

DEADLY COMBAT OVER NATURAL RESOURCES:
GEMS, PETROLEUM, DRUGS, AND THE SEVERITY OF ARMED CIVIL CONFLICT

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This version: October 2008

AUTHORS NOTE: I would like to thank Halvard Buhaug, Scott Gates, Nils Petter Gleditsch, Kåre Johansen, Anke Hoeffler, Gaute Torsvik, and Ragnar Torvik for their valuable comments and suggestions. I am grateful for the financial support of the Norwegian Research Council. Location data for diamond and hydrocarbon occurrences are available at <http://www.prio.no/CSCW/Datasets/Geographical-and-Resource/>, data for drug cultivation at <http://www.svt.ntnu.no/iso/Paivi.Lujala/home/Data%20Projects.htm> and data for gemstone mining can be obtained from the author.

ABSTRACT

This article empirically examines how natural resources affect the severity of armed civil conflict. It finds that drug cultivation in the conflict area is associated with less severe conflicts but that gemstone mining and oil and gas in the conflict zone production increase the severity of conflicts. Most severe are secessionist conflicts in regions with hydrocarbon production. Interestingly, oil and gas production outside the conflict zones is related to less severe conflicts. Measured at the country level, none of the resource variables has an effect on conflict severity. These results have four implications. First, availability of natural resources affects the severity of armed civil conflict. Second, the location of resources is crucial to their impact on conflict. Third, the type of resource matters. Above all, it seems that natural resources affect conflict severity by altering incentives for both the rebel group and the state.

INTRODUCTION

This article empirically examines how natural resources affect the total number of combat deaths and the average combat death rate (intensity) of armed civil conflict. While previous empirical studies have assessed the importance of resources with respect to the onset and prevalence of conflict, only a few have considered whether resources are associated with these two aspects of conflict severity. This article uses data on three different types of natural resources – hydrocarbons (crude oil and natural gas), gemstones, and drug cultivation – and analyzes their effect on combat-related deaths. In addition, the article considers how the location of resources relative to the conflict zone affects the severity of the conflict.

Armed civil conflicts come in different sizes. A conflict in oil-producing Yemen generated 5 500 combat-related deaths in 1994, whereas the Afar conflict in resource-poor Ethiopia in 1989–1991 resulted in fewer than 100 battle deaths. The intensity of conflict also varies considerably. Whereas some conflicts generate thousands of combat deaths in a few months, even in days, others may last for years without exceeding the conventional threshold of 1 000 battle deaths, which is generally considered as the definition for a major war. During the period 1983–2002, the conflict in oil-rich Southern Sudan generated an average of 3 000 combat deaths annually. In the Shan and Kachin States in Burma, where opium poppy cultivation is widespread and a large amount of high quality gemstones such as rubies and jade are produced, conflicts have killed 400–500 combatants annually since the early 1960s. In Afar, the average yearly death rate was less than 40.

Can it be that natural resource endowment partially explains the variation in conflict severity? By using the Ordinary Least Squares (OLS), I find that gemstone mining inside the conflict zone is positively associated with the total number of combat-related deaths. The effect is large: exploitation of gems in a conflict zone more than doubles the number of combat deaths. The results show that this effect is explained by the longer duration of these conflicts. However, I do not find support for the argument that conflicts in which gemstone looting is possible have a lower intensity than do other conflicts ([Addison, Le Billon, and Murshed 2003](#)). Therefore, in the case of gemstones, the evidence lend support to [Weinstein's \(2007\)](#) argument that rebel access to lootable resources makes these movements more violent. On the other hand, drug cultivation (coca bush, opium poppy, and cannabis) in the conflict zone is associated with fewer combat deaths and lower intensity.

Hydrocarbon production inside the conflict zone more than doubles the number of battle-related deaths. In addition, the results suggest that oil and gas production is associated with

more intensive conflicts, although the higher death toll is partially explained by the longer duration of these conflicts. A more detailed analysis reveals that secessionist conflicts in regions with hydrocarbon production are especially severe: the number of combat deaths is more than doubled and the intensity tripled compared to those over government. Interestingly, the results show that hydrocarbon production outside the conflict zone, including offshore areas, is related to fewer combat deaths and less intensive conflicts.

This article confirms earlier results that the location of a natural resource is crucial to its impact on conflict ([Buhaug and Lujala 2005](#); [Fearon 2004](#); [Lujala 2010](#)). When I conduct the analysis with country-level aggregates instead of conflict-level variables, none of the resource variables is related to the conflict intensity. Hydrocarbon production is a striking example: when measured at country level, I find no evidence that the production has an effect on conflict severity, but when I disaggregate it into production inside and outside the conflict zone, the two have an opposite effect on severity. The fact that the location is crucial has two major implications. First, failure to use the conflict-level measures can produce misleading results. In this article, for instance, the conclusion would have been that natural resources are not related to conflict severity if conflict-level measures were not analyzed. Second, these results help in understanding the possible mechanisms behind the perceived relationship between natural resources and conflict. When it comes to the severity of conflict, it seems that these mechanisms are working through both the rebel group and the state.

The main objective of this article is to study the effect of natural resources on conflict severity. However, the article provides several other results that are worth noting. The relative strength of the rebel movement in relation to state's military strength has a strong effect on conflict severity. Most deadly, in the terms of total number of combat deaths, are those conflicts in which the two sides are considered to be of equal strength. On the other hand, when the rebels are the weaker side, the conflicts tend to be less intensive. I also find that conflicts that started during the Cold War period, and those that are fought in mountainous terrain and in more populous countries tend to be more severe. Not surprisingly, internationalized internal conflicts are also associated with more violence. In contrast, ethnically heterogeneous and democratic countries tend to experience less devastating conflicts.

