Because previous literature suggests that stronger states are more likely to face remote conflicts and stronger states may have more effective means of administering violence, there are multiple theoretical reasons to believe remote conflicts might be more violent. Similarly, the same power that influences a state's ability to inflict casualties might also influence, directly or indirectly, the will to fight. Matching as a pre-process allows one to test a hypothesis without mistaking casual inference due to correlation between selection for treatment and the dependent variable. There is reason to believe the treatment, in this case, separation, correlates with the dependent variable, the level of casualties. In other words a disproportionate number of cases of separated conflict will have more powerful states fighting as the incumbents and conflicts in which some or all of the fighting occurs in the capital included a greater number of weaker states. For this reason merely looking at the summary statistics or running regressions of the current dataset does not provide an appropriate counterfactual to compare separated and non-separated conflicts. The use of Coarsened Exact Matching pruned the dataset of extreme outliers so only comparable data within a common "support space" remains. Using the CEM software package algorithm to group conflicts into strata based on a pre-treatment covariate, in this case, state power, and eliminating any strata without a treated and untreated observation, two comparable sets of observations remain.

FIGURE 6.1. Separated conflicts (1) v. Capital-adjacent Conflicts (0) Prior to Matching



separated conflict will have more powerful states fighting as the incumbents and conflicts in which some or all of the fighting occurs in the capital included a greater number of weaker states. For this reason merely looking at the summary statistics or running regressions of the current dataset does not provide an appropriate counterfactual to compare separated and non-separated conflicts. The use of Coarsened Exact Matching pruned the dataset of extreme outliers so only comparable data within a common "support space" remains. Using the CEM software package algorithm to group conflicts into strata based on a pre-treatment covariate,

FIGURE 6.2. Separated Conflicts (1) v. Capital-adjacent Conflicts (0) After Removal of Outliers



in this case, state power, and eliminating any strata without a treated and untreated observation, two comparable sets of observations remain.

From the summary statistics there is very limited support for the core hypotheses. Separated conflicts appear to be both shorter and less violent than conflicts adjacent to the capital, both before and after matching. However, several of the theoretical assumptions are supported. Separated conflicts tend to occur in larger, more powerful states in which the incumbent is more able to keep rebellions contained to remove regions. Interestingly, the mean country-level measure of terrain roughness is approximately equal for each type of conflict. Consistent with conventional wisdom, remote conflicts appear occur in areas more mountainous than the rest of the territory (though only marginally so for capital-adjacent conflicts), suggesting rebellions are more feasible in rough terrain or rebels seek out rough terrain for its advantages in offering refuge.

TABLE 6.1. Summary Statistics

	Pre-match		
	Full Dataset	Separated	Capital Adjacent
Duration (weeks)	453.592	398.600	482.588
Battle Deaths/Year	7,756.523	5,760.720	8,754.424
Country-level Terrain Roughness	0.899	0.893	0.880
Conflict-zone-level Terrain Roughness	1.100	1.384	0.948
Separation-zone Terrain Roughness	3.815	11.446	0.000
Separation-zone Terrain Roughness (Alt)	-	0.344	-
Distance	222.983	666.950	1.000
State Power	0.013	0.028	0.005
Mechanization	2.500	2.575	2.462
Urbanization	0.175	0.217	0.154
Minority Groups	2.642	4.675	1.625
Cross-border Sanctuary	0.342	0.275	0.375
Area	2,257,882	5,050,701	861,473
Start Year	1978	1977	1978
	n=120	n=40	n=80

TABLE 6.1 (cont.). Summary Statistics

	Post-match		
	Full Dataset	Separated	Capital Adjacent
Duration (weeks)	455.697	373.733	486.823
Battle Deaths/Year	7,778.007	5,203.852	8,755.535
Country-level Terrain Roughness	0.886	0.901	0.880
Conflict-zone-level Terrain Roughness	1.021	1.215	0.948
Separation-zone Terrain Roughness	3.124	11.349	0.000
Separation-zone Terrain Roughness (Alt)	-	0.294	-
Distance	139.458	504.100	1.000
State Power	0.005	0.009	0.004
Mechanization	2.514	2.600	2.481
Urbanization	0.173	0.220	0.155
Minority Groups	1.945	2.767	1.633
Cross-border Sanctuary	0.358	0.300	0.379
Area	872,898	1,194,269	750,859
Start Year	1978	1978	1978
	n=109	n=30	n=79

After matching to create comparable groups of separated and capital-adjacent conflicts based on power, the average of the *state power* measure for separated conflicts decreases to a third of its original value and is yet still more than twice as high as the value for conflicts adjacent to the capital.

TABLE 6.2. Conflicts Removed from Dataset After Matching

1	Forest Brothers (Estonia); LTS(p)A, LNJS, and LNPA (Latvia); BDPS (Lithuania)
2	USSR v. UPA in Ukraine
3	China v. Taiwanese Insurgents (White Terror)
4	Sino-Tibetan
5	Mizo Revolt(Assam)
6	India v. Naxalite I
7	Afghanistan II 1980-1989
8	India-Sikh Insurgency
9	Russo-Chechen I
10	India v Kashmiri
11	Russo-Chechen II

The cases pruned from the dataset for having no corresponding treated or untreated cases within the strata follow a clear pattern. Only those in which the Soviet Union/Russia, India, and China fought against insurgency campaigns were "strong state" outliers. The comparison table suggests that the removal of these cases influenced the data in other ways as well. The mean duration for separated conflict decreased by approximately 25 weeks. The mean of average annual battle deaths also decreased suggesting that in addition to power corresponding with remote conflicts, it also corresponds with a larger number of battle deaths. The decrease in number of minority groups can easily be tied to the removal of several conflicts in India which has a disproportionately large number of minority groups. The level of urbanization for separated conflicts increased as did the availability of a cross-border sanctuary among both separated and capital adjacent conflicts. The mean area of continuous territory the incumbent attempts to control decreased substantially, though this is unsurprising given the incumbents of the conflicts pruned from the dataset.

