Poverty and Civil War Events
A Disaggregated Study of Liberia

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This article examines the link between subnational poverty and the location of civil war events. Drawing on the ACLED dataset, which breaks internal conflicts down to individual events at the local level, we take a disaggregated approach to the study of conflict. Local-level socioeconomic data are taken from the Liberian Demographic and Health Survey. With geographical cells of approximately 76 km² as units of analysis, we test how absolute and relative welfare affect the presence and number of conflict events during the 1989-2002 Liberian civil war. We control for neighboring conflict events, distance to Monrovia and national borders, population density, diamond deposits, and ethnic affiliations. War events were more frequent in the richer locations. This may provide better support for “opportunity” explanations than for “relative deprivation” theories of conflict, but we argue that the relative weakness of the Liberian government makes it difficult to distinguish between the two.

Keywords: civil war; poverty; Liberia; disaggregated data; GIS

The direct link from economic development to domestic peace is among the most robust findings in empirical studies at the country level (see, e.g., Collier and Hoeffler 2004; de Soysa 2002; Fearon and Laitin 2003; Hegre and Sambanis 2006). However, although there is agreement on the existence of this empirical relationship, there is no consensus on the theoretical explanation for it. Fearon and Laitin (2003) maintain that gross domestic product (GDP) per capita is a proxy for state capacity,
indicating that richer regimes are better able to monitor the population and implement effective counterinsurgency strategies. Collier and Hoeffler (2004), on the other hand, focus on the viability of rebellion movements through opportunity costs for potential rebels. Neither Collier and Hoeffler nor Fearon and Laitin attribute the relationship to the poverty of populations as such. This is partly because they both conclude that economic inequality (between individuals) does not increase the risk of conflict.

These studies compare income levels between countries. The theoretical arguments regarding poverty and conflict, however, all have implications for where within countries we would expect to see civil wars. This applies to theories of relative deprivation (Davies 1962; Gurr 1970), the opportunity arguments (Collier and Hoeffler 2004; Fearon and Laitin 2003), and the impact of “horizontal inequalities,” or systematic inequality between identity groups (Ostby 2008; Stewart 2002). Country-level studies are in danger of masking the impact of processes central to these arguments. Conflicts are often local. Country-level measures of average horizontal inequality, for instance, may fail to capture the relevant groups or the relevant dimension of inequality. The horizontal inequality argument only requires one underprivileged group to predict conflict. If the rest of the population in the country is homogenous or members have small income differences, a country-level measure would be attenuated and unable to capture this.

This article examines the importance of absolute and relative poverty using data at the subcountry level, exploring the implications of these arguments for where, within countries, conflicts occur. We investigate the link between local levels of poverty and the location of actual fighting in a conflict. This exercise requires a careful examination of the implications of the theoretical arguments for the observed outcomes.

Using Geographic Information System (GIS) software, we convert the territory of Liberia into grid squares of approximately 8.5 km x 8.5 km. Based on geographically referenced data from the 1986 Demographic and Health Survey (DHS) in Liberia, we calculate local-level measures of economic wealth operationalized as an index of household consumer durables. The conflict data is derived from the Armed Conflict Location and Event Dataset–ACLED (Raleigh, Hegre, and Carlsen 2009),

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which disaggregates internal conflicts into individual events, covering the Liberian civil war 1989-2002. The data are analyzed by means of a zero-inflated negative binomial model.

The next section provides a theoretical framework for studying the relationship between spatial distributions of welfare and the location of conflict. We develop the concepts “support level” and “target value.” These, we argue, are not easily testable in themselves, but are necessary to formulate implications of central theoretical arguments that we can test with our data. The third section introduces the Liberian case and provides a narrative of the course of the civil war. In the fourth section, we present the data and research design. The fifth section provides the empirical results. The analysis indicates that civil war events predominantly happened in the relatively richer locations of Liberia. We argue that this finding may be consistent both with opportunity and relative deprivation explanations, if we take into account that the Liberian rebel groups were strong relative to the central government. The last section concludes.

**Theoretical Framework: Support Level and Target Value**

We seek to identify how poverty affects the location of civil wars. To investigate this, we analyze a straightforwardly observable entity: clashes between the government and a rebel group. News source reports detailing the time and place of such “conflict events” are compiled in the ACLED data set (Raleigh, Hegre, and Carlsen 2009).

Many theoretical accounts of civil war take local issues and center-periphery relations into account. Relative deprivation arguments, for example, imply that the population of locations that are relatively poor and are marginalized by the central government should be more likely to support and join a rebel group that works to topple the government. Deprivation and inequality was arguably an important motivation in the Liberian civil war, stated by a female ex-combatant in 2004: “I joined the rebel forces to fight inequality in the country, and because of this issue I also encouraged my three children to join” (cited in Richards 2005, 579).

The standard relative deprivation argument requires some additional development to generate exact observable and quantifiable implications regarding where, within countries, conflicts occur. The problem is that a group of soldiers may derive support or be motivated by aspects of one location, but target another location. We can easily observe the target location where the event takes place. The extent of “support” in a location is harder to observe. A local population caught in the middle of a conflict will not signal support for a rebel group if they fear government retaliation against supporters, or vice versa. An effective rebel group will obviously attempt to protect their zones of influence and rather take the conflict to the government’s support base. We distinguish between the concepts of support level and target value. These concepts are not observable in themselves, but allow us to derive implications for the likely
location of observable conflict events from the theoretical literature that is tested for our disaggregated civil war events data.

Support level relates to the extent to which a local population is likely to support either the rebel group or the government in a conflict. This support may be in the form of economic contributions, places to hide or set up bases, or as recruits to the rebel army. The residents of a region that has been consistently favored by the government are likely to support the government, whereas the local population of marginalized and systematically neglected regions may be more likely to support the rebel group (Humphreys and Weinstein 2008). A government in war may see a need to target locations from where the rebel group derives strength.

