Article:
Hinkkainen Elliott, K orcid.org/0000-0002-7552-0882 and Kreutz, J (2019) Natural resource wars in the shadow of the future: Explaining spatial dynamics of violence during civil war. Journal of Peace Research, 56 (4). pp. 499-513. ISSN 0022-3433

https://doi.org/10.1177/0022343318821174

Natural resource wars in the shadow of the future

Explaining spatial dynamics of violence during civil war

August 13, 2018

Abstract

Previous studies on natural resources and civil wars find that the presence of natural resources increases both civil conflict risk and duration. At the same time, belligerents often co-operate over resource extraction, suggesting a temporal variation in the contest over this sub-national space. This study argues that parties' fight over natural resources primarily when they expect that the conflict is about to end. In contrast, belligerents that anticipate a long war will not fight in natural resource rich areas since that will negatively influence extraction and thus provide them with less income. We test our argument using yearly and monthly grid-cell level data on African civil conflicts from 1989-2008, and find support for the expected spatial variation- in the location where battlefield events take place- depending on whether parties are involved in negotiations or not.

1 Introduction

The contest over territory occupies a central position in the study of conflict processes. A state's ability to dominate its territory is seen as a prerequisite for rebellion (Tilly, 1978; Fearon and Laitin, 2003) and influence the severity of civilian victimization (Kalyvas, 2006; Wood, 2014), conflict duration (Buhaug, Gates and Lujala, 2009), and outcome (Greig, 2015; Butcher, 2015). The ebbs and flows of fighting also have an immediate impact on the international community, creating vast refugee flows, posing a challenge for mediation attempts and where to deploy peacekeepers (Walter, 1997; Cederman et al., 2013; Ruggeri, Dorussen and Gizelis, 2016).

But a growing research agenda has noted that armed conflict does not *only* consist of 'battles'[1] but also different forms of co-operation between ostensibly opposed actors (Kalyvas, 2003; Christia, 2012; Mampilly, 2011; Staniland, 2017). This leads to 'intricate and often surprising relationships between states and non-state violent actors emerge and change within internal conflicts: mainstream politicians build armed wings, states collaborate with militias against common foes, police ignore private counterinsurgent armies, militaries tacitly share sovereignty with insurgent enemies, and warlords place their loyalists inside state security forces' (Staniland, 2012, 243).

A puzzling feature is that such collaboration notably often occurs in natural resource rich areas (Snyder, 2006); that are also often highly contested (Ross, 2004*b*; Lujala, 2010). Indeed, one of the most prominent studies on the resource-conflict nexus, Ross (2004*a*) finds occasional belligerent co-operation in exploiting natural resources in 88% of the civil conflicts fought over resources. Examples include Colombia and Myanmar where drug traffickers have paid off local guerrillas, warlords and state officials to pursue their business during the

[1]Kalyvas and Balcells (2010) find that 'conventional' warfare for decades have been an exception rather than the rule in civil wars.

conflict (Metelits, 2009; Meehan, 2011). In Angola, UNITA rebels and army officers were reported to have a 'gentlemen's agreement' to exploit diamonds on each bank of the river in the Cuango Valley (Le Billon, 2005). In the Democratic Republic of Congo, the control over trade networks in diamonds, gold and coltan was never successfully monopolized, but revenue consistently funded different rebel and foreign armies levying taxes (Kennes, 2005).

This indicates that fighting over natural resources varies over the course of the conflict. But what can explain these dynamics? We contend that the key factor relates to the negative effect that intense fighting has on resource extraction. When clashes are prevalent, warring sides have to dedicate all resources to armed action, local civilians flee the violence, which in turn decimates the workforce and reduces the natural resource income. This subsequently undermines belligerents ability to maintain or strengthen military capabilities, implying that fighting over natural resources may provide short-term gains but only if fighting is brief so as not to destroy the income from these areas.

Civil war belligerents have to pay attention both to short-term and long-term goals when they determine their strategy. The minimum short-term goal is to ensure that they are able to maintain the armed struggle, while the long-term goal is to extract as many future political or economic concessions as possible from the opponent. We argue that belligerents balance between these short-term and long-term goals on the basis of their perceived expectation of their own and the opponents strength to maintain fighting - i.e. perceived conflict duration - which influences their perceived strategic importance of controlling natural resource rich areas. When they expect conflict to continue indefinitely, ensuring long-term survival is the main prerogative, where getting a cut of the resource trade is more important than taking full control of the extraction. However, when they expect that the conflict may soon be over, they will boost

their efforts for maximizing short-term gains (Knutsen et al., 2017).

To approximate belligerents expectations about the future duration of the conflict, we use information about whether negotiations are underway or not. We assume that parties are more likely to expect that the conflict is closer to its end during rather than when there are no talks. Consequently, we expect that fighting in the vicinity of natural resources is more likely when talks are underway *ceteris paribus*. Our empirical investigation explores this argument both on the macro-level, focusing on across-year variation, and micro-level, tracking month-by-month changes with the onset of negotiations as a cut-off point. Our analysis of all African civil wars 1989-2008 find less fighting in natural resource-rich areas when conflicting parties are expecting a protracted fight. In contrast, as belligerents expect that the conflict is about to end, remaining battle-field action takes place primarily in areas with natural resources.

Our findings are relevant for scholars seeking to understand or predict the dynamics of civil war violence, and constitute one of the first empirical investigations into the puzzle why enemies at times collaborate in war zones (Staniland, 2012, 2017). Further, we show that the localized risk of violence may increase in some areas when peace talks are launched which is useful knowledge for policymakers seeking to facilitate conflict resolution, and should be considered in decisions about where to deploy peacekeeping forces. Our study identifies where 'spoilers' are likely to emerge, and this information can prevent their ability to sabotage a peace process (Ruggeri, Dorussen and Gizelis, 2017).

2 Resources, territorial control, and violence

Recent decades have witnessed vast scholarly interest in the possible correlation of natural resources and armed conflict (Buhaug and Rød, 2006; Østby, Nordås and Rød, 2009; Weidmann, 2009; Buhaug, 2010; Buhaug et al., 2011). Country-

level studies have found mixed results between the primary commodity exports - oil in particular - and civil war link (Ross, 2004*b*; Basedau and Lay, 2009; Koubi et al., 2014), but sub-national studies have identified that the presence of natural resources in the *conflict zone* correlates with longer and more violent conflicts (Lujala, 2010; Berman et al., 2015).