1. Duration

Duration modeling measures the relationship between conflict length and variables of interest rather than predict duration. The hazard ratios, presented in table 3, measure the impact of the covariate on the likelihood the conflict will terminate relative to the baseline hazard function (how long a conflict would last if all covariates were set to zero. A hazard ratio greater than 1 suggests a greater likelihood of conflict terminating, in other words, shorter conflicts, while a hazard ratio less than 1 indicates that increasing the value of the covariate will increase the duration of the conflict. Because the baseline is "absorbed" into the hazard function, there is no intercept value.

FIGURE 6.3. Survival Time of Matched Conflicts

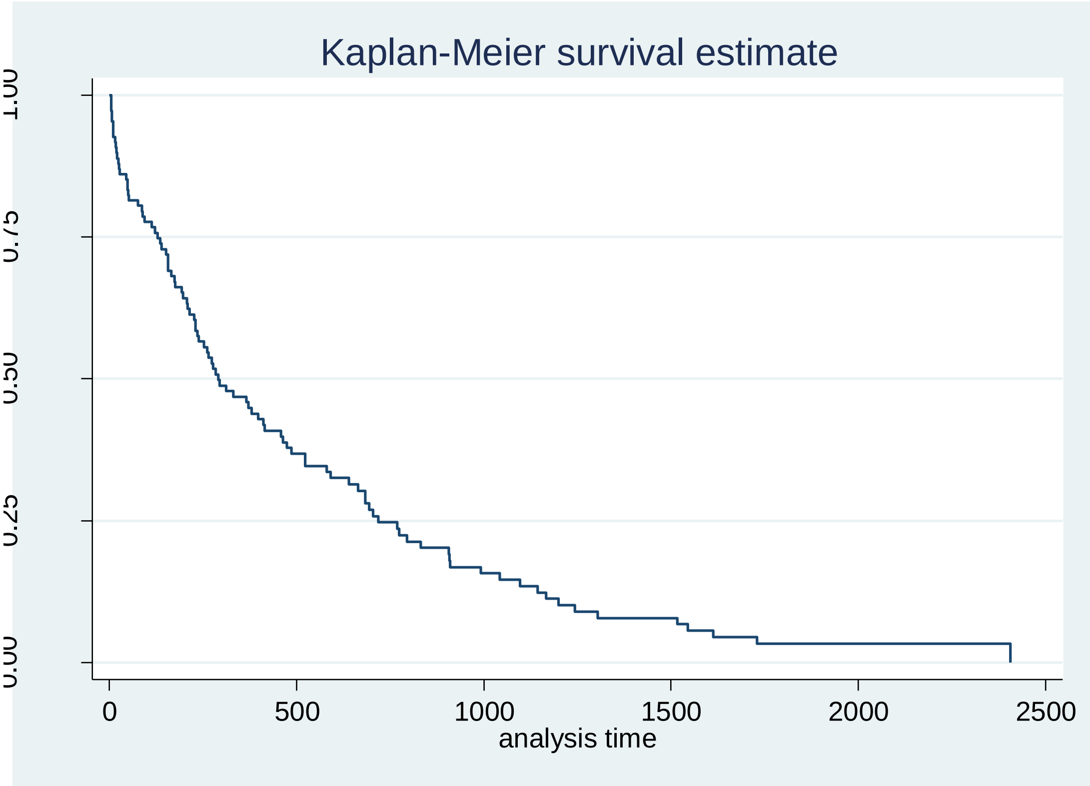


TABLE 6.3. Duration Analysis

	Model 1	Model 2	Model 3	Model 4
Country-level Terrain Roughness	.8245 (.1246)	-	-	-
Conflict-zone-level Terrain Roughness	-	.9683 (.1217)	-	-
Separation-zone Terrain Roughness	-	-	1.0461 ** (.0232)	-
Separation-zone Terrain Roughness (Alt)	-	-	-	.2681 (.2201)
Distance	1.0958 ** (.0493)	1.0936 ** (.0489)	-	.8318 (.2921)
Mechanization	1.0555 (.1306)	1.0797 (.1372)	1.0789 (.1254)	.8656 (.2636)
Urbanization	2.9104 (2.4319)	3.2029 (2.6770)	2.0480 (1.7099)	.2495 (.5295)
Minority Groups	1.0329 (.0847)	1.0170 (.0825)	1.0269 (.0391)	.8309 (.1305)
Cross-border Sanctuary	.5506 ** (.1349)	.5719 ** (.1402)	.5349 *** (.1224)	.8620 (.5088)
State Power	.7016 *** (.0812)	.6975 *** (.0809)	.7024 *** (.0819)	1.1349 (.3212)
Area	1.0048 (.1011)	1.0084 (.1029)	1.0093 (.1032)	1.7798 (.6872)
Battle Deaths/Year	1.2298 *** (.0894)	1.2193 *** (.0919)	1.1926 ** (.0895)	1.3577 (.2809)
Start Year	1.0117 (.0114)	1.0092 (.0116)	1.0094 (.0112)	1.0556 ** (.0256)
	n=109	n=109	n=109	n=30