Target value, on the other hand, refers to the extent to which a location is a valuable target for either group. Obviously, the extent to which a local population supports the opponent increases its target value. But other factors also affect target value. The strategic importance of a location is obviously one such factor. Both parties to a conflict will seek to control strategic locations such as crossroads, bridges, ports, and airports held by the opponent, and invest resources to protect them. Another factor is the extent to which the location can provide revenue to the parties (Reno 1997). Alluvial diamond deposits are only one example of such locations.

Support levels are almost by definition different for the various actors. The target value of a location, on the other hand, may be similar to all. Alluvial diamond deposits are easily translated into finances by any actor. Other locations may be more valuable to one actor than to another. Still, the other actor may want to target such locations to weaken the opponent.

Whether support level or target value in a location results in observable war events also depends on other factors. With limited resources, actors to a conflict will consider to attack or defend only the locations that are most valuable militarily or economically. Where we tend to observe conflict events relative to A and B’s home bases depends on the parties’ relative strength.

This logic is well captured by Boulding’s (1962) “loss-of-strength gradient” (Figure 1). The point \( L_A \) represents the point at which actor A is strongest militarily, and \( L_B \) the stronghold of B. In locations close to \( L_A \), B has little chance of winning and is unlikely to attack. Likewise, conflict events are not likely close to \( L_B \). The \( x \)-axis represents the physical distance between A and B’s home bases, which partly coincide with differences in support levels for A and B. Both parties prefer to target locations that support the opposition rather than themselves, since fighting in a location brings destruction to it. Boulding’s model suggests that conflict events tend to occur in locations where both actors are willing and able to engage the other, that is, the point \( L_C \) where their strengths are roughly equal. In other words, if B is considerably stronger than A, we will see conflict events in locations close to \( L_A \). In many instances, these are also locations that support A. The implication is that conflict events are more frequent in locations with high support levels for the weaker party to the conflict.
Internal conflicts are in general asymmetrical relationships in which the rebels tend to be weak challengers to the central power (see Hultman 2008). However, the Liberian civil war seems to be an exception to this rule.

**Poverty and Support Level**

What makes the local people at a location support a rebel movement, and what motivates a person to risk his life in armed conflict? An essential factor relating to this is people’s discontent with the status quo. Such discontent is often a result of poverty (Humphreys and Weinstein 2008).

Gurr’s (1970) theory of relative deprivation implies that grievance-induced discontent because of the marginalization of certain groups is a major determinant of violent political mobilization. However, inequality is among the grievance factors largely dismissed by recent large-N country-level studies of civil war (e.g., Collier and Hoeffler 2004 and Fearon and Laitin 2003). But such studies typically consider economic inequality between individuals, while ignoring spatial variations in socioeconomic welfare. Østby (2008) argues that such conclusions may be not necessarily well supported because of the neglect of the group aspect of inequality. Civil wars are organized group conflicts—not confrontations between individuals.
randomly fighting each other. Hence, the focus should be on inequality between identity groups (not between individuals), or so-called “horizontal inequalities” (see Stewart 2002).

The horizontal inequality argument states that inequalities coinciding with cultural cleavages may enhance group grievances and thus facilitate mobilization for conflict. Stewart (1998, 2002) discusses several case studies that suggest evidence for a positive relationship between horizontal inequalities and civil conflict in a number of countries, including Liberia. Predating Stewart, Gourevitch (1979) discussed regional economic inequalities as a potential cause of conflict. Although dismissing a deterministic relationship, Connor (1984) holds that economic deprivation may be a catalyst for conflict, and that economic considerations are likely to exert maximal impact where socioeconomic class and ethnic identities coincide. The Minorities at Risk (MAR) project constitute another body of research on group grievances and conflict (e.g., Gurr [2000], Saideman et al. [2002], and Scarritt and McMillan [1995]). MAR studies are often criticized for restricting the analysis to groups that are already perceived to be “at risk.” We avoid this shortcoming by including all geographical units (cells) within Liberia.

Poverty and wealth tend to be spatially clustered within countries (Buhaug and Rød 2006; Toft 2003). The poverty or deprivation of the local population relative to other groups may be more important for its support of rebel movements (Humphreys and Weinstein 2008) than their absolute poverty. Support can thus derive from an unequal geographical distribution of welfare. The local population is likely to feel frustration and antagonism, especially when their deprivation is the result of the government’s exploitation and discrimination.

The literature on intergroup inequality and conflict (Gurr 1970; Horowitz [1995] 2000; Sen 1997; Stewart 2002) implies that people in locations that are deprived relative to the rest of the country or their neighbors will be the most likely to support or join rebel groups. On the other hand, people in relatively privileged regions should be more likely to support the government, especially if their relative privilege is a result of the government’s favoring of these regions.

Toft (2003, 5) argues that violence tends to plague rich and poor regions alike. Since popular support can be directed either in favor of the government or in favor of a rebel it is complicated to evaluate the link between horizontal inequality and level of conflict events. It is reasonable to assume that actors seek to protect areas where the local population is supportive, and to attack areas that support the opponent. The prediction from the relative deprivation argument, then, is dependent on the parties’ ability to decide where battles are fought. Boulding’s (1962) “loss-of-strength gradient” discussed above provides a model for how predicted locations depend on relative strength. If the rebel group is the weak group \( A \) and their supporters are located close to the point \( A \) in Figure 1, the government \( B \) is better able to target rebel group supporters than vice versa. In that case, most conflict events will be in locations that support the rebels. If the rebel group is strong, on the other hand,
most conflict events will occur in locations not supporting the rebel group. For a large part of the Liberian civil war, the government was very weak. This was particularly the case when the Economic Community of West African States Monitoring Group (ECOMOG) controlled only Monrovia, but also reflects well the situation during parts of Taylor’s reign. In this case, we consider the rebel groups to be strong compared to the government. In conjunction with the support level argument and Boulding’s model, this fact leads to our first proposition:

**Proposition 1**: In cases where the rebel group is relatively strong, the most privileged locations will see the most civil war events.