The theoretical logic for how the presence of natural resources influences conflict relates to the need of belligerents to fund their war efforts. Rulers and rebels who trade natural resources can use the revenue income from this source to enrich themselves or as means to buy weapons and recruit fighters (Lichbach, 1998; Humphreys, 2005). While this makes intuitive sense, existing studies have not considered two crucial on-the-ground features that we contend motivate further theoretical development.

First, civil war actors do not need to fully *control* the natural resources location to get access to revenue from its trade. It is both easier and more rewarding to collect tax from extracting companies or civilians, or by organizing the transportation of the resource to the world market. Examples of this include the setting up of markets for the sale of coca in Peru (Weinstein, 2006), oil theft from pipelines in Nigeria (Asuni, 2009), offering 'licenses' for individual diamond miners in Sierra Leone (Le Billon, 2008), and protection rackets for companies in Indonesian Aceh (Aspinall, 2009).

Second, intense warfare is *destructive* of the local environment which may harm economic profitability. This means that increased contest over natural resources should lead to decreased revenue and subsequently fewer resources for warfare, thereby directly contradicting the rents-and-rebellion mechanism. It is worth considering a competing logic regarding natural resources and incentives for belligerents to avoid fighting, and potentially even implicitly co-operate, as suggested by Staniland (2012). This possibility has been observed by Ross

(2004*a*, 56) who concludes that 'combatants fought for control of areas rich in alluvial gemstones (Sierra Leone, Liberia, Cambodia), drug fields and processing plants (Peru, Burma), oil pipelines that traveled over disputed lands (Colombia, Sudan), mines (DRC, Liberia), and commercially valuable forests (Cambodia, Liberia). Yet in eight of these nine cases, combatants intermittently cooperated in exploiting the same resources they fought over. In four cases (Sierra Leone, Liberia, DRC, and Cambodia) there were long periods in which the major parties more or less ceased their combat and entered a kind of commercial equilibrium. Even in extraordinarily bitter wars such as the one in Sudan, profitable alliances were often struck between groups on opposing sides-in this case, to guard the pipeline and oilfields that the rebels had long opposed.'

In what follows, we propose a theory that emphasizes the temporal variation of localized fighting in civil conflicts. We seek to explain why rebels sometimes fight in natural resource rich areas, but other times avoid fighting specifically in such territory to avoid disrupting their taxation of the trade. But what determines these shifts between fighting and not fighting?

For studying shifts in strategy, it is necessary to consider that warring organizations have multiple aims during civil conflicts. The main aim is to 'win' the conflict by defeating the opposition or at least acquiring as many concessions as possible in a settlement. A secondary aim, however, is the need to preserve organizational capability to maintain the armed struggle, which means simply to avoid defeat (Arreguin-Toft, 2001; Acosta, 2014). Depending on the prime objective of an actor at a given point, we argue that the strategic value of fighting in different areas shifts. When the aim of the belligerents is to maintain fighting capabilities, they have incentives to protect tax income and avoid fighting close to the natural resource trade. However, when parties are seeking a decisive end to the conflict, they have particular incentives to fight over natural resources

because of the economic importance of these areas. Launching offensives near resources during talks may improve the actors bargaining leverage as the negotiations focus on the future division of income from these areas (Knutsen et al., 2017).

We contend that the strategic calculation about the importance of the primary aim versus short-term survival depends on whether the long-term goal is considered achievable in the immediate future. Thus, government and rebel strategies are influenced by expectations about future duration of the conflict. At the beginning of a conflict, both sides aim for a short duration and focus all effort on the military struggle (Bapat, 2005). However, if neither side can win quickly outright, they have to develop organizational structures to maintain and improve their long-term fighting ability, which is facilitated by natural resource rents. In other words, belligerents in protracted conflicts make strategic calculations based not only on the present contest, but also the shadow of the future.

2.1 Long expected war duration

When belligerents expect that conflict may continue for years to come, their most important objective is that fighting capabilities are maintained and, if possible, strengthen. The means for doing this differ somewhat between the regime and the rebels. A government has to consider both the threat of the civil war and other political challengers (Roessler, 2011), meaning they have to ensure that the state functions as efficiently as possible under the circumstances. A state can therefore rarely focus all its capacity towards fighting, but need to protect income that may be used for public spending or patronage for elites. The government also needs to pay attention to the political costs of mounting fatalities from the conflict, thus they have incentives to preserve resources until

they perceive an opportunity to defeat the insurgents.

Rebels also consider the cost of fighting and the need to collect levies from natural resource trade, but they have one additional objective. Rebels have to establish control over at least *some* territory in the country or in a cross-border sanctuary. This 'safe area' is needed for recruitment, training, recuperation, and offers an opportunity to build institutional structures in preparation for a future post-conflict ruling position (Mampilly, 2011). Rebel movements use such control over territory to establish external and internal legitimacy also as a reputation-enhancing feature when seeking support from external backers and demand concessions from the regime (Salehyan et al., 2011). Natural resources in this territory are advantageous, but not necessary. It is often easier to take control over areas with little state presence and this is probably more likely in locations without natural resources (Buhaug, 2010). Thus, in a protracted conflict, rebels should be relatively content with control over some peripheral territory for bases, providing they - at the same time - have access to a share of natural resource rents in other areas. This means that only a limited part of the rebel movement is de facto engaged in collecting natural resource taxes. In Sierra Leone, for example, involvement in the diamond trade was largely kept secret within the rebel group RUF and controlled by a subset of senior leaders (Wannenburg, 2006).

The implications of these strategic calculations are that while fighting will occur, it will be less likely in territories with natural resources. Although control over natural resources is advantageous for the competing factions, they will also be aware that intense fighting will diminish the value of taxes from extraction and trade of the actual resource. The parties are also aware that trying to advance into these areas may be particularly costly as the opponents are unlikely to retreat from these important areas. Furthermore, getting access to a share of

natural resource rents does not necessarily mean that it needs to be conquered in direct competition between the parties. For example, in Aceh, Indonesia, the local military deployed their forces to collect 'protection money' from multinational companies, while the rebel group GAM collected a monthly share of the salaries from the employees of the same companies (Schulze, 2004; Kingsbury and McCulloch, 2006). It is, further, even possible that the extractive business leads to active state-insurgent cooperation. In the Democratic Republic of Congo, for example, 'regional strongmen did business with [government] associates as they fought other members of that clique on a different front' (Reno, 1997, 57).