NATURAL RESOURCES AND THE SEVERITY OF CONFLICT

The variation in conflict severity is likely to depend on various factors, including the size of the state army and the rebel force, the relative capability of the two, and the military

strategy adopted by the rebel group. Natural resources may have an effect on all these factors, directly or indirectly. A state with access to large resource revenues may be able to hire more soldiers and equip them better. Similarly, rebel groups that can exploit natural resources may be able to recruit more participants and buy weapons that are more effective. The promise of future resource income may motivate rebels to join a movement and increase the intensity of the fighting effort as only successful fighting will secure the revenues. In addition, abundant resources may have a detrimental effect on a state's fighting capacity, as argued, for example, by [Laitin and Fearon \(2003\)](#). Access to lootable natural resources¹ may contribute to the fact that some rebellions are characterized by warlordism, with multiple actors fighting over state and natural resources, as, for example, in Liberia. In other places, the promise of resource exploitation may motivate the rebel movement to use indiscriminate violence to clear resource areas of civilians. In Sierra Leone, the atrocities committed by the rebels effectively emptied the diamond areas of civilian miners. Unfortunately, little theory has been developed to explain how natural resources may be linked to the severity of armed civil conflict, with the rare exceptions being Addison, Le Billon, and Murshed (2003) and Weinstein (2007).

Addison, Le Billon, and Murshed develop a two-actor model to describe African civil wars. They argue that if resource looting is the main motivation of the rebellion, the conflict is likely to become protracted and to be characterized by longer periods of low intensity warfare. Limited fighting, even collaboration, between the rebel group and the military forces provides opportunities to loot resources (such as alluvial diamond deposits) while at the same time minimizing the risk of death and injury. Sometimes, as in Sierra Leone and the Republic of the Congo, soldiers participate in the plunder. At the same time, continuation of the conflict is preferred over peace, as the same opportunities for revenue raising may not be available during peacetime. For example, the rebels may face competition from other actors such as artisanal miners and mining companies.

The framework has three implications. First, conflicts over lootable resources should have a lower intensity level with fewer combat-related deaths and longer duration. Of course, the total number of combat deaths may remain relatively high if the conflict is prolonged substantially. Second, the model predicts that only lootable resources are related to the severity of conflict. Third, even if the number of battle-related deaths is limited, the burden on civilians may be enormous if the rebels resort to indiscriminate violence.

In contrast to Addison, Le Billon, and Murshed, Weinstein (2007) seeks to explain rebel violence toward civilians. Based on extensive fieldwork, he argues that a rebel group's access to easily accruable income, for example from lootable natural resources, is central in shaping

the organizational structure of the rebel movement and its strategies regarding treatment of noncombatants. A rebel movement that is able to reward its participants in the short term is more likely to attract individuals that seek short-term personal gain and are less committed to the long-term objective of the movement. In addition, the members are less likely to share ethnicity or social or ideological values with the local population, and are more likely to be difficult to discipline by the rebel group leadership. These characteristics make the rebel group generally more violent and the rebels more likely to use indiscriminate violence towards civilians.

Although the two frameworks are not mutually exclusive, they provide a useful starting point to form hypotheses.

Hypotheses

Most natural resources are located in the soil or in the underlying rock formations. Therefore, exploitation of these resources is bound to a specific location and relocation is impossible. Revenues from resources are available to those that control the resource location and have access to appropriate equipment. Therefore, in most cases, to loot resources for personal gain or to finance warfare during a conflict, a rebel group has to control the resource area.ⁱⁱ This is a central condition in the Addison, Le Billon, and Murshed and Weinstein arguments: in both models, rebels' access to natural resources during the conflicts is crucial. Thus, if natural resources have an effect on the level of violence through their effect on the rebel group, then the location of resources in relation to the conflict zone should matter:

Hypothesis 1. Natural resources have an effect on conflict severity when located in the same region as the conflict.

Some natural resources are more accessible to rebel exploitation than are others. Roughly, resources can be divided into two categories: those that can be exploited by individuals using simple means and those that require sophisticated equipment and greater expertise. Secondary diamonds and many other gemstones are often available near the surface and are accessible to artisanal miners. These types of resources can be exploited by rebels or small groups of forced labor. Gemstone occurrences tend to be spread over larger areas and, therefore, are more difficult for government forces to defend than, for example, oil production installations. For the same reasons that gemstones are lootable during a conflict, their production in peacetime may be partially outside government control. Therefore, the state may have few incentives to

effectively stop fighting because part or most of the revenue flows would not accrue to it anyway.

Following the Addison, Le Billon, and Murshed argument, if the main motivation for the conflict is to loot gemstones, we would expect the rebel group to allocate time from fighting to resource exploitation. Consequently, we would expect these conflicts to be less intensive:

Hypothesis 2. Gemstone production in the conflict zone is related to less intensive conflicts.

All other things being equal, this should also result in a lower number of total combat-related deaths. However, conflicts in which rebels have access to gemstone deposits tend to last longer (Fearon 2004; Lujala 2010). If the conflicts are substantially longer, the total combat death toll may still be relatively high. Thus, the effect of production on the total number of combat deaths is ambiguous.

If Weinstein's argument – that the presence of lootable resources alters the organizational structure of the rebel movement, making it more violent – holds, then gemstone mining in the conflict zone should make these conflicts more severe.ⁱⁱⁱ

In most cases, drug cultivation is strictly illegal and beyond a state's taxation control. Cultivation itself is likely to profit from the lawless environment created by conflict and, consequently, a rebel group may have little interest in challenging the state. Drug cultivation differs considerably from gemstone mining in that it is labor intensive and less flexible. If, for example, a harvesting season is interrupted by fighting, this is likely to lead to a decline in revenues. Gemstone miners, on the other hand, are less dependent on the time of year at which they exploit the deposits. For these reasons, drug cultivation is likely to require a more stable environment and a tighter collaboration with the local civilians than gemstone mining. Consequently, we would expect that drug cultivation would be related to fewer combat deaths and less intensive conflicts:

Hypothesis 3. Drug cultivation in the conflict zone is related to less severe conflicts.