**Poverty and Target Value**

Rebel groups often have the advantage that they to a large extent decide where the battles occur, at least in the initial phase of a conflict (or when they are powerful relative to the government, as seems to have been the case in Liberia). These decisions are based on such factors as the opportunities for rebel recruitment and financing (Buhaug 2007) in addition to strategic concerns. Relative poverty levels may affect the likelihood of observing events through impact on target value in addition to its importance for support level. Rebel groups depend on financing to sustain operations (Collier 2000; Collier and Hoeffler 2004).

In Liberia and Sierra Leone, access to alluvial diamonds presented a useful source of revenue for the rebel groups. In addition, looting is one source of income for a rebel group. Looting, in turn, is most profitable in areas that are relatively well off, irrespective of whether the local population support one of the parties or not. If this argument holds, locations where the population is relatively well off should have a higher target value. Various accounts of the civil war in Liberia indeed demonstrate that fighting frequently occurred where easy money could be made (Duyvesteyn 2005). This leads to our second proposition:

**Proposition 2**: Independent of relative strength, the target value argument implies that the risk of conflict events increases with the level of socioeconomic wealth at the location.

Although Propositions 1 and 2 are derived from different arguments, the implication is the same: we expect to see more civil war events in the richer locations in Liberia.

**Why Liberia?**

Liberia had a long record of political stability before the civil war broke out in 1989 (Kieh 2004). It has a great geographical variance in political violence as coded by the ACLED dataset, and disaggregated measures of socioeconomic status can be
generated from the 1986 Liberian DHS, which is geo-referenced and dates back to three years prior to the civil war in Liberia. The availability of such data provides a unique chance for testing the link between socioeconomic factors and conflict.

Liberia’s population of about 2.5 million is divided into sixteen officially recognized ethnic groups living in thirteen counties (see map of Liberia with administrative regions in Figure 2). The Gio, Mano, Krahn, and Mandingo groups are particularly important to the conflict in Liberia (Ellis 1999). Those classified as “Krahn” consider their home area to be the Grand Geddeh County in the southeastern part of the country; the “Mandingo,” who largely allied to the Krahn during the war, are spread between Lofa County in the north and the northeastern Nimba County. Nimba County is also home to the Gio and Mano, two ethnic groups that formed the basic support of Taylor’s forces during the war (Ellis 1999, xix). The map in Figure 3, taken from Ethnologue (Grimes 2000), shows the major languages spoken in different areas of Liberia.6

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*Figure 2
Map of Liberia

The case study literature offers many perspectives from which to analyze the Liberian civil war. Ellis (1999) examines religious dimensions (although he concludes elsewhere that “if the war can be said to have been ‘about’ anything, then it was power, money, plunder and revenge” [Ellis 2001, 224]); Utas (2003) focuses on
youth; Kaldor (2007) sees the conflict as an example of a “new war”; Reno (1999) focus on warlord commerce, whereas Bøås (2005) highlights the Liberian case as a war about identity and distribution of resources. We are also aware of at least two different surveys of Liberian ex-combatants (Pugel 2007; Bøås and Hatløy 2008). These invaluable studies provide summary results on the background characteristics of the fighters of the various factions, and their motivations for joining an armed group. A common conclusion of the two studies is that family protection and security concerns were among the most important motivating factors for recruitment, whereas economic motivations were of less importance. Both the qualitative case studies and the postconflict surveys provide important insights to the roots and nature of the Liberian civil war. However, they reveal little information regarding in which locations the actual fighting took place. For this purpose a systematic, disaggregated analysis is needed. Before we present our research design, we provide a short narrative of the course of the Liberian war that motivates the subsequent analysis.

The Liberian Civil War

The civil war in Liberia naturally divides into two phases. The first (1989-1997) includes Charles Taylor’s insurgency which led to the surrounding of Monrovia, the killing of Samuel Doe, and finally the electoral process that made Taylor president in 1997. Then followed a brief interlude in which Taylor continued the legacy of authoritarian rule. This set the stage for the second phase, lasting from 1999 until the Taylor’s defeat in 2003 (Pugel 2007). Apart from the fact that the conflict intensity was more intense in the first years of the conflict, the major differences over time pertain to the changes in governments and rebel groups, as will be elaborated below.

As a prelude to the Liberian civil war, Samuel Doe organized a coup d’etat in 1980 to bring an end to the rule of the Americo-Liberian oligarchy. Members of Doe’s ethnic group, the Krahn, came to control most of the leading national political and military state institutions (Nilsson and Kovacs 2005). Furthermore, since many of his political opponents had support from the Gio and Mano groups, Doe attempted to build a rival alliance in Nimba county by favoring the Mandingo, appointing them to political positions and helping them to secure land (Ellis 1999).

The Liberian Civil War began on Christmas Eve 1989, when Charles Taylor led a small band of insurgents into the border town of Butuo, Nimba. With that attack, the National Patriotic Front of Liberia (NPFL) initiated over seven years of brutal violence. More than half of Liberians became refugees and about 8 percent of the population (two hundred thousand people) were killed in fighting or massacres (Humphreys and Richards 2005). Taylor’s attack was the second attempt to overthrow Doe’s government—a failed coup in 1985 had resulted in repression of the Gio and Mano groups (Dunn 1990, 68). NPFL initially consisted of about a hundred men, recruiting mainly from areas marginalized after the attempted coup (Reno 1997, 498). During
the first war, the NPFL recruited fighters from practically all Liberian ethnic groups (Duyvesteyn 2005, 25).

The government response to the NPLF raid was a scorched-earth policy. The Armed Forces of Liberia (AFL), consisting mainly of soldiers from the Krahn and Mandingo groups, targeted members of the Gio and Mano communities. The soldiers moved from village to village, shooting inhabitants, looting properties, and burning houses. This unrestrained behavior of the Liberian army bolstered popular support for the NPFL (Duyvesteyn 2005, 27). In retaliation, rebels targeted the Krahn and Mandingo communities (Dunn 1990, 71), which in turn indicates relative weakness of the governing forces, represented by these groups.