This leads up to our first hypothesis:

H1: When belligerents expect that the conflict will continue indefinitely, most violence will occur in areas without natural resources.

2.2 Short expected war duration

When belligerents expect that the conflict is getting closer to the end, their strategic calculus will be substantively different. In this scenario, there are incentives both for the warring organizations and individual commanders to concentrate their military contest specifically to natural resource-rich areas.

Organizations that expect that the conflict is about to end will perceive military superiority (winning), inferiority (losing), or seek peace talks (stalemate). A party aiming to defeat its opponent will accept a temporary set-back in natural resource income providing it affects the weaker party more. At the same time, the weaker party will concentrate its remaining forces to secure the revenue it needs for rebuilding military strength. During peace talks, in order to maximize parties' bargaining leverage, they will seek to signal military strength to get the most beneficial settlement (Walter, 2002). Since the income

from natural resource-rich areas is of great importance both during and after conflict, parties have incentives to ensure visible presence specifically in these regions to gain concessions in the talks. At the same time, parties can avoid fighting in the at-the-moment less important non-resource areas during talks to signal restraint and commitment to the peace process.

In addition to the organizational considerations for the warring parties when conflicts are predicted to end, individual commanders also have incentives to direct attention towards natural resources at this point. To begin with, since the post-conflict environment may lead to demobilization of rebel forces, this is the last opportunity to loot. Furthermore, rebel leaders may also make plans for institutionalizing their control over natural resources in the post-conflict period. This objective may be particularly important in Africa where official appointments often are intended to institutionalize patronage networks (Reno, 1997; Chabal and Daloz, 1999). An example of this is how Foday Sankoh, the leader of RUF, was given the ministerial portfolio over resources in Sierra Leone as part of the 1999 Lome peace agreement (Gberie, 2002).

Even if there is no official recognition of former commanders' share of natural resource rents in the post-conflict period, they may seek to maintain influence as a strictly criminal enterprise. However, considering that the end of conflict will shift the power resources among local actors, they have difficulties in credibly committing to upholding any collaborative war-time political orders in the future (Kreutz, 2018). In the Democratic Republic of Congo, for example, there were comprehensive reviews and re-negotiations of natural resource concessions after the conflict in 2004 and 2007, illustrating the importance of local actors to control these areas at the point when the fighting ends (Rustad, Lujala and Le Billon, 2011).

All in all, this provides civil war belligerents with multiple incentives to

seek dominance over natural resource-rich areas when they expect the conflict is coming to a close. Capturing these territories - even if the fighting means a temporary reduction in output - renders them with a stronger position in the ongoing bargaining, offers opportunities for post-conflict appointments, as well as provides them with economic resources in the post-conflict society. Simultaneously, the expectation that fighting will only continue for a short time will make them more willing to accept high costs of fighting.

This leads up to our second hypothesis:

H2: When belligerents expect that the conflict is about to end, most violence will occur in areas with natural resources.

2.3 Identifying belligerents expectations of conflict duration

To identify how the 'shadow of the future' influences belligerents' strategic calculations, we cannot rely on direct data. Expectations are impossible to systematically collect data on, both because they are difficult to quantify, and because parties have incentives to bluff. We measure parties' expected duration of conflict through information on whether negotiations are underway or not. We consider this a better measure than the intensity of fighting, or shifts in a warring party size as it is unclear in what way either of these influence parties' expectation regarding the future duration of conflict.

Table 1: Summary statistics on negotiations

Variable	N	Term.	% term.	Dur.	% 1,000+ bds
No talks	268	83	31%	30.6	11%
Talks	148	65	44%	58.2	26%
Mediation	84	36	43%	71.5	33%
Peace agreement	49	24	49%	61.8	17%

Table 1 provides descriptive statistics about peace talks and how they cor-

relate with conflict termination in our sample.[2] The termination of conflict is more common in years with talks, and even more so if these are mediated, and in years with a peace agreement compared to years without any negotiations. We also see that both negotiation and mediation are more common in difficult cases, i.e. with longer duration and when fighting causes more than 1,000 battle deaths in the year, consistent with existing research (Fortna and Howard, 2008). This gives us confidence that actors are likely to consider the end of the conflict when they participate in talks. We do not assume that peace talks are the only way in which civil conflicts end, but that there is variation in actor consideration of expected duration when they are involved in peace talks of not.

3 Research design

To explore the local level impact of belligerent expectations in fighting over natural resource areas, our analysis employs the PRIO-GRID (Tollefsen, Strand and Buhaug, 2012) structure as the unit of analysis. PRIO-GRID divides the world into terrestrial grid-cells with 0.5 x 0.5 decimal degrees in resolution, which constitute roughly an area of 55 x 55 kilometers at the equator. Our study covers all African grid-cells from 1989-2008[3], and we use information on battle incidence from UCDP-GED, version 1.5 (Sundberg and Melander, 2013). We follow the UCDP-GED definition of internal armed conflict[4] as violence between state forces and an organized group with stated political incompatible positions regarding the control of government or territory, leading to at least 25 battle-related deaths in a year (Gleditsch et al., 2002).

[2] Termination data from Kreutz (2010).

[3] Altogether 10 261 grid-cells are observed over a period of 20 years (205 220 observations), but our negotiation variable reduces the sample to the grid-cells in country-conflict-years.

[4] We collapse internationalized internal and internal armed conflict into one. We use the terminology 'civil conflict/civil war' interchangeably with internal armed conflict.