* p<.10
** p <.05
*** p <.01
standard errors in parentheses

The Cox regression was run for each of the three measures of terrain roughness as well as for the alternative measure of separation. Terrain roughness reached significance only in the third model, in which it suggests separation increases the likelihood of conflict termination. In the first two models, country-level terrain roughness and conflict zone terrain roughness both correspond with longer conflicts though fail to reach statistical significance. The distance of the conflict zone from the capital significantly predicts shorter conflicts in both models one and two. Though this is consistent with the result in model three, in which distance is omitted to avoid multicollinearity since the separation zone roughness could also be described as a two-dimensional distance gradient. These results are inconsistent with Buhaug, et al. (2005, 2009) who suggest country-level terrain roughness corresponds with longer conflicts, which in this study fails to reach significance. Perhaps more interesting is that Buhaug et al.'s conclusion that distance of the conflict zone from the capital is strongly associated with longer conflicts (412, 2005), while in this study the distance from the conflict zone to the capital is associated with shorter conflicts, significant at $p<.05$. Counterintuitively, mechanization and the number of concentrated minority groups appear to be associated with shorter conflicts, though only slightly so and failing to reach statistical significance. Urbanization, likewise, appears to be associated with shorter conflicts, though failing to reach significance. The size of the territory in which the conflict was fought fails to reach statistical significance but the hazard remains close to 1. The hazard ratio for the start year also remains close to 1 and only State power is significantly associated with longer conflicts at $p<.01$, this relationship remained significant when the models are run on the pre-matched dataset (not shown) which included the most powerful outliers though the hazard ratios were slightly closer to 1. While from the model it appears that terrain roughness offers little advantage as a place of refuge, the presence of a cross-border sanctuary does significantly increase the duration of conflict. This relationship becomes even stronger (with hazard ratios closer to zero and lower standard errors) in each model for the pre-matched data (not show). The average annual battle death rate is strongly and significantly associated with shorter conflicts which is consistent with the notion of cost sensitivity among both rebels and incumbents. In the fourth model, which measures the effect of separation-zone terrain roughness among only conflicts separated from the capital. Only start year reaches statistical significance with a hazard ratio that remains close to 1. These results are unsurprising, given that only 40 of the conflicts occurred entirely outside of the capital, ten of which were pruned from the dataset during the matching process.

2. Casualties

Because of the possibility that duration and casualties are jointly determined, in which longer conflicts can lead to an escalation or de-escalation of violence and, at the same time, an escalation of violence or de-escalation of violence could prolong conflict, or in other ways potentially related, I employ Seemingly Unrelated Regression models to measure the effects of separation on casualties. Though they could be included as censored cases for the duration analysis, all conflicts continuing as of January 1, 2006, in other words exceeding the period of observation for the Correlates of Insurgency dataset, were dropped for this phase of the analysis.

TABLE 6.4. SUR Analysis to Test the Effects on Casualties

	Model 2	Model 3	Model 4	Model 5
Duration (Weeks)				
Country-level Terrain Roughness	13.0045 (55.0326)			
Conflict-zone-level Terrain Roughness		-32.6315 (39.3491)		
Separation-zone Terrain Roughness+			-12.6008 (9.1486)	
Separation-zone Terrain Roughness (Alt)				150.2144 (209.9177)
Distance+	-21.0615 (18.6477)	-21.0500 (18.5288)		174.8037 (86.8244)
Mechanization	-19.6202 (47.7442)	-21.6753 (47.6503)	-19.8974 (47.5766)	-97.9839 (83.6736)
Urbanization	-84.3158 (345.3548)	-136.6446 (338.6209)	-53.8762 (339.879)	694.5061 (588.5206)
Minority Groups	.5868 (33.4491)	4.5889 (32.9948)	2.5395 (32.5308)	28.2741 (44.0931)
Cross-border Sanctuary++	281.019*** (100.7385)	274.3134*** (100.345)	278.4435*** (100.2242)	43.7151 (179.7305)
State Power+	90.6278** (42.4600)	97.2484** (42.1742)	94.2311** (41.8294)	33.1044 (76.9056)
Area+	-4.8891 (37.5513)	-8.4893 (37.5099)	-9.6639 (37.3816)	-342.542*** (111.8892)
Start Year	-5.5273 (3.8886)	-5.6091 (3.8726)	-5.6025 (3.8706)	-19.5692*** (7.3890)
Constant	1244.212* (695.3853)	1389.141** (690.6032)	1343.286** (682.1448)	4774.289*** (1563.24)
RMSE	422.3321	420.9965	421.249	329.8655
"r^2"	0.1683	0.1736	0.1726	0.3855
chi^2	19.65	20.42	20.31	17.2
p	0.0202	0.0155	0.0092	0.0457