By April 1990, the NPFL controlled over 90 percent of Liberian territory (Dunn 1992, 70), but the NPFL’s assault on the capital, Monrovia, was halted by ECOMOG later that year. In the following years, multiple rebel groups emerged. An anti-Taylor militia, the United Liberation Movement of Liberia for Democracy (ULIMO), was founded in 1991. Later, both ULIMO and NPFL splintered, and Liberia descended into chaos. At one stage the countryside was contested by no less than eight armed factions. The various rebel groups survived in “Greater Liberia,” as Taylor had renamed his holdings, by engaging in battles against each other and accessing valuable natural commodities as well as looting consumer goods (Reno 1995). In our empirical analysis, we evaluate the impact of target value in terms of lootable goods—both in terms of natural resources, and regular consumer goods.

In the second phase, shifting rebel alliances led to the creation of two main groups, both dedicated to the overthrow of the Taylor government. The Liberians United for Reconciliation and Democracy (LURD) emerged from Lofa county in the northeastern part of the country, and was largely a Mandingo project. The second group, Movement for Democracy in Liberia (MODEL), consisting mainly of Krahn, marched toward Monrovia from the southern part of the country in the second part of the civil war (Kamara 2003). An effective insurgent strategy by LURD led to Taylor’s resignation, and a peace agreement was signed in Accra on August 18, 2003.

This account of the Liberian civil war suggests that it is not unlike many recent conflicts in the developing world. The Liberian war is interesting since it is typically explained by “greed” rather than grievances (Collier and Hoeffler 2004). Reno (1999, 79), for example, argues that the Liberian conflict followed a clear logic in which “warlord pursuit of commerce has been the critical factor.” Poverty has received less attention in the literature on the Liberian civil war. Still, arguments relating to relative deprivation may be relevant in conflicts of this type, as poor areas may be important for rebel groups’ “support levels,” and may be easily exploitable areas for the armed groups. The current study considers both issues of support level and target value.

Spatially referenced data on population densities, major city locations, road densities, diamond deposit information are publicly available and have been used in previous studies of civil war (see, e.g., Buhaug and Rød [2006] and Raleigh and
Urdal [2007]). We have added information on conflict events, ethnic homelands, and development indices. Below, we present all the variables used in the study in turn.

**Research Design**

This section describes the design of our statistical setup and discusses the empirical implications of a disaggregated study. Our theoretical framework implies that within-country variation in poverty levels should affect where and if conflicts emerge, where rebel groups are able to recruit soldiers, and where rebel groups operate. Country-level studies are not able to account for this variation and are therefore limited in their ability to predict why and where civil wars occur and endure.

**Data Structure and Description of Variables**

Disaggregated conflict event data requires a disaggregated analysis structure and spatially varying attributes. The basic data structure for this project is a grid of 1,375 squares imposed over Liberia. The grid is shown as horizontal and vertical lines in Figure 4. Each cell, or grid square, is 0.08 decimal degrees or approximately 8.5 km by 8.5 km. Spatially referenced variables, including conflict events, are added to this grid structure. These 1,375 squares are the units of analysis in our cross-sectional statistical model, which indicates that each cell covers the period between 1989 and 2002. Some grid cells at borders and along the coast have smaller areas than ordinary cells. These were weighted down according to their area in the estimation.

The Armed Conflict Location and Event Dataset (ACLED) (Raleigh, Hegre, and Carlsen 2009) compiles reported information on conflict events by political actors by date and location.8 Events include battles, headquarter or base establishment, violence to civilians, and rebel presence. Events can occur between any political actor (i.e., government, rebels, and militias) either within a civil war or outside of that context. All collected events are associated with a date and a georeferenced location. Information on the Liberian conflict is collected from a range of sources including international, national, and regional news sources; human rights reports; UN humanitarian information and analysis (IRIN); and field reports. The ACLED data for Liberia includes 262 reported events from 1989 through 2003. The majority of events (90 percent) are battles between governments and rebels. In half of those battles, territorial control changed hands. The remaining events include base and headquarter establishment and violence against civilians by rebel and government groups.

We have chosen to aggregate these events into counts of events in each grid cell over the entire period. We consider 262 events to be a too-small number to allow a fully dynamic model like the one developed in Hegre and Raleigh (2006), who analyze
a much larger data set. Moreover, our right-hand side variables do not vary over time. This aggregation choice reflects the priority given to the spatial aspect in the theoretical discussion—our analysis shows where events occur most frequently.

Figure 4

Source: Data on war events are from Raleigh, Hegre, and Carlsen (2009). Population data are from the Center for International Earth Science Information Network (CIESIN).
The presence or frequency of conflict events is associated with each grid square and ranges from zero events (in 1,312 squares) to thirty-nine events (in Monrovia). The outlined squares in Figure 4 show the locations of war events in Liberia, and the circles in Figure 6 also visualize the cumulative number of events in each location for the period 1989 through 2002.

The geo-referenced information on economic development is derived from the 1986 Liberian DHS. In a DHS, a sample of households is selected throughout the entire country and then interviewed using a household questionnaire to collect housing characteristics. Women between the ages of fifteen and forty-nine are interviewed about health, nutrition, and other issues, such as household welfare. The sample design is a probabilistic two-stage sample, in which several enumerated areas (EAs) within each country are randomly selected with a probability proportional to their size. The households within the selected EAs are randomly selected with equal probability, and sampling weights are assigned to individuals.

In general, the DHS surveys have high reliability as evidenced by the large sample sizes, random sampling, and standardized questionnaires. To address potential sources of measurement errors, the DHS program spends large resources on training of field workers and data processing staff and has developed standard procedures, methodologies, and manuals to guide the survey process. A thorough review of the DHS data collection procedure and sampling methodology is presented in the DHS Sampling Manual (Macro International 1996).

During the last decade, the DHS Surveys have begun to include detailed information about the geographical location of each EA. In the Liberian DHS, data on the presence or absence of basic development facilities were collected at 156 locations across the state (see Figure 4). An average of thirty-four respondents were interviewed at every location. These point data are geo-referenced with latitude/longitude coordinates. We have assigned values to the grid square in which they fall.