Table 2: Summary statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
Fatalities	39.786	346.708	0	15143	4379
Natural resources	0.079	0.288	0	4	205220
Cell area	2.832	0.509	0	3.099	204705
Govt external	0.122	0.328	0	1	4379
Rebel external	0.016	0.125	0	1	4379
Duration	1.957	2.803	0	12.541	4379
Conflict lag	0.163	0.359	0	1	205220
Contiguity	0.167	0.137	0	0.953	199920
Capital distance	0.659	0.42	0.004	1.948	205220
Population size	0.684	1.821	0	70.124	205220
Country fatalities	0.315	1.305	0	17.356	205220
Talks	0.244	0.429	0	1	4379
Mediation	0.156	0.363	0	1	4379
Peace agreement	0.072	0.258	0	1	4379

* Variables have been scaled (/1000).

3.1 Dependent variable

Our dependent variable measures the number ('best' estimate) of battle-related deaths from events in a given location. In our first analysis, these are aggregated into a yearly estimate while our second analysis uses monthly data. To ensure that our findings are unaffected by coding errors regarding the actual location of an event, we restrict our sample to observations with spatial precision scores of 1 (exact), 2 (near), and 3 (second order administrative division).[5]

3.2 Natural resource data

We superimpose geocoded data onto the PRIO-GRID structure using Perl code (Pickering, 2012) to combine different natural resources into an aggregate category.[6] There is no theoretical reason to expect different effects for different

[5](1) Exact location, (2) Up to 25 kms away from an exact location, (3) ADM2 indicate areas such as a district, municipality or commune. See Sundberg and Melander (2013) and Croicu and Kreutz (2017) for more details.

[6]We don't separate between lootability and obstructability of the resource (Koubi et al., 2014) as this does not vary over time.

resources as belligerents will organize according to the local context, but there may be variation with regards to the profit margin for some resources, which could influence parties' military strategy. This should, however, not likely covary with the decisions of parties to negotiate or not and thus should not bias our empirical analysis. We conduct additional tests to check whether the type of natural resource matters.

Our *Natural resource* variable is composed of five different natural resource categories spatially distributed as shown by Figure 1[7]. Information on onshore and offshore hydrocarbon sites (oil and gas fields) consist of polygon data from Lujala, Rød and Thieme (2007) which correspond with 851 grid cells,[8] illegal drug production from Buhaug and Lujala (2005) is present in 1,573 grid-cells.[9]. Finally, we use geographically coded data from Gilmore et al. (2005) and superimpose lootable and non-lootable diamonds deposits into our grid-cells. Lootable diamonds are secondary (alluvial) diamonds found, for example, in river channels and marine deposits through the process of erosion from the primary diamond deposits. The extraction of these diamonds does not require sophisticated mining techniques, and they can be found in 360 grid-cells. Non-lootable diamonds refer to primary (kimberlite or lamproite) diamond deposits and are extracted with the help of substantial infrastructure and sophisticated technology. Non-lootable diamonds are present in 87 of the African grid-cells.[10]

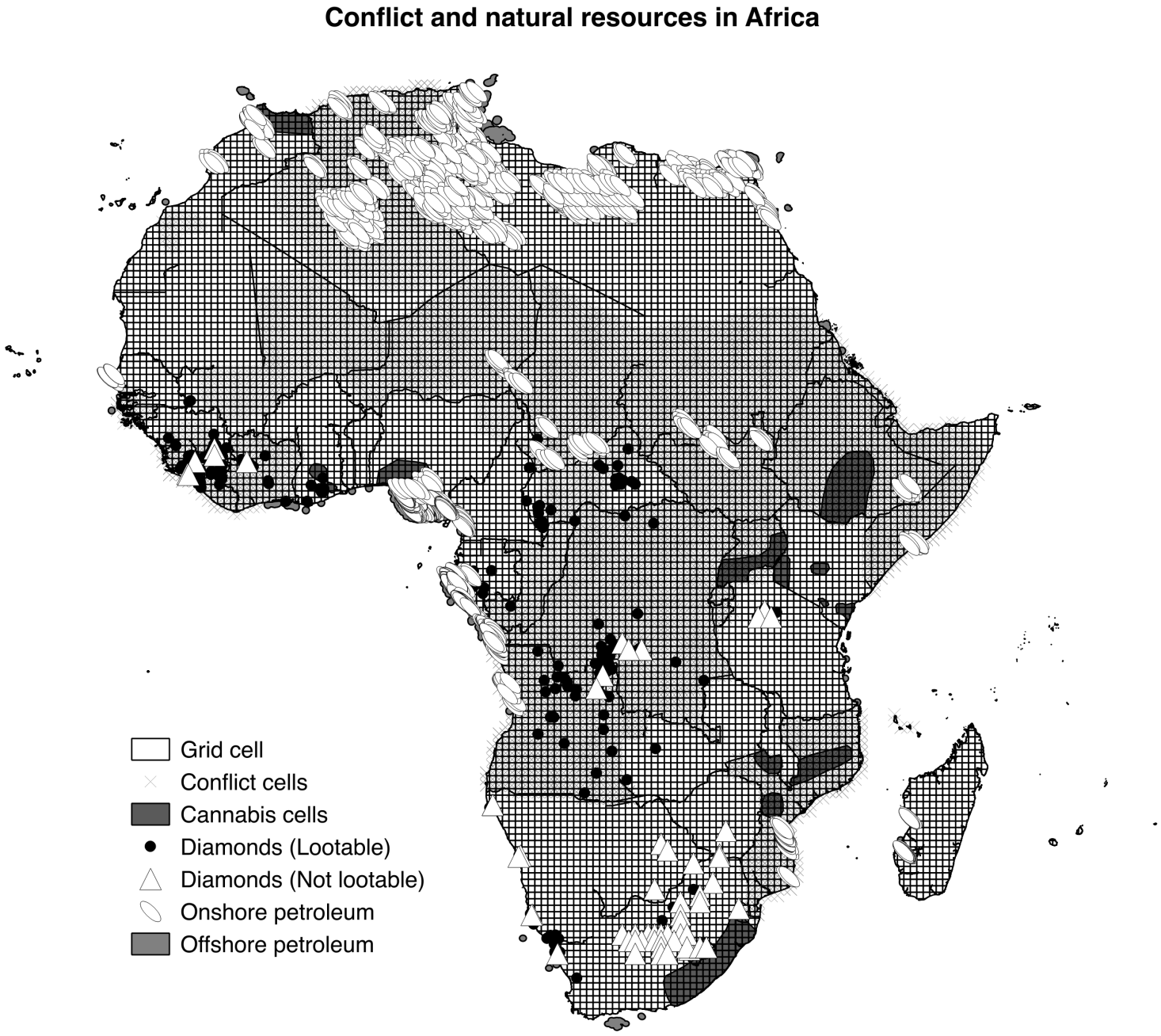
[7]Conflict areas are based on the PRIO-GRID coding whereby cells that intersect conflict polygons and part of the country in conflict are shaded.