TABLE 6.4 (cont.). SUR Analysis to Test the Effects on Casualties

		Model 2		Model 3		Model 4		Model 5	
Casualties (average annual battle deaths+)									
Country-level Terrain Roughness		.3995	**						
		(.2009)							
Conflict-zone-level Terrain Roughness				.3156	**				
				(.1441)					
Separation-zone Terrain Roughness+						-.0329			
						(.0346)			
Separation-zone Terrain Roughness (Alt)								1.4318	**
								(.6688)	
Distance+		-.1022		-.1172	*			-.4693	**
		(.0682)		(.0676)				(.2031)	
Mechanization		.4565	***	.4706	***	.4624	***	.6742	***
		(.1750)		(.1745)		(.1801)		(.2510)	
Urbanization		-.0126		-.2135		-.4303		3.6337	**
		(1.2562)		(1.2327)		(1.2786)		(1.6738)	
Minority Groups		-.0643		-.0485		-.0547		.1164	
		(.1222)		(.1205)		(.1227)		(.1398)	
Cross-border Sanctuary++		.1411		.1273		.0712		.3408	
		(.3621)		(.3598)		(.3712)		(.5462)	
State Power+		.1361		.1351		.1519		.0196	
		(.1372)		(.1365)		(.1397)		(.2436)	
Start Year		-.0308	**	-.0277	**	-.0287	**	-.0591	***
		(.0140)		(.0138)		(.0143)		(.0201)	
Constant		8.1247	***	8.0419	***	8.5178	***	8.5222	***
		(1.0866)		(1.0855)		(1.0747)		(2.4641)	
		n=97		n=97		n=97		n=28	
* p<.10	RMSE	1.5497		1.5432		1.5958		1.0506	
** p<.05	"r^2"	0.1549		0.1619		0.1039		0.6459	
*** p<.01	chi^2	17.78		18.74		11.24		51.07	
+ logged variable ++ dichotomous variable	p	0.0229		0.0163		0.1283		0	
standard errors in parentheses									

The duration portion of the analysis is largely consistent with the Cox Proportional-hazard models in the previous section despite the change from a non-parametric model to a linear model and the omission of right-censored cases. State power and the availability of a cross-border sanctuary continue to be significantly associated with longer conflicts, while each of the terrain roughness variables fail to reach significance.

The analysis on casualties differed surprisingly from the duration analysis. Both country-level and conflict-zone-level terrain roughness are significantly associated with a larger number of casualties. The separation-zone roughness measure fails to reach significance, though is associated with a lower number of casualties. Similarly, distance from the capital is associated with a lower number of casualties, reaching significance in model 6 and model 8 (which contains only conflicts which took place outside of the capital). However, in model 8 the average value of roughness in separation zone is significantly associated with higher casualties. This suggests terrain, unrelated to distance has some effect on the state's application of violence. The strongest predictor of casualties, reaching significance at $p<.01$ in all four models, is Lyall's measure of mechanization. Start year weakly and significantly predicts a lower number of casualties suggesting a temporal trend of insurgency wars becoming less violent. The level of urbanization reached statistical significance as a predictor of higher casualties in model 8 suggesting that this particular conflict type, conflicts fought away from the capital, may have different dynamics than those in which the fighting takes place in or near the capital. It is worth examining each conflict type separately to see if covariates have different effects on each type.

TABLE 6.5. Comparing Conflict Types with SUR Analysis

	Model 9		Model 10	
Duration (Weeks)	Capital-adjacent		Separated	
Conflict Zone Terrain Roughness	-31.8030		-33.2378	
	(53.7341)		(58.1457)	
Mechanization	-21.2848		-72.3737	
	(56.6270)		(88.8081)	
Urbanization	145.4025		-121.7918	
	(449.0899)		(543.0045)	
Minority Groups	11.3242		13.0564	
	(58.9149)		(43.3373)	
Cross-border Sanctuary++	252.8437	**	239.2111	
	(127.0513)		(173.4365)	
State Power+	98.9465	*	121.7345	
	(52.0654)		(78.0702)	
Area+	6.8784		-191.4812	**
	(43.6761)		(87.3334)	
Start Year	-4.3492		-18.1052	**
	(4.5802)		(7.9797)	
Constant	1124.617		4342.768	***
	(809.003)		(1623.443)	
RMSE	427.8123		361.0472	
"r^2"	0.1987		0.2639	
chi^2	17.11		10.9	
p	0.029		0.2074	

TABLE 6.5 (cont.). Comparing Conflict Types with SUR Analysis

		Model 9		Model 10	
Casualties (average annual battle deaths+)					
Conflict Zone					
Terrain Roughness		.2110		.4782	
		(.1870)		(.1667)	
Mechanization		.2980		.6198	**
		(.1962)		(.2468)	
Urbanization		-4.5876	***	5.0504	**
		(1.5579)		(1.5602)	
Minority Groups		-.0489		.0195	
		(.1702)		(.1230)	
Cross-border Sanctuary++		.1979		-.2138	
		(.4290)		(.5000)	
State Power+		.1673		-.1332	
		(.1538)		(.2064)	
Start Year		-.0145		-.0447	**
		(.0158)		(.0189)	
Constant		8.9611	***	4.7137	***
		(1.1797)		(1.6752)	
		n=69		n=28	
* p<.10	RMSE	1.49		1.0422	
** p<.05	"r^2"	0.1824		0.6515	
*** p<.01	chi^2	15.39		52.34	
+ logged variable	p	0.0313		0	
++ dichotomous variable					
standard errors in parentheses					

From models 9 and 10, one can see clear differences in the variables that correlate with both duration and casualties suggesting that mere location does not capture the difference between each type of conflict. It appears that rough terrain within the conflict zone is strongly associated with higher casualties only for separated conflicts. The same regressions were run with country-level terrain roughness (not shown), however it failed to reach statistical significance in either model, while the rest of the covariates performed similarly. Urbanization significantly predicts a lower number of casualties in conflicts in which fighting occurs in and around the capital, while predicting a higher number of casualties in conflicts fought away from the capital. While mechanization continues to be associated with a higher number of casualties for each conflict type, it only reaches statistical significance for remote conflicts. Similarly, start year only remains a significant predictor of lower casualties among remote conflicts.

The duration analysis offers similar discrepancies. State power and the availability of cross-border only reach statistical significance for capital-adjacent conflicts, though the coefficients displayed the expected signs for separated conflicts. Similarly, area becomes a strong and significant predictor of shorter conflicts among those fought away from the capital, as does the start year.