The DHS surveys lack direct information on income or consumption expenditures. We overcome this obstacle by using information collected on household characteristics to generate a wealth index. The index is constructed on the basis of the following variables: the share of households in the grid cell that have piped water; toilet facilities; a radio; a refrigerator; metal/concrete roof; a table and chair; a bed with mattress; as well as the share of surveyed women that are literate, and their average number of years of education. Following Filmer and Pritchett (2001), we generate a linear welfare index based on each of these variables weighted according to their individual loadings resulting from a principal component analyses. The appendix lists the factor loadings and explained variance. The variable ranges from –4.02 (lowest level of wealth) to 5.68 (highest level of wealth). Our index produces very similar classifications when different subsets of variables are used in its construction, indicating that our measure should be quite robust. Furthermore, in an LDC like Liberia, where many people are part of the informal sectors, household assets might better capture variations in welfare than GDP per capita (Filmer and Pritchett 2001).
Only 101 of the 1,375 grid cells were covered by the Liberian DHS. Our welfare scores are obtained as mean values for all the respondents in each EA (one or more) represented in a cell. A potential challenge to our study is that the DHS surveys are only representative for that location and cannot inform us about nonsampled locations. We present below our method to interpolate measurements between locations. This method must necessarily underestimate variability within locations, and we do not see any obvious source of systematic bias. If so, our imperfect data should attenuate our results, leading to nonsignificant findings.

Figure 4 shows the survey locations laid over information on population densities. The DHS design ensures that the density of survey locations correspond to population densities. The remaining 1,275 grid squares have no information to use for our index. The figure shows there is little overlap between grid cells with DHS surveys and cells with war events. To relate the wealth index and the conflict events to each other, we interpolate data on wealth levels using a method designed for spatial data in GIS. The “Inverse Distance Weighted” (IDW) method is a spatial interpolation technique, which relies on the value of known sample points to estimate the values at surrounding points, using an inverse distance weighting method (see Philip and Watson [1982] and Watson and Philip [1985]). The result of the IDW function is a surface where the value at any point is a function of the values of the surrounding locations, where the most proximate locations are given the most weight. The parameters chosen can alter the resultant surface considerably. For this project, the “neighborhood method” was chosen, where between ten and fifteen surrounding points are used to estimate the new interpolated value for any point. The shades in Figure 5 shows the countrywide estimates for our wealth index before and after spatial interpolation. The map indicates that the region around Monrovia and the Nimba county are the main clusters of relative wealth. The Mandingo home land in the very north is also relatively well off. The Krahn homelands, on the other hand, are no richer than the national average.

There are several ways to measure relative deprivation using these data. Since we are analyzing locations within a single country, all estimated wealth levels may be interpreted as wealth relative to the average of Liberia. We also constructed a more geographically local measure based on the IDW-generated values. We measure local relative deprivation (LRD) as the absolute gap between each cell’s value on the wealth index compared to the overall performance of the neighboring cells (third order). Grid cells that are considerably poorer than the average of cells that are located roughly 25 km away are coded as locally deprived. This measure is obviously dependent on the quality of the interpolated data. Again, we believe any bias should attenuate our results. Where DHS sample points are clustered (such as in the Monrovia region), our measure should accurately reflect local variations in income. Where cluster points are sparse, the interpolation technique yields small differences between adjacent cells, and the LRD measure is close to zero.
Control Variables

We include a set of control variables potentially associated with the location of civil war events. If the resource-curse argument on abundance of natural resources is valid, we would expect resource-rich regions to see more conflict events than regions without such endowments. Information on diamond deposits are derived from Lujala, Gleditsch, and Gilmore (2005). We include a dummy which records whether a grid has diamonds within the third-order neighborhood (i.e., the forty-eight closest cells to each cell).

Ethnic identity is a factor which has received wide attention in the civil war literature (e.g., Collier and Hoeffler [2004], Fearon and Laitin [2003], and Reynal-Querol [2002]). Regional distribution of ethnic groups may be more relevant for conflict than the overall national composition of ethnicity (Toft 2003). The ethnic homeland information shown in Figure 3 is derived from Ethnologue shapefiles of linguistic communities (Grimes 2000). Converting these linguistic homeland designations to variables representing spatially referenced ethno-political groups is not straightforward, as linguistic communities are not, by nature, politicized. Of the twenty-seven linguistic communities noted by Ethnologue for Liberia, we limit attention to the four

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**Figure 5**

Wealth Index by Location in Liberia, 1986. Spatial Interpolation, IDW Method

Source: Data on local wealth are calculated on the basis of the Liberian Demographic and Health Survey (DHS) from 1986.
groups discussed above. We code two measures denoting whether (1) the majority of each cell is dominated by the Krahn or Mandingo groups (associated with Samuel Doe) or (2) the Gio (Dan-speaking) and Mano (Mann-speaking) groups (associated with Charles Taylor).12

The number of war events is likely to be dependent on conflict intensity in neighboring squares. To control for spatial dependence between observations, we include a variable that records whether there was a conflict event going on in cells within the third-order neighborhood.

Population is another variable which figures prominently in most studies of civil war. In a disaggregated study of civil wars in Central Africa, Hegre and Raleigh (2006) found that conflict events tend to occur more often in locations that are relatively populous. Population density is also likely to be correlated with our wealth index. To control for this, we use information on population density figures for the 1980s and 1990s derived from CIESIN13 (see Figure 4).

Proximity to international borders may provide rebel groups with safe havens across the border, and weapons may be more easily smuggled into border regions. Proximity to the capital is another factor that may be relevant for where conflict events take place. For example, Buhaug and Rød (2006) found that conflict over state governance is more likely in regions that are near the capital city. We hence include variables measuring the distance to international borders and to Monrovia.

**Statistical Method**

The dependent variable in our analysis is the cumulative number of war events in each grid cell over the entire war period. If event counts within grid squares had been completely independent, they could be modeled using a Poisson distribution. In this case, however, they are unlikely to be independent of one another—an attack by one actor in a location is likely to lead to repeated attempts if unsuccessful and to retaliations by the other actor if successful. We accordingly estimate a zero-inflated negative binomial model that allows for a large number of zero-count observations and possible overdispersion within the positive-count observations.