[8]The shapefile data unfortunately do not separate between fields with known production and fields where this information is missing. In Africa overall, there are 95 oil fields with only 49 providing information about known production. The start date is known for 28 fields and for 25 of these production began before 1989 and an the estimated production life of an oilfield is about 20-30 years (Lujala, Rød and Thieme, 2007; DCLG, 2014).

[9]In Africa, this effectively means cannabis produced for external markets, as there are neither opium nor coca production reported in the region and small scale domestic production is not picked up. Cannabis can be cultivated from the same spot for several years and illicit exports of the drug began at the latest in the 1960s and has been reported to be on the increase (Farrell, 1998; UNODC, 2007; Ellis, 2009).

[10]The data are limited to lootable and non-lootable diamonds with known production to ensure that these locations are deemed valuable. Diamonds can be mined from the same site for decades and thus we can assume that the impact these sites have on our conflict dynamics

Figure 1


Conflict and natural resources in Africa
Grid cell
Conflict cells
Cannabis cells
Diamonds (Lootable)
Diamonds (Not lootable)
Onshore petroleum
Offshore petroleum

3.3 Negotiation data

We code periods of ongoing negotiations using a combination of existing data and new data collection. Our starting point is the information about mediated talks provided by the Civil War Mediation dataset (DeRouen, Bercovitch and Pospieszna, 2011). In order to complement this data with non-mediated talks, we use information from Harbom, Högbladh and Wallensteen (2006), Kreutz (2012) and UCDP (2014). For cases where we still couldn't confirm whether talks were underway or not, we collected additional data which included identifying the month in which talks started - provided there had been at least one calendar year of non-talks prior. In all of our analyses, *Talks* are coded as a dichotomous variable.

3.4 Control variables

Since natural resources may not be the only thing influencing the timing and the location choice for battles, we include several control variables in our estimations. First, the size of the grid-cells (in square kilometers) may be important as bigger grid-cells may facilitate more battle fatalities than smaller grid-cells. The geography of the cell may impact the battle locations in terms of its distance to strategic locations such as the capital city and state borders. *Capital distance* captures the distance (in kilometers) from the cell centroid to the national capital city, whereas *Contiguity* is measured as the distance (in kilometers) from the cell centroid to the border of the nearest contiguous neighboring country. Conflict in neighbouring cells may also spill-over to battle fatalities in a given grid-cell, which motivates an inclusion of spatial *Conflict lag* variable that indicate the share of ongoing conflict among contiguous cells in the same country. We also control for *Population size* since more populous areas might have more

over 20 years is constant.

battle fatalities. The population estimates for the grid-cells are only available in 5 year intervals from 1990-2005 and thus we interpolate an average for each grid-cell year based in the existing data. All of the above mentioned control covariates are taken from the PRIO-GRID dataset (Tollefsen, Strand and Buhaug, 2012).

The conflict context may also influence belligerents capacity to engage in battles so we control for the presence of external support. *Government external* captures military support from another state to the government side in their fight against (any) present rebels, while *Rebel external* indicate the same provided to (any) rebels. We also include a *Duration* variable of the time (in days) since the first death in the conflict-dyad, calculated as of 31 December for the year of observation. In countries with multiple active groups, the average duration is coded. We also control for *Country fatalities* by aggregating all the fatalities for each country years. All these variables are obtained from the UCDP-GED dataset (Sundberg and Melander, 2013). Finally, in order to account for possible time dependency, we include a variable of *Previous fatalities* in the grid-cell into our models.

3.5 Method

Our theoretical argument suggest that belligerents' expectations regarding future conflict duration influences whether they will fight in the immediate vicinity of natural resources. The visible implication of this is that we expect relatively less violence in natural resource areas when there are no talks and more violence in natural resource areas during talks. We also expect to see a change in where fighting occurs when talks are initiated as this indicates that parties re-evaluate their expectations on the duration of conflict. Fighting should shift from primarily non-resource areas to resource-rich areas. We empirically assess both

these propositions, the first using yearly data, and the second with monthly data around the time of the onset of talks.

Our dependent variable in all models is the number of battle-related deaths in a grid-cell in a given time period. As this constitutes an over-dispersed count variable, a negative binomial regression model is suitable (Hilbe, 2011).

For our yearly analysis, we split the sample between years without talks (expected long duration) and years with talks (expected short duration), before estimating the effect using an interaction effect of talks and natural resource areas. We then zoom into the specific time period when talks are initiated as this period should indicate a shift in warring parties expected duration of conflict and the subsequent conflict trend. We disaggregate the data to monthly observations for the 12 months prior and post every onset of talks.[11] To identify if there is an overall change in conflict dynamics when talks begin, we first estimate an interrupted time series analysis (Wagner et al., 2002). Controlling for both auto-regressive and moving average time trends, these models estimate the overall effect of talks on conflict dynamics. Following a data-driven optimization of the best fit of pre-and post- functional forms (Calonico, Cattaneo and Titiunik, 2015), we employ the most common assumption of linear trends.

To explore whether we observe variation in the violence trends in areas with or without natural resources, we estimate Difference-in-difference (D-i-D) models for the same sliding time windows. D-i-D models are commonly used for evaluating the change experienced after an intervention among a certain group (the treatment group) in comparison to an non-treated similar group (the control group) (Athey and Imbens, 2006). While there is no unaffected 'control' territory for our study, the theoretical argument suggest that conflict violence will shift from areas without natural resources to areas with resources

[11] The actual 'onset month' is consistently excluded from the analysis as we don't have daily data on when talks were initiated.

as talks begin meaning that the relative shift is of interest. The D-i-D design, under mild continuity assumptions, provide us with a universe of cases that are ex ante comparable in all other ways (on average) except the presence of negotiations.