The next chapter will examine these results in greater depth with respect to the core hypothesis and underlying assumptions about conflict and its corroboration with and challenges to existing literature within political science. It will also discuss limitations that may have impacted the results and the ability to draw conclusions from them. Finally, it will discuss avenues for further research.

Chapter VII: Discussion

From the results of the quantitative analysis, several of the variables reached statistical significance and provide insight on conflict duration and states' willingness to apply violence as well as providing new direction for future conflict research. However, before discussing the results and their implications for the hypotheses, the limitations of this study must be acknowledged. Like other methods within political science, cross-national quantitative studies can provide only a limited portrait of the forces that influence conflict. In this instance both the available data and methodology may have biased the results.

1. Limitations with Casualty Data

A cursory examination of the dataset assembled by (Lacina and Gleditch 2005) demonstrates the level of difficulty in compiling battle death statistics cross-nationally. The variance between the high and low estimates were often considerable and in some instances set at threshold levels for other datasets. For example, a conflict included in Lacina and Gleditch (2005) but not, for example, in Fearon and Laitin (2003) may have a high estimate of 999 on the assumption that it was excluded from Fearon and Laitin for failure to reach the casualty threshold of 1000 battle deaths per year. Because they assembled casualty data from multiple sources, they risk several potential reporting biases. Some researchers documenting the number of battle deaths in conflict may use different qualifications for what constitutes a battle death or may have varying abilities or inclinations to distinguish between true conflict-related deaths and other instances of violence. Similarly casualty estimates obtained from personal accounts may under- or overestimate, while estimates obtained from government or non-government organizations may suffer inaccuracies due to vested interests in understating or overstating the severity of the violence to encourage or discourage intervention, to demonize one side of the conflict to a global audience, or to better preserve the appearance of their own innocence.

The timing of the research relative to the timing of the conflict may have also impacted collection abilities. Estimating casualties in more recent conflicts allows researchers to draw upon multiple sources including newer technologies that allow for better communication and documentation, though *Start Year* may control for these variations.

The larger potential issue with using battle death data from Lacina and Gleditch (2005) is the aggregation of deaths at the hands of the government and deaths at the hands of the insurgents. The compilation of disaggregated casualty data would subject the similar constraints as the collection of total casualty data. Without distinguishing between whether the government or the rebels inflicted the casualties, this study risks the results being heavily influenced by conflicts in which one ethnic group massacred another, potentially inflicted a large number of casualties while the government may have exercised restraint in its attempt to control the fighting.

Similarly, the study is predicated on the assumption that a higher level of casualties corresponds to a higher level of indiscriminate violence, which may not always be the case. As Kaylvas (2006) describes, indiscriminate violence is difficult to measure cross-nationally and the approach is not always clear from mere casualty statistics (48-49).

2. Limitations with Geography Data

While the conflict zone size and location data in PRIO's Armed Conflict Data Set provide a better indication of where the conflicts took place than assuming the fighting took place throughout the country (as many cross-national studies that included geography variables do), it fails to capture the concentration of the fight as well as failing to account for spatial-temporal variation. Because of the way the data is reported, in terms of a center point and radius, it is unclear if the fighting occurred equally throughout the circular area or if the circular area was enlarged to accommodate an isolated confrontation or attack outside of the regular conflict zone. The conflict zones also say nothing of potential variations in battlefields or conflict dynamics. For example while rebels may be engaging in guerrilla warfare in a remote region, the conflict may look quite different in urban areas, involving acts of terrorism or assassination attempts. Similarly, a conflict zone may have been drawn to include several urban areas in which the conflict was fought, or may have only occurred in remote regions but included relatively calm urban areas as a mere by product of using a center point and radius to identify the conflict zone. As Kalyvas (2006) mentions, a common misconception of civil war is that fighting occurs in all areas all the time rather (117-118). Similarly, larger conflict zones may be endogenous to longer conflicts, in other words, all other things being equal, all conflicts may eventually spread to the capital if they last long enough.

In addition, because the geographic designation of "conflict zone" does not always imply the same level of fighting across observations, the casualty numbers become more difficult to normalize for population size. In other words, while a per capita measure of casualties might be more appropriate, examining casualty data as portion of the total population may skew the results for large countries fighting conflicts in remote regions. Similarly, attempting to normalize casualties for conflict zone size suffers from the same potential problem. The inability to account for spatial-temporal variation limits the explanatory power of a measure of casualties per geographic unit such as casualties per 100 sq km. For example, some conflicts may begin in remote regions and remain isolated for several years before expanding to a larger conflict zone or the whole country. In which case it would appear from the spatial data that the conflict was fought over a very large area for its full duration.

3. Limitations with Methodology

Methodologically, Cox Proportional-hazard Models allow for testing whether the presence of a covariate makes it more or less likely that a conflict will terminate at time, t, than if the covariate were not present. However, the absence of observations in which conflict did not occur may introduce bias when testing the effects of terrain roughness. Because some conflicts may be predicated on the existence of rough terrain, including observations in which conflict did not occur would reduce this bias assuming in at least some cases, it did not occur as a result of the absence of the independent variable. Other studies (Fearon and Laitin 2003) utilize logistical regression to account for these unobserved conflicts when exploring the determinates of conflict onset. Such an approach bears some similarity to Cox Proportional-hazards Model and other event-timing models in terms of determining which covariates correlate to an event occurring after periods in which the event (in the former, conflict onset, and in the later, conflict termination) did not occur. However, logistical regression does not account for censored observations, in this case, conflicts continuing beyond the period of observation, so using that approach for this analysis may have simply traded one potential bias for another. An alternative approach would be to use some form of truncation in which both non-conflict observations and censored cases could be accounted for.

