Bringing Peace from Above? State Capacity, Civil War De-Escalation and The Composition of the Stock of Military Equipment*

Nauro F Campos	Martin Gassebner	Tobias Korn
Brunel University London	University of Hannover	University of Hannover

This version: December 17, 2018

****Preliminary****
Please do not cite, quote or circulate without the authors' permission

Abstract: State capacity crucially affects the outset and duration of civil wars. The literature uses indirect measures (such as capacity to tax) to proxy for a state's ability to fight or prevent civil conflict. In this paper, we employ a new measure of state capacity and test its effect on the (de)escalation of civil violence. We assemble unique data for more than 120 countries, yearly 1989-2010, to estimate the effect of the composition of the military capital stock (e.g. number of attack helicopters vis-à-vis tanks) on the onset, escalation and dynamics of civil conflict. Our main finding is that attack helicopters are associated with the (de)escalation of civil wars. Yet this comes at the price of more indiscriminate violence against civilians.

JEL Codes: D74, H40, O11
Keywords: violent conflict, economic growth, instrumental variables

* We would like to thank Daniel Arce, Atin Basu Choudhary, Mario Gilli, Pierre-Guillaume Méon, Silvia Marchesi, Günther Schulze, and seminar participants at EPCS 2018 (Rome) and the Beyond Basic Questions Workshop 2018 (Gengenbach) for valuable comments on previous versions. The usual disclaimer applies.

1. Introduction

With more than 70 years of (non-continuous) civil conflict, Myanmar leads the list of the most conflict-prone countries since World War II, closely followed by Israel with only a couple of months less. Unfortunately, these two countries are not the only ones with a vivid conflict history.

Since World War II, almost 40% of all countries experienced a civil war, which on average lasted for about 7 years. Econometric estimates suggest that around 3% to 6% of GDP are lost per year because of violent conflict (Cerra & Saxena 2008). Moreover, trade flows are disrupted for affected countries (Bayer & Rupert 2004) as well as for their (non-belligerent) neighbors (Qureshi 2013). Violent conflict is also associated with indirect global costs, particularly in terms of drug and human traffic and the spread of diseases (see e.g. Salehyan & Gleditsch 2006, Ghobarah et al. 2003). The bottom line is that it is essential to learn more about the determinants of civil wars and how do they de-escalate.

The literature has identified as the most robust drivers of civil conflict poor economic conditions (Collier & Hoeffler 2004) and sudden economic shocks (Miguel et al. 2004, Berman & Couttenier 2015, Ross 2006, Crost et al. 2014). Further, the feasibility of conflict (i.e. the potential of rebel groups to form and contest power) is a necessary condition for civil wars to emerge and persist (see Blattman & Miguel 2010 for an overview).

Our paper adds to the conflict literature by discussing the role of state capacity in the escalation and de-escalation of civil wars. With unique data on the composition of governments' militaries, i.e. the number of different heavy weapon systems in their national armories, we test whether specific weapon categories allow de-escalating civil wars faster, and impede lingering conflicts from converging into serious open battles. This paper hence contributes to the literature by taking the term state capacity quite literally, applying a novel measure of conflict (de)escalation, and addressing different aspects of conflict de-escalation.

When measuring violent conflict, the literature mostly focusses on the presence or absence of battle events in a given country or year, be it at the national (Collier et al. 2008) or subnational level (Berman & Couttenier 2015). Most prominently, a country or subnational unit is coded as experiencing "conflict" in a given year if a threshold of battle related deaths is reached, often set to either 25 of 1,000 (Pettersson & Wallensteen 2015).

Such a wide range makes it difficult to distinguish between different severities of conflict. For example, the lower threshold of 25 battle deaths assigns the same conflict coding to Syria or Yemen in 2017 as to the United Kingdom in 1998, when an IRA splitter group killed 29 civilians at the Omagh car bombing in Northern Ireland. Choosing the larger threshold of 1,000 battle deaths excludes a large number of important cases. Further, this treatment comes short in explaining the exact dynamics of civil wars, i.e. how lingering conflicts escalate towards open battles and how wars calm down towards (stable) peace.

We follow the work in Bluhm et al. (2016) to address the dynamics of civil wars. We estimate a dynamic ordered probit model using a categorical variable to distinguish between times of peace, lingering conflict, open battle, and full-scale civil war. Especially the inclusion of the lingering conflict category is important as this category *i)* is not part of the conservative measures of civil violence but rather coded as peace, and *ii)* involves a large number of actual observations.