3.6 Robustness checks

Our online appendix reports a battery of robustness tests, including the use of a dichotomous measure of battle occurrences (to control for high-violence outliers), only mediated talks or those that result in a peace agreement, disaggregating different natural resources, including yearly dummies and random effects into our models, reconfiguring our data using nearest neighbour propensity score matching, and testing for spatial dependencies using a spatial weighing matrix.

4 Findings

Table 3: Yearly analysis of natural resources, talks, and battle fatalities; split samples and interaction models

	(1) No talks	(2) Talks	(3) No talks	(4) Talks	(5) No talks	(6) Talks	(7) Interaction	(8) Interaction	(9) Interaction, ZINB
Natural resources	-0.732***	0.118	-0.732***	0.118	-0.732*	0.118	-0.735***	-0.735***	-0.715***
	(-4.71)	(0.67)	(-3.42)	(0.52)	(-2.26)	(0.56)	(-4.96)	(-3.39)	(-6.81)
Talks							0.890***	0.890***	0.860***
							(8.65)	(8.29)	(9.18)
Natural resourcesXTalks							0.607**	0.607	0.586*
							(2.77)	(1.88)	(2.47)
Cell area	0.0800	0.0272	0.0800	0.0272	0.0800	0.0272	0.0571	0.0571	0.0634
	(0.69)	(0.30)	(0.59)	(0.22)	(0.30)	(0.18)	(0.64)	(0.54)	(0.84)
Govt external	0.994***	-0.217	0.994***	-0.217	0.994	-0.217	0.679***	0.679***	0.652***
	(4.36)	(-1.78)	(3.95)	(-1.57)	(1.66)	(-0.99)	(4.41)	(4.05)	(5.64)
Rebel external	0.709*	0.405	0.709*	0.405	0.709**	0.405	0.669***	0.669***	0.650*
	(2.18)	(1.73)	(2.16)	(1.67)	(2.71)	(1.89)	(3.75)	(3.43)	(2.19)
Duration	0.165***	-0.0935***	0.165***	-0.0935***	0.165	-0.0935*	0.0781***	0.0781**	0.0751***
	(4.32)	(-3.75)	(3.52)	(-3.33)	(0.90)	(-2.33)	(3.75)	(3.21)	(3.68)
Conflict lag	1.856***	0.584	1.856***	0.584	1.856***	0.584	1.870***	1.870***	1.831***
	(8.68)	(1.78)	(8.23)	(1.70)	(4.91)	(1.86)	(10.36)	(9.49)	(18.41)
Contiguity	-2.217***	-0.807	-2.217**	-0.807	-2.217*	-0.807	-1.953***	-1.953***	-1.921***
	(-3.40)	(-1.83)	(-3.21)	(-1.54)	(-2.25)	(-1.25)	(-3.90)	(-3.65)	(-6.93)
Capital distance	-0.381	0.338*	-0.381	0.338*	-0.381	0.338	-0.187	-0.187	-0.185
	(-1.77)	(2.20)	(-1.68)	(2.06)	(-0.92)	(1.49)	(-1.13)	(-1.06)	(-1.68)
Country fatalities	0.312**	0.0938***	0.312*	0.0938*	0.312	0.0938*	0.138***	0.138***	0.130***
	(2.70)	(4.21)	(2.45)	(2.56)	(1.34)	(2.30)	(5.55)	(3.59)	(5.04)
Population size	-0.0289	0.0225	-0.0289	0.0225	-0.0289	0.0225	-0.00190	-0.00190	-0.00476
	(-1.78)	(1.69)	(-1.36)	(1.30)	(-0.84)	(0.96)	(-0.14)	(-0.09)	(-0.44)
Previous fatalities	3.177***	1.486***	3.177**	1.486	3.177*	1.486	2.380***	2.380**	2.606***
	(4.70)	(4.56)	(2.72)	(1.81)	(2.40)	(1.71)	(6.52)	(2.64)	(12.95)
Constant	-0.0748	2.784***	-0.0748	2.784***	-0.0748	2.784***	0.180	0.180	0.220
	(-0.20)	(6.68)	(-0.17)	(5.54)	(-0.07)	(3.84)	(0.65)	(0.55)	(0.90)
Standard errors	Robust	Robust	Clust. grid	Clust. grid	Clust. country	Clust. country	Robust	Clust. grid	
lnalpha									
Constant	2.128***	1.031***	2.128***	1.031***	2.128***	1.031***	1.764***	1.764***	1.689***
	(45.91)	(24.68)	(27.90)	(14.25)	(5.00)	(4.51)	(50.87)	(28.38)	(44.10)
inflate									
Country									-0.00841***
									(-3.40)
Constant									1.312
									(0.98)
N	3302	1066	3302	1066	3302	1066	4368	4368	4368

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.1 Yearly analysis

Table 3 present the results from our negative binomial regressions with the yearly data, focusing on the count of grid-cell fatalities in conflict countries. Models 1 and 2 show the split sample estimates with robust standard errors, Models 3 & 4 use standard errors clustered at the grid-cell level, while Models 5 & 6 use country level clustering of standard errors. Across all models, the results consistently support the expected relationship in our first hypothesis that there is less fighting close to natural resources in years when there are no talks underway. The negative correlation between natural resources and violence in no-talks years (Models 1, 3 & 5) is statistically significant on at least 0.05 level. In contrast, we find a positive correlation between natural resources and violence in the years when talks are underway (Models 2, 4 & 6) which is in line with our second hypothesis but the relationship is not not statistically significant at commonly accepted confidence levels.

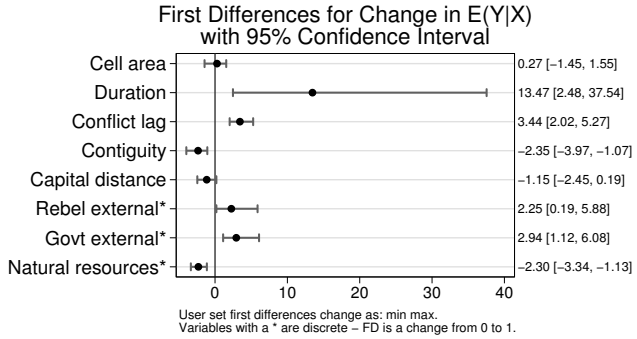
In Models 7-9, we explore the interaction of talks and natural resources on the overall level of grid-cell yearly violence. When we estimate the relationship with robust standard errors (Model 7), or using a Zero-Inflated Negative Binomial regression (Model 9),[12] we find that while natural resources in general have a negative impact on battle fatalities, when interacted with talks there is increased battle fatalities in these areas. When standard errors are clustered on the grid-cell (Model 8), the statistical significance of the interaction is reduced to the 0.1 level although the direction of the relationship remains.