While Coarsened Exact Matching allowed the dataset to be pruned of outliers that might disproportionately influence the results, the CEM software package developed by

(King et al. 2009) could not be fully utilized. After grouping the data into strata based on a specified covariate (in this case power), the program assigns weights to each observations according to the number of treated (in this case, separated) and control (capital-adjacent conflict) cases within its strata to create equally weighted treated and control groups. Observations within a strata that contained only treated or only control cases were given a weight of zero. Unfortunately the Stata commands that run Cox Proportional-hazard Models and Seemingly Unrelated Regression Models do not allow for the weighting of observations. To accommodate this limitation, all observations with a CEM weight of zero were dropped. While this limitation of not fully utilizing the functionality of the CEM software packages may have preserved some of the bias that this method is intended to reduce, its function of pruning the dataset of outliers offered more comparable groups than existed prior to matching.

Another limitation, which the use of Coursened Exact Matching exacerbated, was the number of observations. Although regression analysis for a dataset with 120 observations does not necessarily pose an issue, a limited number of casualties separated from the capital 40, reduced to 30 after dropping powerful outliers and further reduced to 28 once censored cases are dropped for the SUR models greatly limits the potential for this data to offer significant results.

4. The Underlying Assumptions

Both the summary statistics and regression results offer support many of the underlying assumptions upon which the theory is based. The summary statistics suggested that remote conflicts in which none of the fighting takes place in the capital tend to happen in more powerful states. As previously mentioned, prior to matching the mean for power among separated conflicts was five times higher than for capital-adjacent conflicts. Matching reduced this differential but only to the point where the mean of power for separated conflicts is twice that of capital adjacent conflicts. The assumption that a high value for *State Power* covariate correlates to both the application of treatment, *Separation,* and the independent variable appears to be true for the duration analysis. In the first three duration models, power was strongly associated of longer conflicts with high levels of significance. Power continues to be significant in the duration portion of the SUR model for each of the first three models. Though interestingly, power is not a significant predictor of casualties.

Casualties were the strongest and most significant predictor of shorter conflicts in the first three models. This is consistent with the notion that incumbents, rebels, and non-combatants will behave in such a way that most effectively brings about an end to the violence or limits their exposure.

5. Terrain, Separation, and Duration

From the first two models in the duration analysis, neither of the terrain estimates reaches statistical significance though each, consistent with conventional wisdom, is associated with longer conflicts. However, country-level roughness is, albeit with slightly larger standard error, associated with longer conflicts more so than conflict-zone terrain roughness. In the SUR models in which the casualty variable is omitted, 5 and 6, neither reaches significance but country-level terrain roughness continues to be associated with longer conflicts while conflict-zone-level terrain roughness is associated with shorter conflicts. This bears some semblance to Buhaug, et al. (2005, 2009) which found terrain roughness at the country-level significantly associated with longer conflicts while finding conflict level terrain roughness associated with shorter conflicts but failing to reach conventional statistical significance. In other words, in this study as well as in Buhaug, et al. (2005, 2009) there is greater reason to believe that terrain roughness at the country-level is associated with longer conflicts than terrain roughness at the conflict-zone-level.

In attempting to engage Buhaug, et al. (2005, 2009) and explain the counterintuitive result, some differences in the data between the two studies should be acknowledged. First, while Buhaug, et al. (2005, 20009) pooled civil war observations with varying battlefield dynamic, this study included only cases in which insurgency was the primary battlefield tactic. The notion that rough terrain provides an advantage in guerrilla warfare suggests that restricting the data to exclude wars fought conventionally would increase the salience of terrain roughness. This may explain the shift in the conflict-zone roughness variable from an association with shorter conflicts in Buhaug, et al. (2005, 2009) to an association with longer conflicts in the Cox Proportional-hazards Models, albeit not reaching statistical significance in either case. Though the same data was used to calculate terrain roughness, the method of calculation differed considerably. In Buhaug, et al. (2005) the UNEP data was transformed from the 7-tier scale to a dichotomous 1 for mountainous and 0 for non-mountainous and measured as a logged percentage (407) rather than an average value for each geographic section (country or conflict zone). It is possible that the slight differences in results or the lack of effect from a more appropriate case selection may have occurred due to differing calculation methods. However, because this study incorporates the 7-tier scale for differing levels of terrain roughness, it provides a more appropriate measure. It appears that while refuge may be necessary to allow rebels to prolong insurgency wars, refuge may be better obtained through a cross-border sanctuary in a neighboring state.

This study sought to address this counterintuitive result by posing an alternative explanation: that geographic separation between the conflict-zone and the capital by rough terrain would lead to greater levels of indiscriminate violence which would prolong the conflict. However, the duration analysis fails to support this theory. The separation-zone roughness variable tested in Model 3 is significantly associated with shorter conflicts. Consistent with this result in Models 1 and 2 is the distance between the conflict zone and capital reaching significance as well as being associated with shorter conflicts. These results differ substantially from Buhaug et al. (2009) finds distance to the capital to be the strongest and most significant predictor of longer conflicts.

For this reason, Hypothesis 1, that separation will be associated with longer conflicts, is not supported. These results suggest the opposite may be true; conflicts fought in remote regions separated by rough terrain are shorter than those fought in which some of the fighting takes place in the capital. One potential explanation for this would be there are fundamental differences in the type of conflict fought in a remote region and those fought in and around the capital. It is possible the grievances of rebels fighting in remote areas are easier to address than the demands of rebels who attack the state in its urban stronghold. For example, if the conflict involves a minority group seeking greater representation, or a rural population seeking more equitable distribution of resources, the incumbent may find it easier to offer concessions than continue to fight. Similarly, conflicts in which fighting has spread to the capital may correspond with a desire for a complete regime change.