**Empirical Results**

The map in Figure 6 shows the location and number of conflict events overlaid with our wealth map and the location of diamond deposits. The map indicates that conflict events in Liberia predominantly occurred in the relatively rich provinces. There are concentrations of events in the Nimba county in the northeast, in the provinces close to Monrovia and Robertport, and in the eastern-most provinces. In all these provinces, the population had more assets in 1986 than the Liberian average. Events also seemed to happen close to diamond deposits.
Figure 6
Location of War Events, Diamond Deposits, and Variation in Wealth Levels, Liberia 1989-2002

Source: Data on war events are from Raleigh, Hegre, and Carlsen (2009). Data on local wealth are calculated on the basis of the Liberian Demographic and Health Survey (DHS) from 1986. Diamond data are from Lujala, Gleditsch, and Gilmore (2005).
The map in Figure 4, however, also indicates that the same provinces are relatively populous. Moreover, Figure 6 shows that conflict events are concentrated close to Monrovia and to the borders to Sierra Leone, Guinea, and Cote d’Ivoire. These geographical tendencies have military-strategic reasons and are probably not because of differences in income levels. Taylor’s aim was to take control of the capital to be recognized as the head of state.

In Table 1, we report the estimates from a zero-inflated negative binomial regression model of the number of conflict events in each grid cell, controlling for these factors. The upper half of the table reports the estimates corresponding to the negative binomial part of the model. These estimates are to be interpreted as the increase in log number of events associated with a one-unit increase in the explanatory variable. The lower half reports the “inflate” part of the model, or the extent to which there are more zeroes in the data than implied by the negative binomial distribution. These estimates are interpreted as an inverse logistic regression model. A negative estimate means that an increase in the explanatory variable increases the probability of observing at least one event in a location.\(^{14}\)

In model 1, we entered all variables in both equations in the model. In model 2, we removed variables from the inflate equation that were clearly not significant in that equation and removed variables from the “war events” equation that were clearly not significant in that equation and not removed from the inflate equation.\(^{15}\) The more parsimonious models have estimates of the same magnitude but with smaller standard errors.

Four parameter estimates are clearly significant in model 2. In the inflate equation, we see that more populous locations had a higher probability of seeing at least one war event. Events were also more frequent close to borders and close to Monrovia. In the “war events” equation, only the wealth index estimate is significant. The sign is positive—the more assets the local population possess on average, the more frequent are conflict events. This is in line with our theoretical expectation that the target value of a location decreases with the level of socioeconomic deprivation at the location.

Models 3 and 4 divide the war events into those involving the NPFL and those involving other groups. The majority of NPFL events occurred before 1997 and were directed against the Doe government, whereas most other events occurred after Taylor assumed power. In model 4 the Gio/Mano term turns out negatively significant in the “war events” equation, indicating that fewer non-NPFL events happened in locations dominated by these ethnic groups. Otherwise, the results are remarkably similar—the patterns of violence did not seem to change over time, over governments, or over rebel groups.

In model 5, we replace the wealth index with the localized relative wealth index. The results are roughly the same, although the relative wealth index estimate is smaller and less significant. Since the two variables are highly correlated, it seems
### Table 1
Number of War Events, Liberian Grid Cells, 1989-2002

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
<th>Model 6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All Events</td>
<td>All Events</td>
<td>NPFL Events</td>
<td>Other Events</td>
<td>All Events</td>
<td>All Events</td>
</tr>
<tr>
<td>War Events Equation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wealth index</td>
<td>0.247*</td>
<td>0.314***</td>
<td>0.338**</td>
<td>0.436***</td>
<td>—</td>
<td>0.310**</td>
</tr>
<tr>
<td></td>
<td>(0.145)</td>
<td>(0.119)</td>
<td>(0.164)</td>
<td>(0.145)</td>
<td>—</td>
<td>(0.133)</td>
</tr>
<tr>
<td>Relative wealth index</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>0.238**</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.119)</td>
<td>—</td>
</tr>
<tr>
<td>Diamonds</td>
<td>−2.763***</td>
<td>−1.100</td>
<td>−0.883</td>
<td>−0.123</td>
<td>−1.067</td>
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<tr>
<td></td>
<td>(0.651)</td>
<td>(0.789)</td>
<td>(0.652)</td>
<td>(0.837)</td>
<td>(0.820)</td>
<td>—</td>
</tr>
<tr>
<td>Gio/Mano</td>
<td>−0.421</td>
<td>−0.828</td>
<td>−0.572</td>
<td>−1.665**</td>
<td>−0.740</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>(0.680)</td>
<td>(0.517)</td>
<td>(0.652)</td>
<td>(0.685)</td>
<td>(0.538)</td>
<td>—</td>
</tr>
<tr>
<td>Krahn/Mandingo</td>
<td>−0.723</td>
<td>−0.824</td>
<td>−0.875</td>
<td>−0.797</td>
<td>−0.874</td>
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<td>(0.831)</td>
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<td>(0.753)</td>
<td>(0.737)</td>
<td>(0.607)</td>
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<td>Neighboring conflicts</td>
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<td>−0.496</td>
<td>−0.713</td>
<td>−0.248</td>
<td>−0.528</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>(0.567)</td>
<td>(0.526)</td>
<td>(0.718)</td>
<td>(0.715)</td>
<td>(0.574)</td>
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<td>0.019</td>
<td>−0.095</td>
<td>−0.144</td>
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</tr>
<tr>
<td>grid cell, 1980</td>
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<td>(0.143)</td>
<td>(0.172)</td>
<td>(0.174)</td>
<td>(0.144)</td>
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</tr>
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<tr>
<td>Distance from</td>
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<td>—</td>
</tr>
<tr>
<td>Monrovia (in degrees)</td>
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<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Constant</td>
<td>3.311**</td>
<td>2.933***</td>
<td>1.196</td>
<td>1.615</td>
<td>2.296**</td>
<td>0.455</td>
</tr>
<tr>
<td></td>
<td>(1.358)</td>
<td>(1.085)</td>
<td>(1.363)</td>
<td>(1.201)</td>
<td>(1.118)</td>
<td>(0.630)</td>
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Inflate Equation