The control variables in our models behave largely as have been found in previous research, which suggest that there are few reasons to be concerned about model specifications. A history of previous high-intensity fighting in-

[12]It can be assumed that the excess zeroes in our data are generated from two different processes: grid-cells in conflict zones without battle fatalities, and grid-cells outside the conflict zone.

creases the risk of subsequent battle deaths, both within a specific grid-cell and in the country as a whole. Battle fatalities are higher in locations closer to capital cities when talks are underway (Butcher, 2015), while areas closer to the border experience less fighting when there are no talks. External support for the government and rebels predicts more battle fatalities when there are no talks, corresponding with the finding that external support prolongs conflict duration (Cunningham, 2010). Finally, we find that longer running conflicts are more violent when there are no talks, while they are less violent when talks are underway. The latter may be an effect of war fatigue making belligerents in protracted struggles particularly interested in ending the war.

Figure 2 demonstrate the substantive effects of natural resources and violence, using *Clarify* (Tomz et al., 2003) to identify first difference estimates of yearly battle deaths when moving from grid-cells without natural resources to ones with natural resources during and outside peace talks. The baseline probability of battle fatalities regardless of talks indicate that there is overall less fighting near natural resources. In these areas, the average prediction is 4 battle-deaths per year, which is only half of the 8 average predicted fatalities per year in grid-cells without natural resources. This finding is similar as the conclusions of Maystadt et al. (2014, 723) that in the Democratic Republic of Congo 'valuable minerals do foster conflict, but not in the immediate neighbourhood of the mining sites where violence would disrupt the profitability of the business.'



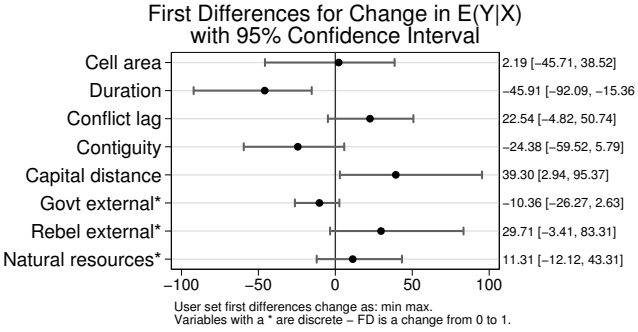


Figure 2: First difference of natural resources without/with talks

When we split the samples between periods where belligerents expect the conflict to continue uninterrupted and when they suspect that it may be soon ending, the patterns are substantively different. Figure 2A illustrates the first differences graphically in conflict situations without talks, whereas Figure 2B illustrates the same in conflict situations with talks. A binary operationalization of the natural resource variable was used in generating these graphs. Figure 2A confirms that the first difference between areas with or without natural resources when no peace talks are underway is -2.30 with a 95% confidence interval be-

Table 4: Parameter estimates from segmented regression models for average monthly battle deaths/grid: 3, 6, 9, and 12 months prior and post peace talk onset.

	(1) +/- 3 months	(2) +/- 6 months	(3) +/- 9 months	(4) +/- 12 months
Intercept	-3.876	2.111	2.105***	2.442***
	(-1.33)	(1.34)	(3.58)	(10.05)
Baseline trend	0.795**	0.192	0.192*	0.149**
	(2.62)	(1.08)	(2.34)	(3.22)
Level change after talks	-1.713	-2.002**	-1.677**	-1.062
	(-1.77)	(-2.68)	(-2.84)	(-1.96)
Trend change after talks	-1.433***	0.0610	-0.0521	-0.118
	(-3.88)	(0.28)	(-0.46)	(-1.68)
N	6518	11963	18136	23824

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

tween -3.34 and -1.13. Figure 2B, however, shows that during peace talks, areas with natural resources experience approximately 11 more battle fatalities than areas without resources, but the effect is not statistically significant according to conventional levels. The 95% confidence interval ranges from -12.12 to 43.31.[13]

4.2 Monthly analysis

Our theory posits that when the expected duration of conflict changes, then we expect to see a shift in the spatial distribution of violence. To explore this, we employ grid-cell-month data for the time period of 12 months before and after talks begin in a conflict. If talks ends and at least 12 months passes until they resume, we include the second episode of talks also as an onset.

Table 4 present a series of Interrupted Time Series estimations, indicating the average overall trend of violence per grid around the time that negotiations are initiated in a conflict. The baseline trend indicates that the general trend for conflicts is of escalation, leading to on average almost 0.8 more fatalities per grid-cell month during the temporal window of 3 months prior and 3 months after talks begins, and 0.15 fatalities for the 12 months prior/post talks onset. That the size of the effect decreases is not surprising given that the violent dynamics after talks will differ sharply between cases when conflict is resolved, and cases when negotiations fail and renewed fighting flares up. When looking at the

[13] Alternative illustrations (Figures 4 & 5) with density estimates of natural resources during and outside peace talks are included in the web appendix.

effect of the level change and the trend change after talks, we can conclude that talks are having a clear impact on conflict dynamics. The direct effect of talks is an overall reduction of violence (level change) which is statistically significant at least at the 0.1 level in all models. Similarly, the short-term dynamics of the conflict is also affected with 1.4 fatalities less per grid-cell month after talks are initiated, even if the trend when analyzing longer windows regresses to the mean. That the overall trend is positive, but the post-talks trend is negative can be interpreted as that conflicts on average are becoming more violent until negotiations begin, suggesting that warring sides are re-evaluating their ability to maintain the war effort as it becomes more costly. We can also conclude from this analysis that the findings from the yearly analyses were not overly influenced by reverse causality. Fighting in general does not increase in the aftermath of talks.