6. Terrain, Separation, and Casualties

Both country-level and conflict-zone-level terrain roughness are significantly associated with a greater number of casualties independent of whether the conflict had some fighting occur in the capital. However, the separation-zone-level of terrain roughness is associated with lower casualties but failed to reach significant. In model 8, which measures only variation between conflicts fought in remote regions, the average value of mountainous terrain in the separation zone (regardless of the size of the separation zone) is strongly and significantly associated with higher casualties. Interestingly, in the same model distance is significantly associate with lower casualties, suggesting that a shorter distance with more mountainous terrain leads to higher casualties while, potentially, a longer distance with less mountainous terrain might lead to fewer. This coincides with Scott's (2009) notion that separation over mountainous terrain creates more salient divisions than separation over longer distance of flat terrain or water. However, these results fail to support Hypothesis 2 and it appears separation does not lead to a greater number of casualties. As previously mentioned a higher number of casualties may be endogenous to larger conflict zones.

While it is not entirely clear why a greater distance from the capital would result in fewer casualties, mountainous terrain appears to be associated with higher levels of casualties. The fact that it reaches similar levels of significance for both conflict-zone- and country-level terrain roughness suggests that either given that a state has mountainous terrain the conflict will likely occur in that terrain or that states with rough terrain carry out counterinsurgency campaigns in a similar manner of using indiscriminate violence. For example a state with a large amount of rough terrain that is difficult to police may attempt to rely more on technology that would allow for better reach into remote locations without developing and maintaining local infrastructure. We also see mechanization strongly and significantly correlated with a higher number of casualties in models . This is consistent with Lyall and Wilson III's (2009) hypothesis that mechanization will result in greater levels of indiscriminate violence due to the incumbents inability to distinguish between insurgent and non-combatant if they have limited contact with the local population. Models 9 and 10, ran the SUR models separately for each conflict type also suggest that mechanization is a more salient predictor of casualties in separated conflicts, while the same variable failed to reach significance for capital-adjacent conflicts. While a greater level of rough terrain within a country may provide an incentive for the incumbent to develop a more mechanized force, a negative correlation between mechanization and mountainous terrain (-.0482) suggest this is not the case. The ability to develop a military force with a large number of armored vehicles requires substantial resources, merely the need for a mechanized force may not be enough to develop one. Alternatively, mechanization, defined by Lyall and Wilson III (2009) as the ratio of military personnel to military vehicles, may not capture other factors such as air power that may be developed to cope with having a significant amount of rough terrain to control and correspond to a larger number of casualties via strategies of indiscriminate violence such as bombings.

When examining whether different factors influence duration and casualties in separated and capital-adjacent conflicts by using SUR models, it appears there are other distinguishing factors beyond geography. Though the strongest predictors of longer conflicts in the original models, state power and the presence of a cross-border sanctuary fail to reach significance for separated conflicts, though they take the expected direction. Area and start year are both associated with shorter duration for separated conflicts, each of which seems counterintuitive.

Perhaps most interesting is the role of urbanization, which failed to reach statistical significance in any model which pooled conflict types. In capital-adjacent conflicts we see urbanization strongly and significantly correlated with lower casualties, while for remote conflicts the same variable is strongly and significantly correlated with higher casualties. There are several potential explanations for this difference. The first is that urbanization may correspond with some other variable such as the country's stage of development which might influence both how they apply violence and the type and location of conflicts they are likely to face. The second, which falls more closely in line with the theory, is the notion of cost sensitivity and that a state may be less willing to apply indiscriminate violence where the majority of its constituents live and where it may substantially disrupt public life. Conversely, if the rebellion occurs in an area that is relatively sparsely populated, the incumbent may be less hesitant to employ tactics of indiscriminate violence. Last, which relates to both the first two explanations, urbanization may exacerbate identity problems in remote areas while diminishing them in urban areas. In other words, incumbents, where they have the highest concentration of resources and security infrastructure, may be better able to indentify insurgents in urban areas. A state with a highly dispersed population may develop security infrastructure to better provide it with information in rural areas, while one in which a greater percentage lives in urban areas may rely on technology and more mechanized forces to provide security to outlying areas. A relatively high correlation (.4778) between urbanization and mechanization suggests this could be true.

7. Linking Casualties and Duration

While the proposed theory suggests that separation between the capital and conflict zone will lead incumbents to administer indiscriminate violence (measured in casualties) and in turn exacerbate grievances against the incumbent leading to longer duration, the results offer little support. However, the analysis does suggest a strong relationship between casualties in duration in terms of cost sensitivity. For this reason it is interesting, despite lower casualty numbers, that separated conflicts still appear to be shorter than those fought in or around the capital. Particularly since the variables associated with higher casualties in remote conflicts suggest use of indiscriminate violence, such as more mountainous terrain or a higher level of mechanization. One possible explanation is that indiscriminate violence may be more effective in bringing the conflict to an end. This is consistent with an argument put forth by Valentino, et al. (2004), "The logic of guerrilla war has often led military and political leaders to conclude that the massive killing of civilian populations may be a bloody but effective solution to the seemingly intractable problems of guerrilla warfare" (384). Though the absolute number of casualties in comparison with other types of conflicts may appear relatively small, this measure does not capture the percentage of persons killed within the conflict area which may, comparatively, be much larger. The unwillingness to apply indiscriminate violence as may be the case in urban areas or areas in which the state absorbs the cost in social and economic terms might lead to an expansion of violence in its geographic scope in terms of the size of the area in which it occurs and its social scope in terms of its uses in settling personal vendettas under the guise of conflict-related violence as Kalyvas (2006) describes. Although the results do not directly support the theory, there is some indication that states may be more inclined to administer indiscriminate violence in remote regions to a point where cost sensitivity among all parties is salient enough to bring about an end to the conflict.