<table>
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<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
<th>Model 6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All Events</td>
<td>All Events</td>
<td>NPFL Events</td>
<td>Other Events</td>
<td>All Events</td>
<td>All Events</td>
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<td>—</td>
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</tr>
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<td>—</td>
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<tr>
<td>Gio/Mano</td>
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<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
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<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Krahn/Mandingo</td>
<td>−0.293</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>(0.791)</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Neighboring conflicts</td>
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<td>—</td>
<td>—</td>
<td>—</td>
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<td>—</td>
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<tr>
<td>Log population in</td>
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<td>−0.373***</td>
<td>−0.314**</td>
<td>−0.231*</td>
<td>−0.371***</td>
<td>−0.303**</td>
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<tr>
<td>grid cell, 1980</td>
<td>(0.144)</td>
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<td>(0.148)</td>
<td>(0.140)</td>
<td>(0.126)</td>
<td>(0.122)</td>
</tr>
<tr>
<td>Distance from</td>
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<td>0.239***</td>
<td>0.259***</td>
<td>0.292***</td>
<td>0.245***</td>
<td>0.240*</td>
</tr>
<tr>
<td>closest border</td>
<td>(0.074)</td>
<td>(0.060)</td>
<td>(0.077)</td>
<td>(0.074)</td>
<td>(0.061)</td>
<td>(0.068)</td>
</tr>
<tr>
<td>Distance from</td>
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<td>0.410**</td>
<td>0.533**</td>
<td>0.568***</td>
<td>0.463**</td>
<td>0.506**</td>
</tr>
<tr>
<td>Monrovia (in degrees)</td>
<td>0.224</td>
<td>(0.179)</td>
<td>(0.229)</td>
<td>(0.217)</td>
<td>(0.183)</td>
<td>(0.209)</td>
</tr>
</tbody>
</table>
that the wealth relative to the national average is more salient than the wealth relative to the immediate neighbors. Finally, in model 6, we reestimate model 2 without the variables that did not obtain significant estimates. The wealth index is robust across all the different models estimated.\textsuperscript{16}

Except in model 1, the diamond deposit variable is not statistically significant. The information we have available does not indicate that diamond deposits affected the frequency of war events in neighboring locations. The same conclusions apply to our ethnic variables—Gio/Mano and Krahn/Mandingo homelands did not see more frequent war events than other areas, controlling for the other variables. We do not identify any strong spatial clustering either.

The value of targets seems to be the major economic determinant of conflict event locations in the Liberian wars. These results are in line with the qualitative literature. Reno (1997, 499) describes how rebels typically proceeded from village to village, laying hands on all available goods. Looted goods included harvested produce, bags of rice, cooking supplies, corrugated tin roofs, clothing, generators, medical and school supplies—in short, anything at all of potential value, not only valuable natural resources (Cain 1999, 285). This corresponds to Duyvesteyn’s account (2005), which focuses on the wealth of Liberia as motivation for fighting during the war. The actual fighting occurred where easy money could be made. In towns, shopping districts were looted. In the countryside, opencast mining, rubber tapping, and logging of timber forests were undertaken. Taylor made millions each month exploiting Liberia’s wealth (Duyvesteyn 2005, 35-36).

One possible objection to our analysis is that several of our explanatory variables change during the conflict, and partly as an effect of the conflict itself. This is particularly likely for our wealth variable and for the population density variable. War

<table>
<thead>
<tr>
<th>Inflated Equation</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
<th>Model 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>3.927***</td>
<td>3.285***</td>
<td>2.735*</td>
<td>1.932</td>
<td>3.120***</td>
<td>2.093*</td>
</tr>
<tr>
<td></td>
<td>(1.267)</td>
<td>(1.001)</td>
<td>(1.448)</td>
<td>(1.246)</td>
<td>(1.024)</td>
<td>(1.186)</td>
</tr>
<tr>
<td>N</td>
<td>1375</td>
<td>1375</td>
<td>1375</td>
<td>1375</td>
<td>1375</td>
<td>1375</td>
</tr>
<tr>
<td>Nonzero obs</td>
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<td>63</td>
<td>63</td>
<td>63</td>
<td>63</td>
<td>63</td>
</tr>
<tr>
<td>alpha</td>
<td>1.42</td>
<td>1.32</td>
<td>2.14</td>
<td>1.52</td>
<td>1.55</td>
<td>1.32</td>
</tr>
<tr>
<td>Log likelihood</td>
<td>−310.58</td>
<td>−317.61</td>
<td>−228.47</td>
<td>−242.17</td>
<td>−319.07</td>
<td>−320.64</td>
</tr>
</tbody>
</table>

Note: NPFL = National Patriotic Front of Liberia.
*** p < 0.01. ** p < 0.05. * p < 0.10 (two-sided tests). Zero-inflated negative binomial regression results. Table entries are coefficients, with standard errors in parentheses.
events in a location are likely to destroy assets, such that conflict locations that were relatively well off at the time of the DHS survey were much poorer toward the end of the war. As noted above, the war in Liberia led to both large refugee flows and severe massacres. This was presumably primarily the case in locations with records of conflict events. This endogeneity may lead to biased estimates, but this bias must be in the direction of attenuating the results: if conflict events decrease our wealth index, we overestimate the wealth of the average conflict location. The same logic applies to population density.

Conclusion

To date, the bulk of large-\(N\) studies of civil conflict have been conducted at the country level. However, popular and intuitive explanations of why and where civil wars occur often refer to variables like inequalities and discrimination of identity groups, phenomena which vary geographically within states. This has contributed to a call for “disaggregating the study of civil war,” which implies investigating the causes of conflict below the national level (see, e.g., Buhaug and Lujala [2005], Buhaug and Rød [2006], Hegre and Raleigh [2006], and Raleigh and Urdal [2007]). These studies have made important contributions to our understanding of the disaggregated causes of civil war, but none incorporates any subnational direct measure of economic welfare. Trying to fill this gap, this article represents a first cut at testing the link between absolute and relative poverty and the location of civil war events in Liberia.