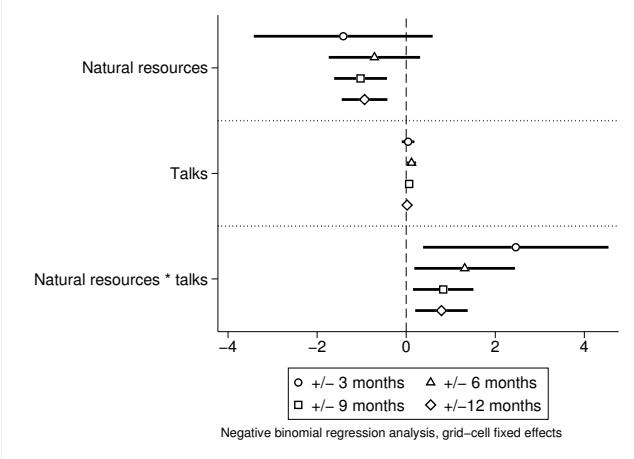


Figure 3: Difference-in-differences estimation of battle deaths/grid: 3, 6, 9, and 12 months prior and post peace talk onset.

Having identified an effect of talks on conflict dynamics, we explore to what extent the fighting during talks increasingly occurs in the vicinity of natural resources. To do this, we estimate a series of difference-in-difference analyses.

Figure 3 present the findings from comparisons of cell violence using the same sliding window of 3, 6, 9, and 12 months prior and post the onset of talks. All estimations control for possible confounds by fixed effects on the grid-cell level.

The relative increase in violence in natural resource areas after talks is greatest in the smallest window with between 2 and 3 battle deaths more per cell per month. The effect decreases to just over 1 fatality per grid-cell-month for the comparison of the six months periods, and it decreased further as the window increases and conflict dynamic regresses to the mean. While a difference of two to three fatalities per cell-month may seem a limited effect, it should be noted this analysis is based on very fine-grained data. For example, one of the geographically smallest conflicts in our sample, Sierra Leone, experienced fighting in 30 different grid-cells which means that extrapolating this effect means a possible shift in violence of over 400 battle-related deaths in a year. This clearly constitutes an amount of violence with the potential to derail a peace process.

The combined findings from the yearly and monthly analysis provide us with substantive information with regards to our theory on belligerent expectations of war duration and strategic decisions about where to fight. The identified trends are in line with our argument about the importance of areas with and without natural resources, but the yearly analysis shows that the effect may be relative rather than absolute. The observed shift consist primarily of a large reduction of fighting in areas without natural resources after talks begin, while the increase of violence close to resources at that point is not statistically significant. This indicates that even in the time periods when natural resources are more contested, warring parties are careful to limit the violence in the area to avoid disrupting the local war economy.

How generalizable are these findings? While we cannot predict how much violence will occur in natural resource rich areas when warring parties expect

the conflict to end soon, we should see the expected violence patterns in an out-of-sample (both temporally and geographically) high profile peace process. The civil war in Colombia is a prominent example of a natural resource-fuelled 'irregular civil war' (Kalyvas and Balcells, 2010). Before the peace talks from 2012-2016, representatives of the state, their (former) paramilitary allies, and the left-wing rebel groups FARC and smaller guerrilla groups, all captured natural resource rents in the form of bribes and/or extortion, but the competition over resources was rarely violent, expect over oil or narco-trafficking (Lavaux, 2007; Jonsson, 2014). There was not much active collaboration between parties to acquire resource income, but any actor forced to give up one income could substitute the loss by expanding its share from another resource (Peceny and Durnan, 2006; Dube and Vargas, 2013). While the overall level of conflict related violence decreased as the peace process progressed, from 776 FARC attacks and clashes in 2013 to 619 in 2014, 338 in 2015, and 18 in 2016 respectively (CERAC, 2017), the decrease was not evenly distributed across the country. Rettberg and Ortiz-Riomalo (2016) find that FARC became increasingly active in gold mining areas after talks were initiated, and there is an overall increase in violence during these years in the Pacific cocaine hub of Tumaco, along drug-trafficking routes in Choc, and in contraband zones along the Venezuelan border (ICG, 2017). Thus, the trajectory of spatial violence during Colombia is similar to our findings from African civil wars 1989-2008, with increasing violence near natural resources when a civil war is ending.

5 Conclusion

This article presents a theoretical logic for the strategic calculations of belligerents' use of violence in natural resource-rich areas depending on expected conflict duration. We argue that when warring parties expect a protracted con-

flict, they limit fighting in natural resource-rich areas. Because the taxation of natural resources is important for maintaining necessary capabilities to continue the war, they are concerned about disturbing this economic activity. We contend that these areas are instead likely to see the kind of 'war-time political orders' where belligerents develop tacit co-operation (Staniland, 2012).

This political order is formed on the basis of self-interest and mutual reward for local commanders, meaning that shifts in the overall wartime strategy are likely to result in shifting spatial conflict dynamics. One particular strategic shift occurs when parties expect that the conflict is not protracted but is drawing to a close - such as when peace negotiations are underway. Then the acceptance of partial income from taxing natural resource trade becomes less important than capturing a greater share of control of this resource in the expected post-conflict society. This means that relative to non-resource-rich areas, parties are expected to focus their contest over resources when the end of conflict is more likely.

Following an analysis of the spatial variation of violence in African civil wars 1989-2008, we find that natural resource-rich areas experience less violence when conflicting parties are expecting a protracted fight. When belligerents expect that the conflict is about to end, however, there is more violence around natural resources. We find this also in a monthly analysis of the dynamics of violence, specifically as negotiations begin, providing evidence of a clear shift in the spatial distribution of conflict violence.

Our findings draw attention to a dilemma for peacemakers: while the prevalence of natural resources offers economic potential that could be used for rebuilding a war-torn society, these areas are most contested just as the conflict is drawing to a close. Thus, the locations with the greatest potential for providing a peace dividend may be destroyed for that very reason. While a recent study

has found that the deployment of peacekeepers restricts contagion of conflict activity (Beardsley and Gleditsch, 2015), we know little about how belligerents use their geographically disaggregated forces already in place. Our findings suggest that it is important to deploy peacekeepers close to natural resources rather than where previous conflict activity has occurred.

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