8. Avenues for Further Research

Although the analysis supported neither hypothesis, the findings did offer strong support for the assumptions on which the theory is based, suggesting that perhaps the link between separation, casualties, and duration may not have been thoroughly explored.

Improved data, such as disaggregated casualty estimates that contain the number of casualties sustained by the incumbent and those inflicted by the incumbent might provide portrait of how states apply violence across different geographies. Similarly, temporal-spatial data for where conflicts are fought and more clearly illustrate how conflicts expand or are contained over time might reduce potential endogeneity problems with larger conflict zones and longer duration or larger conflict zones and higher casualties.

The Cox Proportional-hazards models clearly suggests a relationship between a higher number of casualties and shorter conflict duration. However, conflict duration may impact an incumbent's willingness to apply violence at a given time. For this reason, estimating duration and casualties jointly might provide more accurate results without the need for removing censored observations as was required for the SUR models.

Because of the difficulty obtaining reliable cross-national estimates of casualties and geography data that would account for both conflict density and spatial-temporal trends, the relationship between separation, casualties, and duration might better be observed through qualitative research. Data collection through interviews to identify whether violence was selective or indiscriminate might more clearly indicate whether geography and spatial separation really do limit whether states abilities to identify insurgents. Sub-national survey research might also help illustrate if or under what circumstances an increased number of casualties or the use of indiscriminate violence increases rebel resolve and non-combatant support.

Perhaps the clearest opportunity for further research is the role urbanization and its different conflict geographies. The substantial differences in direction of the urbanization covariate when each conflict type is examined separately suggest that either identification problems, reduced cost to the incumbent or both make higher levels of casualty more likely if the conflict is fought away from the capital. Rather than physical terrain creating a sense of separation between the incumbent and those in the conflict zone, population dispersion may create a sort of human terrain which as more salient effects. Similarly, although Lyall and Wilson III's (2009) mechanization theory corresponds with decline in incumbent victories, it might be worth exploring what factors lead states to develop their militaries with a higher ratio of armored vehicles to personnel.

Chapter VII: Conclusion

In seeking to provide explanation for the lack of consensus among quantitative studies on the role of terrain roughness, this study yielded rather surprising results. While the theory suggested that spatial separation between the conflict zone and capital would increase casualties leading to longer conflicts, instead, separation led to both fewer casualties (though failing to reach significance) and shorter conflicts. Using an arguably better measure of terrain roughness with a more appropriate case selection criteria, the results suggested rough terrain provides a disadvantage to rebels rather than an advantage. In failing to reach significance in its association with longer conflicts for either the country-level or conflict-zone-level terrain roughness, it suggests an insufficiency in offering rebels refuge as they attempt to engage the state in a protracted conflict. Instead it appears from the SUR analysis, that rough terrain is associated with higher casualties, offering partial support for the theory in that it appears states may be more inclined to apply indiscriminate violence in areas with rough terrain. These results must be interpreted with caution, in addition to methodological constrains, a higher number of casualties may not be indicative of indiscriminate violence.

The results not only failed to explain the counterintuitive result in Buhaug et al. (2005, 2009), but offered collaboration in suggesting that there is greater reason to believe that countries with mountainous terrain may have longer conflicts, despite the assertion that terrain most valuable if it offers refuge to rebels engaging in guerrilla warfare. The results also offered collaboration to previous literature. Despite Lyall and Wilson III's (2009) aversion to casualties as a dependent variable (72), its use does lend strong support to their theory that a more mechanized force will lead to greater use of indiscriminate violence, though with the caveat that the effects of mechanization are most salient in remote conflicts.

The former coincides with the findings of Schutte (2012) that a larger percentage of the population living far from the capital leads to higher casualties. This finding may also lend credence to the value of casualties as a proxy for indiscriminate violence in cross-national research.

This study also brought to light a number of methodological constraints when examining power, duration, and casualties for cross-national analysis. The potential for joint-estimation of duration and casualties in future studies might better be able to illustrate the relationship and determine whether cost sensitivity (in terms of casualties) reduces fighting or whether high levels of violence beget more violence, and determine whether these trends vary across different geographies.

However, perhaps the most substantial contribution of this study is highlighting the significance of urbanization in how states choose to apply violence in different types of conflicts. Intending to help establish the relationship between a conflict's location and how it was fought, the comparison of SUR analyses for each type of conflict, separated and capital-adjacent, provided the most insight. Though it failed to emerge as significant in either phase of the analysis when the conflicts types were pooled, examining it for both separated and capital-adjacent conflicts individually offered a compelling avenue for further research. Furthermore, the association of urbanization with higher casualties in remote conflicts, while being associated with lower casualties when some of the fighting takes place in the capital suggests these conflict types differ in ways beyond their proximity to the capital. The salience of some variables among separated conflicts and others among capital-adjacent conflicts further illustrates this difference. Despite the increasingly common assertion that improvements in communication and transportation technology make distance and geographic separation less significant in a modern age, it still appears that where conflicts are fought substantially influences how conflicts are fought.

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