A notable feature of the Addison, Le Billon, and Murshed and the Weinstein models is that they both explicitly connect *lootable* natural resources to conflict severity. However, the conflict region may also contain resources that are not readily available to the rebel group during the conflict, such as oil and gas reserves. To benefit from hydrocarbon production, the

rebels need in many cases to capture the state or achieve greater autonomy for the region, even seceding from the state.^{iv} This is likely to require more intensive fighting to win over government forces than would clashes to keep civilians out of diamond mining fields, for example. At the same time, the government is likely to have better control of revenues from oil and gas production in peacetime compared to its control of lootable resources; point-located extraction sites with one or a few operators increase the state's taxation capacity. The value of the extraction is higher for the state and, thus, it has a stronger incentive to effectively protect its exploitation rights. Moreover, unrest created by fighting increases the risk that foreign companies, in particular, will withdraw from the operations for as long as the region is insecure. Consequently, the government is likely to use its military force more intensively to secure extraction sites. As both sides have an incentive to invest in fighting, with the aim of winning over the other side's forces, and as the price of victory is high, we would expect that these conflicts would be more intensive and accumulate more combat-related deaths:

Hypothesis 4. Oil and gas production in the conflict zone is related to more severe conflicts.

What about hydrocarbon production that is located outside the conflict zone? Can it have an effect on conflict severity? It is plausible to think that oil and gas production that is not directly contested may affect conflict severity differently. This may be due to several reasons. First, the government can continue to produce hydrocarbons without interruptions during the conflict. Second, unless ousted, it is not threatened to be cut off from a major revenue source. Third, in the case the rebel movement grows and becomes alarmingly strong, revenues from hydrocarbon production in peaceful regions can be directed to fight the rebel group. Therefore, the need to suppress the rebellion is less urgent and the government's motivation to fight the rebels is likely to be lower: the financial stake is smaller and not immediately threatened.

Hypothesis 5. Oil and gas production outside the conflict zone is related to less severe conflicts.

DATA

Resource data

For hydrocarbon production (crude oil or/and natural gas), I use PETRODATA (Lujala, Rød, and Thieme 2007), which assigns geographic coordinates for more than 1 200 regions with hydrocarbon fields. I overlay conflict zones (Gleditsch et al. 2002; Harbom and Wallensteen 2005)^v and regions with hydrocarbon production to ensure spatial overlap and use the temporal information from both datasets to check whether hydrocarbons were produced in the area at the time of conflict. I code a production dummy that takes a value of 1 if hydrocarbon production had started prior to the conflict or started during the conflict.

Similarly, I code a dummy for hydrocarbon production that takes place outside the conflict zone. The dummy excludes production in regions where another conflict is ongoing. Offshore production is always coded as production outside the conflict zone. In addition, I use PETRODATA to code a country-level dummy, e.g., whether there was production in the country at the time of the conflict.

To include a more lootable natural resource in the analysis, I code a dummy for secondary diamond and other gemstone mining. The procedure is the same as above, with conflict zones encompassing gem mining that had started prior to or during the conflict being identified and coded. Data for secondary diamonds come from DIADATA, which provides coordinates for more than 1 000 diamond deposits throughout the world (Gilmore et al. 2005). For other gemstones, such as rubies, jade, sapphires, and opals, I use GEMDATA (Flöter, Lujala, and Rød 2005). Because of the very different mining methods involved, primary diamonds are not included in the gemstone dummy. In addition, I code a country-level gemstone dummy as for hydrocarbon production.

Further, I have collected location data on coca bush, opium poppy, and cannabis cultivation for the period 1945–2002 (Lujala 2003). I use these data to construct drug cultivation dummy in line with the gemstone and hydrocarbon variables.

In total, my dataset consists of 258 armed civil conflicts from the UCDP/PRIO Armed Conflict Dataset (Gleditsch et al. 2002; Harbom and Wallensteen 2005). At the median, a conflict in the dataset lasts for two years and produces 800 combat deaths (Table 1). The distribution of the duration and combat deaths is highly skewed: on average, a conflict lasts for more than five years and results in 20 000 battle-related deaths.

TABLE 1 IN HERE

An initial examination of the descriptive data in Table 1 suggests that there may be a link between natural resources and the number of combat deaths. This is especially true when

hydrocarbon or gemstone production is located inside the conflict zone. A total of 75 conflicts took place in regions with hydrocarbon production, with the median conflict lasting for almost three years and producing more than 2 000 combat deaths. Interestingly, the statistics suggest that hydrocarbon production outside a conflict zone may reduce the number of deaths. Gemstones are produced in conflict zones in 60 cases. These conflicts produce over 100% more combat deaths and last twice as long as the median conflict. When hydrocarbon and gemstone production are measured at the country level, the figures approach the values for the median conflict. Drug cultivation in the conflict zone is associated with higher median figures for both the number of deaths and duration. However, these figures do not differ substantially from the country-level measures.

Dependent variables

I use the annually updated UCDP/PRIO Armed Conflict Dataset (Gleditsch et al. 2002; Harbom and Wallensteen 2005) in the analysis. The dataset includes all conflicts with more than 25 annual battle-related deaths. From the dataset I include, and merge, all internal and internationalized internal armed conflicts. Conflicts with more than two years of peace are coded as separate conflicts. Following the UCDP/PRIO data, a conflict is coded as new if there has been a total change in the opposition side. In total, the dataset used in the analysis consists of 258 distinct conflicts for the period 1946–2002.^{vi}

The combat death data come from Lacina and Gleditsch (2005), who define combat deaths as ‘all people, soldiers or civilians, killed in combat’.^{vii} The battle deaths data are available for the period 1946–2005, and for all armed civil conflicts in the UCDP/PRIO dataset. For the dependent variables in the analysis, I use the total number of combat deaths accumulated during the conflict and the average daily death rate over the whole conflict (intensity).^{viii}

Control variables

There is a profound lack of theory in the studies on conflict severity. Lacina (2006) tests whether the same culprits that cause conflict onset also explain the severity of major civil wars (over 900 combat deaths). Her analysis reveals only a few robust findings. Democracies and countries with a minority larger than 8% tend to have fewer deaths. In addition, conflicts that started in the post-Cold War era are less violent.

In this article, I take the same approach as Lacina: I use variables that are related to civil conflict onset and duration. In contrast to Lacina, I also test several conflict-level variables,

thus providing insight as to whether severity is partially determined by the local conditions and not only by country-level characteristics.