Regarding better measures of state capacity, the main novelty in our paper is the use of unique data on the quantity and type of military weaponry, equipment, and personnel. The term state capacity is very prominent in the general economic literature, yet its treatment in conflict research so far comes relatively short. Generally speaking, state capacity can be defined as "the capacity to enforce law and order, regulate economic activity, and provide public goods" (Acemoglu et al. 2015, p. 2364). When talking of civil wars, it is the first part, i.e. the capacity to enforce law and order in times of civil unrest, which deserves special consideration. However, this capability is mostly proxied relatively vaguely in econometric studies, e.g. by GDP, amount of taxes collected, or distance to a country's capital (Besley & Persson 2014, Hendrix 2010). Of course, the presence and reach of governments to e.g. collect taxes is an important attribute of state capacity when one is interested in macroeconomic efficiencies and economic growth (Besley & Persson 2009a, Dincecco & Katz 2016, Acemoglu et al. 2015, Acemoglu et al. 2016). Besley & Persson (2014) argue that these do not include all the relevant dimensions of state capacity. Another dimension, which is probably most essential but also most difficult to measure, is a government's legal capacity. In studies of civil wars, this legal state capacity is part of most theoretic frameworks but comes short in most econometric models (Besley and Persson, 2010).

We here take a more literal approach to directly measure state capacity in civil conflict, which we interpret as a state's military strength. To do so, we make use of unique data on countries' stocks of heavy weapons. Among other things, we have data on the exact number of attack helicopters, light or heavy tanks, and rocket launchers that are at the disposal of a country's government in a given year. With these data at hand, we investigate whether some weapon categories are more useful than others when the government is dealing with a civil war. Take as an example the comparison between attack helicopters and submarines. While the former rather easily allow for operations in inaccessible terrain like mountains, forests, or even urban areas and hence constitute a huge advantage in reconnaissance, the latter are rather useless as long as the rebel forces do not try to take control over the government via the sea.

We investigate the effect of different weapon systems on the transition probabilities in civil conflict in a dynamic ordered probit setting. Together with the common covariates proposed in the conflict literature, we investigate how each weapon system affects the country's chances of moving from one conflict category to another. We expect attack helicopters to deliver a unique advantage in fighting insurgencies. Rebel groups seek hideouts preferably in inaccessible terrain (Holtermann 2016). This terrain, mostly mountains and forests, is easily explored from the air. Attack helicopters, which allow slow and stationary flights, have here a unique advantage. Further, attack helicopters have turned out as the most effective weapon against infantry and enemy tanks. Their comparative weakness in air-to-air fighting and their vulnerability towards anti-aircraft missiles is less relevant in civil wars as rebels only seldom can acquire combat aircraft or anti-aircraft cannons.

Our results confirm the advantage of attack helicopters in suppressing civil wars and maintaining peace. If an army possesses a higher number of attack helicopters in their military, holding total military expenditures constant, conflict becomes significantly more likely to de-escalate regardless of the initial state. If a country starts out at peace, a higher number of attack helicopters is also associated with a higher probability to maintain peace, probably because the stock of attack helicopters exerts a deterrent effect on potential rebels. On average, a one standard deviation increase in the number of attack helicopters is associated with almost 0.09 percentage points higher likelihood to directly de-escalate from civil war to peace – about 4 percent compared to the mean transition probability.

Next we test two more aspects of civil war (de)escalation: how rebels react to the government’s military composition, and whether the faster de-escalation with the help of attack helicopters comes at the cost of more indiscriminate violence. Measures of rebel capacity are quite advanced in the literature and incorporate such things as the availability of hideouts (Buhaug et al. 2009), differences in timing of attacks (Condra et al. 2018), and recruitment waves (Walch 2018). We find that rebel groups know about, and adapt to, the composition of the government’s military. Our regression results suggest that once an incumbent’s army possesses a high number of attack helicopters, fighting becomes more likely to take place in urban areas. In these areas, attack helicopters are less effective as they do not allow to easily distinguish between rebel fighters and innocent civilians. Further, we find that while attack helicopters help to de-escalate a civil war, they do so at a price. Once there is a larger number of attack helicopters involved in the civil war, the degree of indiscriminate violence increases, causing a larger collateral in the form of civilian casualties.