By means of spatial interpolation of the detailed information about the geographical location of each cluster of respondents from the Liberian Demographic Health Survey of 1986, we were able to generate local-level variables for absolute and relative wealth, measured by durable household assets. These data were coupled with geographically recorded data from the ACLED dataset on the location of civil war events in Liberia in the period 1989 through 2002, as well as other geographical variables such as the location of diamond deposits, ethnic affiliations, population density, and distances to Monrovia and international borders. Liberia is possibly a special case, with a large number of actors and shifting alliances. However, there is also an advantage to choosing a case where the government is weak, as we are able to observe rebel group behavior when strategic constraints are relatively lenient.

Our tests show that conflict events are more frequent in locations that were absolutely and relatively well off in the Liberian context in 1986. Based on surveys and case studies in combination with our wealth data, we also find that Liberian rebel groups tended to recruit from the same, relatively wealthy regions.\(^\text{17}\) In the Liberian war, the value of available targets seemed to determine where conflict events occurred. Our analysis, then, provides better support for “opportunity” explanations of armed conflict (e.g., Collier and Hoeffler 2004) than for “relative deprivation”
theories. We do not think the results are completely contrary to “grievance” accounts, however. Since the rebel groups were relatively strong during the years in which the Liberian government had very limited control outside the capital, they were relatively free to choose the locations of engagement. Both aggrieved and greedy rebels have an incentive to target the wealthy locations where hostilities will pay off.

To generalize beyond the Liberian case, we would have to expand the analysis to more countries. This requires appropriate survey data on economic factors in combination with disaggregated conflict data. More overlap between the DHS surveys and the ACLED dataset would allow for such an extension in the future.

Appendix

Results of Principal Component Analysis Used to Create the Household Wealth Index

<table>
<thead>
<tr>
<th>Variables used in wealth index</th>
<th>Factor loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piped water</td>
<td>0.651</td>
</tr>
<tr>
<td>Toilet facilities</td>
<td>0.764</td>
</tr>
<tr>
<td>Radio</td>
<td>0.800</td>
</tr>
<tr>
<td>Refrigerator</td>
<td>0.864</td>
</tr>
<tr>
<td>Metal or concrete roof</td>
<td>0.562</td>
</tr>
<tr>
<td>Table and chair</td>
<td>0.687</td>
</tr>
<tr>
<td>Bed and mattress</td>
<td>0.571</td>
</tr>
<tr>
<td>Female education (mean years)</td>
<td>0.907</td>
</tr>
<tr>
<td>Female literacy (share)</td>
<td>0.879</td>
</tr>
<tr>
<td>Total variance explained by component (%)</td>
<td>56.71</td>
</tr>
</tbody>
</table>

Source: Liberian Demographic and Health Survey (DHS) from 1986 (authors’ calculations).

Notes

1. Other conflict studies that use the “grid approach” include Buhaug and Rød (2006), Hegre and Raleigh (2006), and Raleigh and Urdal (2007).

2. Both Pugel’s (2007), and Bøås and Hatløy’s (2008) studies of Liberian ex-combatants found that family protection and security concerns were most often cited as a motivation for joining a faction by respondents of all groups.

3. There are also a handful of quantitative case studies that find a positive relationship between horizontal inequalities and civil war (e.g., Murshed and Gates [2005] on Nepal), but these are conducted at a higher level of analysis than the Liberian study presented here.

4. Recruitment, on the other hand, should be most frequent in poorer locations, but this assumption cannot be tested systematically with our data.

5. Target value also depends on military factors. Rebel leaders are likely to target locations that are easier to control, such as remote areas where the government is less able to monitor the population and conduct effective counterinsurgencies. In our statistical model, we also account for such strategic concerns.

6. The Mann language corresponds to the Gio group, and Dan to Mano. The Mandingos speak Manya, and the Krahn speak Krahn.
7. Although our analysis is cross-sectional, we try to account for the potential effect of these differences by breaking the events down by rebel group.

8. For more information on ACLED or to download the publicly available beta version, please consult http://www.prio.no/CSCW/Datasets/Armed-Conflict/Armed-Conflict-Location-and-Event-Data/.


10. We also created indices based on education levels and village-level infant mortalities. These variables yield results in the same direction as those presented below, although the infant mortality index turned out to not be robust.

11. See Filmer and Pritchett (2001, 116-17) for a detailed description of the construction of the asset index and a discussion of the internal validity of such an index with an application to India.

12. We considered creating more nuanced relevant ethnic groups, drawing on for example, Scaritt and Mozaffar (1999). However, in this analysis, we only separate between the most central groupings related to the civil war.


14. Vuong tests are not implemented in Stata for analysis of weighted cases. The test statistic is positive and clearly significant in reestimations without weights. The alpha parameter estimates the overdispersion in the negative binomial model. The parameter is consistently significant in negative binomial estimations of the model without zero inflation but rarely significant in the reported models. Reestimating the model as a zero-inflated Poisson model yields very similar results as those reported here.

15. In general, more parsimonious variables yield more precise estimates. One might object that one should not drop variables if they are well motivated as in this case. However, no variables are removed from both equations in Table 1. The more parsimonious models use all available information but reflect the redundancy of including all variables both in the inflate equation and in the events equation. Also note the large standard error for the “Diamonds” coefficient in the inflate equation. In this case, we have a near-empty cell problem (extremely few observed diamonds locations with conflict events). The parsimonious models 2 through 6 avoid this problem.

16. We have also estimated a straight negative binomial model and obtain the same results.

17. Oyefusi (2008) observes a similar pattern in Nigeria in a survey of willingness to join rebel groups.

References

Buhaug, Halvard. 2007. Dude, where’s my conflict? LSG, relative strength, and the location of civil war.