Variables specific to the conflict zone

Buhaug and Lujala (2005) argue that local conditions should be included in the analysis of conflict. Following their approach, I construct three measures for rough terrain. I measure the forest cover by accounting for the proportion of covered, open or fragmented forest in the conflict zone (FAO 1999). Mountainous terrain is calculated similarly and data come from UNEP (2002).^{ix} In addition, I construct a rainy season dummy for conflict zones with more than 8 mm of rain daily for a month or more (GPCP 2002). I also include a dummy for conflicts that abut an international border.

Other conflict characteristics

I use data on the relative strength of the rebel group from Cunningham, Gleditsch, and Salehyan (2007) to construct two dummies. The first dummy takes the value of 1 if the rebel movement is considered to be weaker than the governmental forces. The second dummy takes the value of 1 if the two are considered to be of equal strength.

Previous studies have shown that territorial conflicts differ from governmental (Buhaug 2006) and last substantially longer (Fearon 2004; Lujala 2010). Therefore, I code a dummy for incompatibility from the UCDP/PRIO Armed Conflict Dataset that takes a value of 1 if the conflict is over territory. Using the UCDP/PRIO dataset, I code a dummy for internationalized internal conflicts. Since the severity of individual conflict may depend on whether there are other active conflicts in the country at the time, a dummy for parallel conflicts. Finally, following Lacina (2006), I code a Cold War dummy for conflicts that started before 1990.

Variables measured at the country level

The control for the income level, per capita income, comes from Fearon and Laitin (2003) and is updated using the Penn World Tables 6.0 (Heston, Summers, and Aten 2002) and World Bank Development Indicators (World Bank 2002). Per capita income is coded for the year before the conflict started. Population size, measured at the beginning of the conflict, also comes from Fearon and Laitin and is updated from World Bank Development Indicators. Fearon and Laitin is also the source for the ethnicity, ethnic polarization, and religious fractionalization variables. I use a lagged Polity IV variable to measure the level of

democratization (Marshall and Jaggers 2002). The Polity score varies from –10 to 10, which denote the most autocratic and the most democratic state, respectively. Following [Lacina \(2006\)](#), I code a democracy dummy that takes a value of 1 if the country was democratic the year before the conflict started (Polity score > 5).

Conflict duration

Generally, longer conflicts tend to create more combat deaths (Table 2). At the median, a conflict that dies out relatively quickly, in one year or less, produces about 200 combat deaths. However, many of these conflicts are very short and intensive. In total, 43 conflicts lasted less than 10 days, with more than 70 deaths per day (at the median), which gives an annual death rate of 26 000.

TABLE 2 IN HERE

The median estimates for the total number of battle-related deaths increase over the duration of conflict, culminating in 35 000 deaths for those conflicts lasting between 20 and 30 years. Very long conflicts, those over 30 years, are rare (the dataset only has six) and they tend to have lower total combat deaths figures. Most intensive are the conflicts lasting less than six months and those lasting between 10–30 years.

The summary table (Table 1) suggests that conflicts in which natural resources are located in the conflict zone are more violent and last longer than other types of conflicts (the effect on duration is also documented in [Lujala \(2010\)](#) and [Fearon \(2004\)](#)). Therefore, it is likely that if the duration is included in the estimation model as a control variable it will capture all or part of the resources' effect on the total death toll. As the main objective of this article is to determine the total effect of hydrocarbon and gemstone production and drug cultivation on the severity of armed civil conflict, it would be inaccurate to include the length of conflict in the analysis. If I included duration in the model, I would be able to tell only whether these resources have an effect on conflict severity over and above their possible effect on duration. Of course, this is an interesting question in itself, and it is assessed in the analysis section. In the analysis, the conflict duration is measured in days. The data on conflict duration come from [Gates and Strand \(2004\)](#).

ANALYSIS

This article looks at the role of resources in explaining two aspects of conflict severity: the total number of combat deaths and the intensity of the conflict. The analysis tests one aspect – the relevance of natural resources and their location – and seeks to conclude whether the

results are robust to a set of control variables, the removal of outliers, and other robustness checks. Tables 3 and 4 present the main results.

Natural resources and the total number of combat-related deaths

Models 1-3 in Table 3 presents the main results from the multivariate OLS regressions on the number of combat deaths (log transformed). The coefficients are reported in exponential form, which are easily interpreted; the coefficient shows the multiplicative change in combat deaths for one unit change in the independent variable. For example, in Model 1 hydrocarbon production in the conflict area triples the number of deaths.

TABLE 3 IN HERE

Model 1 includes the four resource dummies and the other conflict level variables. The results show that gemstone mining and hydrocarbon production in the conflict zone are strongly associated with the number of combat deaths: both more than double the number of combat deaths. Drug cultivation in the conflict zone and hydrocarbon production outside the conflict region are significantly associated with a decline in the number of battle deaths. Mountainous terrain and access to international border are positively related to number of combat deaths.^x

In Model 2, I add controls for conflict and country characteristics: the relative strength of the rebel movement, dummies for internationalized conflicts and for those that started during the Cold War, population size, two ethnicity variables, and level of democracy.^{xi} The statistics for country characteristics are missing for some observations and, in total, I lose 14 conflicts from my dataset.^{xii}

The inclusion of these variables makes the negative relation between drug cultivation and the total number of casualties both stronger and more significant. They have a similar effect on the relationship between hydrocarbon production outside the conflict area and combat deaths. Both resource dummies are associated with a large decline in combat deaths: drug cultivation decreases the number by more than 60% and oil and gas production halves it.

The controls increase both the magnitude and the significance of the gemstone dummy. The effect of hydrocarbon production declines a slightly but it stays highly significant. Both exhibit a large and significant effect on conflict severity: the production of one of the two more than doubles the number of combat-related deaths. If I set all other covariates to their mean, hydrocarbon production in the conflict area increases the death toll from 900 to 2 300 and gemstone mining increases it from 950 to 2 600.

There are 18 conflicts in the dataset in which both gemstones and hydrocarbons are produced in the conflict zone. I create a dummy for these conflicts to study whether they are unusually violent. Analysis that includes the dummy measure in Model 2 shows that the combined measure has no effect on the results. If I remove the two original resource dummies and only use the combined measure, I find that the number of combat deaths is increased by a factor of 4.1 for these conflicts. Adjusted R-squared, however, shows that this model performs worse than Model 2 (results not shown).

Model 2 shows that conflicts in which the rebel and governmental forces are equally strong accumulate over four times more combat deaths. Similarly, internationalized conflicts and those that started during the Cold War era produce substantially more combat deaths. Countries that were considered to be democracies a year before the conflict started seem to experience conflicts with fewer battle-related deaths, as do ethnically diverse countries. The total population size and the number of combat deaths are positively associated.^{xiii}

The base model (Model 2) has 10 control variables. In Model 3, I trim the number of controls. I retain the variables that gemstone and hydrocarbon production and drug cultivation may affect, i.e., dummies for the internationalized conflict, relative strength between the rebel and governmental forces, and democratic countries. In the reduced model, gemstone mining and hydrocarbon production in the conflict zone are significantly and strongly related to combat deaths, but drug cultivation is rendered weaker and not significant. In this model, hydrocarbon production outside the conflict region has negative effect on the number of combat deaths although its effect is slightly smaller and less significant. It is worth to note that Model 3 performs substantially worse compared to Model 2: the adjusted R-squared is more than halved.

The analysis presented in this section has shown that production of natural resources in the conflict zones is related to the number of total combat deaths. However, it is possible that natural resources in general are related to the number of battle deaths (and that their location does not matter) and the results are merely picking up this effect. To ensure that this is not the case, I run the base model (Model 2) with the country-level aggregates instead of the conflict-level measures. It shows that none of the country-level aggregates is related to the number of combat deaths.^{xiv}

Intensity of conflict

In this section, I examine the intensity of conflict. From earlier empirical studies, it is known that gemstone mining and hydrocarbon production inside the conflict zone increase the

duration of conflict ([Fearon 2004](#); [Lujala 2010](#)). Similarly, Table 2 shows that longer conflicts tend to have more combat deaths. An interesting question is whether the perceived link between gemstone and hydrocarbon production and the number of combat deaths is a result of the fact that they make conflicts longer. In Model 4, I control for the duration of conflict. The model includes the same dependent variable and the same controls as the base model (Model 2) in addition to a control for conflict duration, which is measured in days and log transformed.

The model shows that oil and gas production in the conflict zone increases the number of deaths by a factor of 1.8 even after accounting for its effect on duration. In numbers, hydrocarbon production increases deaths from 1 000 to 1 900 (with all other covariates set to their means). After I control for conflict duration, gemstone mining is no longer significantly related to the number of combat deaths. The effect of hydrocarbon production outside the conflict zone decreases slightly, and the effect of drug cultivation in the conflict region remains unchanged.

Next, as a more sophisticated analysis of conflict intensity, I use the average daily death rate as the dependent variable (log transformed). At first glance, only drug cultivation in the conflict zone seems to be related to the intensity of conflict (Model 5). This effect is large: drug cultivation is associated with a more than 60% decline in intensity. In numbers, drug cultivation decreases the yearly death rate from 1 500 combat deaths to 600. Gemstone and hydrocarbon production are unrelated to conflict intensity in this model. Other variables show that conflicts in the Cold War era were more intensive as are conflicts in more mountainous areas. Maybe not that surprisingly, conflicts in which rebels are relatively weak are less intensive. Proximity to border, ethnic fractionalization, and polarization are related to less intensive conflicts. Countries that were democratic the year before conflict started tend to experience less intensive conflicts.

Table 2 suggests that very short conflicts (with a duration of 10 days or less) are considerably more intensive than the other conflicts. This may be a result of special circumstances that the model is not able to pick up. Therefore, I add a dummy for these conflicts (Model 6). The results show that this has a considerable impact on several variables: the measures for mountainous terrain and population size and the dummy for internationalized conflict increase substantially in both magnitude and significance. The dummy that indicates the proximity to a neighboring country loses all its explanatory power. Importantly, the results now suggest that hydrocarbon production inside conflict area significantly predicts more intensive conflicts: production increases the death rate by a factor of 1.6. Production outside

the conflict zone decreases the combat death rate by 40%. The explanatory power of the model (adjusted R-squared) increases substantially when the dummy for the very short conflicts is introduced.

Secessionist aspirations, hydrocarbon production, and conflict severity

Collier and Hoeffler (2006) argue that oil production is especially salient for secessionist conflicts. Model 7 in Table 4 tests whether territorial conflicts over regions with hydrocarbon production have a higher number of combat deaths by adding an interaction term between these two factors. The interaction term renders the original hydrocarbon production insignificant, but, jointly, territorial conflicts and the presence of hydrocarbon production are highly significant ($p = 0.004$). The effect is large; given that there is hydrocarbon production in the conflict zone, conflicts over territory result in a total of 3 700 deaths compared to 1 600 when the conflict is not over territory (with all other variables set to their means).

TABLE 4 IN HERE

In Model 8, I test whether conflicts over territory with hydrocarbon production are more intensive. The interaction term renders the original dummy for hydrocarbon production in a conflict zone weaker and insignificant, whereas the interaction term is large and significant. The combined effect of the two is huge: given that there is hydrocarbon production in the conflict zone, the death rate in conflicts over territory is nearly tripled compared to those over government.

Robustness checks^{xv}

The possibility of reversed causality is always present in statistical analysis. In this article, I have limited the endogeneity problem by using dummies for resource exploitation. The use of production volumes would have been much more susceptible to reversed causality, as the size of production is likely to be affected by the conflict severity and vice versa. In an extreme case, production may stop altogether because of heavy fighting. In some cases, production may even increase because of conflict or because the government is anticipating a conflict. For example, the state may increase the volume of oil production to compensate for a rise in military expenditures before and/or during the conflict.

In this article, the resource dummies take a value of 1 if production occurred before the conflict commenced or if production started during the conflict. This leaves room for the possibility that conflict severity may have affected the commencement of production in some cases. However, the number of such cases is likely to be very limited. In gemstone mining,

there are usually very few impediments to production starting, and extraction usually starts as soon as the deposits are discovered. Therefore, the conflict is unlikely to have an effect on the timing of production start, although the scale of production may vary as a result of unrest in the mining region. Similarly, it is unlikely that the start date of hydrocarbon production is related to conflict severity. Production requires significant investment in production technology and transport, and in many cases involves large multinational companies. This makes it almost impossible for rebels to commence production during a conflict for the first time. Moreover, it seems farfetched that a government would start production in a conflict-affected area earlier than planned because of the conflict there. If anything, it is far more plausible that the government would postpone production because of the conflict. Again, production volumes may vary, but this factor is not included in the model and thus does not pose a problem. Drug cultivation is most likely to suffer from a potential endogeneity problem, as it is plausible that drug cultivation is made possible by a long, less severe conflict.

As a robustness check, I run an alternative specification of Model 2 in which I replace the resource dummies with dummies that indicate production status the year before the conflicts start. For drug cultivation the results are very robust. Hydrocarbon production in the conflict zone loses one third of the effect and becomes less significant and production outside the conflict zone increases in both magnitude and significance. Gem production loses slightly in magnitude but it still more than doubles the number of combat deaths.^{xvi}

An outlier analysis of Model 2 indicates seven potential outliers that have either large residuals and/or a strong influence on the results.^{xvii} The exclusion of these has a slight effect on the hydrocarbon production dummies; both become stronger and more significant. The exclusion weakens the effect of the gemstone variable, which nevertheless continues more than double the total number of combat deaths. Similarly, the effect of drug cultivation declines slightly but it remains strongly associated with battle-related deaths. The outlier analysis of Model 6 (conflict intensity) reveals four potential outliers.^{xviii} The removal of these has no effect on the results.

The dataset includes 25 conflicts that were ongoing in 2002. These conflicts differ substantially from other conflicts when it comes to the total number of deaths, conflict duration, and the occurrence of resource exploitation in the conflict zone. At the median, they are six times longer and their death toll is six times higher. In addition, these conflicts are more likely to take place in regions with gemstone mining or hydrocarbon production. These conflicts may form a distinct subgroup and their inclusion may lead to bias in the analysis.

Therefore, as a robustness check, I code a dummy for these conflicts and run the base models with the dummy.^{xix} Model's 2 and 6 results are robust to the inclusion of the dummy: only the dummy for hydrocarbon production inside the conflict zone loses slightly.

Next, I run the base model for the total combat deaths (Model 2) with alternative specifications for ethnic diversity and democracy. I use Alesina et al.'s (2003) ethnic fractionalization data instead of data from Fearon and Laitin (2003). This does not have any substantial effect on resource variables' coefficients or standard errors and the model performs slightly worse than the base model. If I use the Polity score instead of the dummy for democracies and add the square term, I find a weak indication of nonlinearity, suggesting that conflicts in more democratic countries are increasingly less severe. This has little effect on other variables or standard errors. I include religious fractionalization and the size of the conflict area (log transformed) in the model but these extra controls do not have any substantial effect on the results and both variables are insignificant. I run the same robustness checks for the intensity model (Model 6) and find that the results for gemstone mining, drug cultivation, and hydrocarbon production outside the conflict zone are robust to these checks. Hydrocarbon production inside the conflict zone loses slightly in significance in some of these tests.

I also add the five variables that were excluded in the model building – the dummies for territorial conflicts, rainy season, and parallel conflict in country, and the measures for the forested terrain in conflict zone and per capita income level – in the base models one by one. The model on total combat deaths is robust to these additions and none of the extra controls is significant. I find a weak indication that two or more simultaneous conflicts in a country are associated with less intensive conflicts and that forested terrain is related to more intensive warfare. These controls have no effect on the resource variables.

Finally, as the last robustness check, I add dummies for continents and former French and British colonies in the base models. All resource variables are robust to these dummies, and the continent and colony dummies themselves are insignificant.

DISCUSSION OF THE MAIN RESULTS

At a general level, one of the most important results in this article is the confirmation that it is essential to control for the site of resource production in relation to conflict location. In this article, using country-level measures for production would have resulted in nonresults and wrong conclusions. Hydrocarbon production is a striking example of the importance of location control: the location of oil and gas production inside the conflict zone is associated

with severer conflicts, but their location outside the conflict zone is related to fewer combat deaths and less intensive conflicts. Yet, at the country level, production is seemingly unrelated to conflict severity.

The results show that lootable gemstones in the conflict zone more than double the number of battle-related deaths. At least partially, if not entirely, this is because these conflicts tend to be longer. In any case, I do not find evidence that these conflicts are less intensive when it comes to battle related deaths. Therefore, these results do not lend support to the argument proposed by Addison, Le Billon, and Murshed (2003) that resource looting during a conflict should be associated with a lower intensity of fighting. Of course, it could be the case that in conflicts in which resource looting is the driving motivation for the rebel group, the Addison, Le Billon, and Murshed argument is correct. My analysis is not able to differentiate these conflicts from the others.

Drug production appears to lend partial support to the Addison, Le Billon, and Murshed argument. These conflicts have fewer combat deaths and are substantially less intensive. However, one should be careful in drawing strong conclusions about the relationship. In contrast to gemstone production, which is exogenous to the model, drug cultivation may not be exogenous. For example, drug cultivation can be introduced to areas affected by conflict, after the conflict has started. However, the results show that drug cultivation before conflict starts is strongly related to less severe conflicts.

Oil and gas production in the conflict region tends to more than double the number of combat deaths. Even when accounting for the fact that these conflicts last longer, the effect remains large. In addition, the analysis suggests that production contributes to the higher intensity of these conflicts. A likely explanation is that oil and gas production is a highly valuable revenue source for both the government and the rebels. Rebels can access these revenues only through successful state capture or secession, or by increasing their negotiating power in terms of how resource revenues originating from the region are shared. This requires more offensive fighting than conflicts in which victory is not necessary for resource looting. Government, on the other hand, may face a substantial decline or outright interruptions in oil and gas exploitation during a conflict when, for example, foreign companies deem the risks to be too high and withdraw from the fields. Together, these two facts – the extremely high value of oil and gas production and the forgone revenue flows during the conflict – are likely to provide a greater incentive to invest in winning the conflict (in the form of machinery, weaponry and numbers of rebels/soldiers) than would otherwise be the case. In addition, both sides are likely to seek victory or a beneficial settlement as fast as possible. Even in the case

that oil and gas production continues throughout the conflict, government is likely to use more force to protect the installations.

A more detailed analysis reveals that conflicts over territory with hydrocarbon production are the most severe, with prime examples being the secessionist conflicts in the oil rich Southern Sudan and Niger Delta. The Second Sudanese Civil War killed more than 55 000 in combat during the 21 years it was active (1983–2004), whereas the Nigerian Civil War (the Biafran War) in the 1960s accumulated more than 70 000 battle deaths in just four years. This result further underscores the argument that conflicts in which the financial stakes are high for both sides are the most severe.

Interestingly, hydrocarbon production outside the conflict zone and in offshore areas has an opposite effect on the total death toll: in these cases, conflicts kill considerably lower numbers of combatants. One explanation could be that these states have a source of revenue that is not affected by the fighting and can thus be used to invest in the military, even to hire mercenaries, in order to crush emerging conflicts quickly and effectively. This would result in lower numbers of casualties as the length of the conflict should be limited. However, when I control for the length of conflict, the effect remains considerable and significant. The results also show that these conflicts also tend to be less intensive, which runs against the logic of the explanation above.

What could explain this effect? From earlier empirical studies (for example, [Fearon and Laitin 2003](#); [Humphreys 2005](#); [de Soysa and Neumayer 2007](#)), we know that countries dependent on oil production and exportation tend to have a higher risk of conflict onset. These countries are often described as weak, which, among other things, manifests as weak military capacity and inability to control the entire country. If the state is militarily weak, then small, relatively feeble rebel movements may be able to emerge in regions that are geographically or/and economically less central, as the barriers to insurgency there are lower. It is possible that in these cases neither side is able to, or interested, in engaging in a full-blown conflict as in contrast to conflicts in resource-rich regions. Rebel movement may be too weak to contest the state seriously, and the state may be unwilling to invest in fighting as long as the rebel movement is not a direct threat to its existence or its resource revenue base. Therefore, the weak state -channel from natural resources to conflict may be important in determining the hydrocarbons' effect on severity of armed civil conflict.

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Table 1. Total Combat Deaths and Conflict Duration of Armed Civil Conflict, 1946–2002. Median and Mean Estimates by Type and Location of Natural Resources

	N	%	<u>Combat deaths</u>		<u>Duration (years)</u>	
			Median	Mean	Median	Mean
All conflicts	258	100	800	20,000	1.9	5.2
Hydrocarbons (crude oil and natural gas)						
Conflicts in countries with production	159	62	950	21,000	2.0	6.1
Conflicts in regions with production	75	29	2,100	37,000	2.8	7.8
Conflicts in countries with production <i>outside</i> conflict zone(s)	129	50	700	9,000	2.0	4.9
Gemstones ^a						
Conflicts in countries with production	122	47	1,000	28,000	2.4	6.6
Conflicts in regions with production	60	23	1,700	49,000	4.0	9.5
Drugs (coca, opium, cannabis)						
Conflicts in countries with cultivation	78	30	1,000	21,000	4.0	8.7
Conflicts in regions with cultivation	34	13	1,000	28,000	3.3	9.4

^aIncludes secondary diamonds and other gemstones such as rubies, sapphires, emeralds, and jade. Primary diamond production excluded.

Table 2. Total Combat Deaths and Average Annual Death Rate of Armed Civil Conflict, 1946–2002. Median and Mean Estimates by Conflict Duration

Duration	N	Combat deaths		Intensity	
		Median	Mean	Median	Mean
<10 days	43	150	400	26,000	74,000
10-30days	13	200	6,000	3,300	184,000
1-6 months	18	850	2,000	2,000	6,000
6-12 months	33	150	3,000	250	4,000
1-5 years	76	700	24,000	250	7,000
5-10 years	32	7,000	31,000	900	4,000
10-20years	27	18,000	34,000	1,400	2,000
20-30years	10	35,000	111,000	1,500	4,000
>30 years	6	17,000	16,000	400	400

Table 3. OLS Equations for Total Combat Deaths and Daily Death Rate (Intensity) of Armed Civil Conflict, 1946–2002

	Total combat deaths			Intensity		
	1	2	3	4	5	6
Gem production, conflict zone	2.565 (2.05)**	2.720 (2.51)**	2.754 (2.34)**	1.761 (1.46)	1.163 (0.33)	1.592 (1.13)
Drug cultivation, conflict zone	0.445 (1.86)*	0.388 (2.39)**	0.693 (0.78)	0.398 (2.50)**	0.407 (2.03)**	0.422 (2.21)**
Hydrocarbon production, conflict zone	3.007 (3.75)***	2.558 (3.41)***	3.679 (4.41)***	1.845 (2.53)**	1.351 (0.93)	1.570 (1.85)*
Hydrocarbon production, outside conflict zone	0.583 (1.79)*	0.481 (2.55)**	0.582 (1.91)*	0.561 (2.06)**	0.650 (1.18)	0.586 (1.92)*
In Mountainous terrain, conflict zone	1.052 (2.30)**	1.061 (2.98)***		1.055 (2.85)***	1.049 (1.82)*	1.060 (3.46)***
Conflict at border, conflict level	3.062 (3.31)***	2.470 (2.75)***		1.002 (0.01)	0.424 (2.55)**	0.886 (0.43)
Weak rebel group		1.262 (0.37)	1.560 (0.69)	0.419 (2.05)**	0.146 (3.84)***	0.346 (2.29)**
Equal strength		4.410 (2.11)**	3.756 (1.75)*	1.669 (1.07)	0.661 (0.70)	1.567 (0.86)
Cold War		3.885 (4.08)***		3.521 (4.31)***	3.207 (3.40)***	2.690 (3.43)***
Internationalized conflict		10.702 (5.72)***	6.920 (3.96)***	4.096 (3.98)***	1.639 (1.43)	2.870 (3.49)***
In Population size		1.590 (5.46)***		1.286 (2.57)**	1.051 (0.37)	1.254 (2.18)**
Ethnic fractionalization		0.259 (2.43)**		0.213 (3.07)***	0.176 (2.51)**	0.191 (3.21)***
Ethnic polarization		0.454 (2.00)**		0.392 (2.72)***	0.341 (1.96)*	0.332 (2.87)***
Democracy		0.481 (2.07)**	0.691 (0.87)	0.401 (3.17)***	0.337 (3.15)***	0.293 (4.52)***
In Duration				1.668		

(10.78)***

						<i>Yes</i>
<i>Dummy for conflicts with duration of 10 days or less</i>						
No. of conflicts	258	244	247	244	244	244
F	8.59	23.23	8.99	31.48	9.67	24.50
R-squared	0.15	0.39	0.17	0.58	0.37	0.58
Adjusted R-squared	0.13	0.35	0.14	0.55	0.33	0.55

NOTE: Table shows the exponential form of coefficients. Absolute t-values, adjusted over countries, in parentheses. * $p \leq 0.1$, ** $p \leq 0.05$, *** $p \leq 0.01$. Dependent variables are log-transformed.

Table 4. OLS Estimates for Total Combat Deaths and Daily Death Rate of Armed Civil Conflict, 1946–2002. Interaction effects

	7		8	
	<u>Combat deaths</u>		<u>Intensity</u>	
	Estimate t/F		Estimate t/F	
Hydrocarbon production, conflict zone	1.804	(01.47)	0.942	(0.20)
Territorial conflict	0.932	(0.15)	0.565	(1.31)
<u>Interaction term</u>	2.269	(1.35)	2.847	(1.90)*
F: Joint significance test	<i>6.01***</i>		<i>2.59*</i>	
F	20.56		24.85	
<u>Adjusted R-squared</u>	0.35		0.56	

NOTE: Table shows the exponential form of coefficients. Absolute t-values, adjusted over countries, in parentheses. F-values for the joint significance -test (the interaction term and hydrocarbon production), in italics. * $p \leq 0.1$, *** $p \leq 0.01$.

Models 7 and 8 include the same covariates as Models 2 and 6 in Table 3, respectively.

ⁱ Lootable resources can be extracted by individuals with simple methods. In this article, I consider secondary diamonds, other gemstones, and drug cultivation as lovable resources. Hydrocarbon production is nonlovable.

ⁱⁱ Resource looting may also take place along transport routes. For example, oil can be tapped from pipelines, although the obstacles to transport it further limit its scope as a revenue source.

ⁱⁱⁱ As the numbers of combat deaths and civilian deaths tend to be correlated (Weinstein, 2007: 306), conflicts characterized by a large number of civilian deaths also tend to have a higher number of combat deaths and to be more intensive.

^{iv} In some cases rebels may sell future extraction rights – “booty futures” – to raise income (Ross, 2005), or oil is looted from pipelines in considerable quantities as in Nigeria (Human Rights Watch, 2003). Rebels may also be able to raise money from oil companies through extortion, as in Colombia.

^v The UCDP/PRIO Armed Conflict Dataset (version 3-2005) includes coordinates for the conflict center that represents the geographic mid-point of battle-zones. The scope of conflict is represented by a radius variable that indicates the largest geographic extent of the conflict zone from the center point during the course of conflict.

^{vi} Conflicts that started in 2002 or later are excluded.

^{vii} A combat/battle death is defined as a death from two-sided violence, in which resistance is possible. The combat death toll excludes, for example, one-sided massacres and indirect deaths caused by displacement and diseases.

^{viii} The unit of analysis in this article is conflict. It does not include the null cases, nonconflicts, as these cannot have a location by definition.

^{ix} All area calculations are conducted using ArcGIS 8.0 from Environmental System Research Incorporated (ESRI), which is based in Redlands, California. ESRI also provides a series of base maps that were used to calculate surface areas for conflict zones.

^x I also try two other measures for rough terrain: the proportion of terrain covered by forests and the occurrence of a rainy season. Neither is associated with the number of combat deaths and nor have an effect on the adjusted R-squared, other coefficients, and standard errors. Therefore, they are excluded from the subsequent models.

^{xi} A Ramsey Reset test for omitted variables suggests that Model 2 does not have omitted variables.

^{xii} To ascertain that the missing observations are not driving the observed changes in coefficients and error terms, I run Model 1 without the 14 observations. Model 1's results are robust to the elimination of the 14 observations (results not shown).

^{xiii} I test two other conflict-specific variables: territorial conflicts are not associated with the number of deaths, and other active conflicts in a country do not have an effect on the severity of the individual conflict. I also find that per capita income is not related to the number of combat deaths. These variables have little effect on other coefficients or the adjusted R-squared, and therefore they are excluded from the subsequent models to limit the number of covariates.

^{xiv} Contact the author for the results.

^{xv} Results from the robustness checks are included in the additional tables that are available from the author.

^{xvi} As the changes in the production status for gemstones and hydrocarbons are unlikely to cause endogeneity problems and the results for drug cultivation are robust to whether or not cultivation during the conflict period is included, I prefer to use dummies that account for

production status during the conflict. This approach captures the effect of these resources on conflict severity also in the cases in which production starts during the conflict. This is especially relevant for longer conflicts.

^{xvii} These are the conflicts in Iran (Kurdistan, 1946), Algeria (1992–), Cuba (1961), Nigeria (1966), Ethiopia (Eritrea, 1962–1991), Afghanistan (1978–), and Guinea Bissau (1998–1999).

^{xviii} These are the conflicts in China (Tibet, 1959), Guinea Bissau (1998–1999), Yemen (1986), and Papua New Guinea (Bougainville, 1989 – 1996).

^{xix} The dummy for the ongoing conflicts includes also the conflicts that ended in 2001 or 2002 but were revived during the following two years.