The rest of this paper is organized as follows. Section 2 provides a brief overview of current theoretical work on violent conflict and describes a simple model to frame the analysis. Section 3 describes the data set and methodology. Section 4 presents and discusses the main econometric model. Afterwards, we analyze the behavior of rebels and the degree of indiscriminate violence in section 5. Section 6 concludes.

2. Theoretical Framework

There is a very long tradition of theoretical work on the economics of conflict. It dates back to the seminal contest model by Haavelmo which was published in 1954. In the last two decades, this literature has grown exponentially. This section does not attempt to summarize it (for one excellent a survey, see Garfinkel and Skaperdas, 2007), but instead to present a simple theoretical framework that can help guide the empirical analysis that follows. Besley and Persson have developed it in series of papers (2008, 2009b, 2011.) Below we focus on this framework because it highlights jointly two aspects that have not yet received (empirically) the attention they deserve, namely, the role of government repression capabilities and the notion that the separation between onset and duration is not as stark as it is often made of.

Clearly, other models have focused attention on each of these aspects individually. For example, Acemoglu et al. (2010a) model the persistence of civil war but stress elite heterogeneity and its implications for (military) capabilities instead of factors more often associated with conflict duration, such as ethnic polarization and income inequality. They explain the persistence of civil wars by modelling the choices by a civilian government when faced by the risk of violent civil conflict, in particular, the choice of how and when to strengthen the armed forces. Investing in military equipment and personnel is not only a deterrence strategy for violent conflict but also an important political risk because, especially in countries with poor, badly-functioning or non-inclusive institutions, it opens the way for excessive influence (e.g., the heightened possibility of coups) by the armed forces. In their model, one explanation for the persistence of civil wars is that (civilian) governments for which rents are largely unaffected by violent conflict tend not to invest in the armed forces. This means that such governments choose to have weak or small armies that are insufficient or incapable of managing (or, more decisively, ending) violent rebellions (see also Acemoglu 2010b). An additional result of interest is that when the civilian government's rents start to be affected by the risk of violent conflict, the government reacts by over-investing in the armed forces. That is, it puts together "over-sized" armies as a commitment device or, in other words, as a way of buying-out the military so that it does not challenge for political power (cf. military coups.) There is also a considerable amount of theoretical work that focuses on the relationship between onset and duration. A recent example is the work of Powell (2013). He models the government decision to fight rebellion, or the when and why the government chooses "to consolidate power and monopolize violence." Using an infinite-horizon framework, Powell examines how much the government offers the opposition in each period and how that affects the rate at which it consolidates power. The opposition chooses whether or not to accept. The opposition rejecting the government offer implies it will try to disrupt the government efforts to consolidate power (through violence or peacefully). The government chooses violence when it has coercive power, meaning power that is sufficient to force the opposition to acquiesce by lowering its payoff to resisting, or fighting. The crucial element here is the rents that accrue to the government (or to the victorious faction) in terms of the size of the benefits from an increase in economic activity (that directly results from the monopolization of violence) as well as from the higher level of security that it generates. These "contingent spoils" determine whether the government consolidates power peacefully or through violent conflict. If these spoils are large, the government buys off the opposition; if they are large, the government will be more likely to choose violence. The interesting aspect of this model is that the onset and duration of violent conflict are intrinsically and explicitly related as they are part of the process through which the government tries to consolidate power.

A simple and elegant theoretical framework that is particularly useful for our purposes is the one developed by Besley and Persson in a series of papers (2008, 2009b, 2011.) It highlights two important aspects, namely the role of government repression capabilities and the relation between onset and duration of violent conflict. The basic set-up is that of two groups (denoted by *J*), an incumbent government and opposition (idem, *I* and *O*), each comprising up to half of the country's total population and each able to motivate a fraction of its members to become part of each group's armed forces (or armies, militias, etc.) If the fraction each group can mobilize as fighters is given by A^J, let the (discrete choice) decision of whether to mobilize be δ^J. Conflict generates the probability of a political transition, i.e., power moving from the incumbent government to the opposition group and this probability is given by the linear conflict technology

$$\frac{1}{2}+\frac{1}{\mu}[\delta^O-\delta^I] \qquad (1).$$

In this simpler version, this assumes that each of the two groups, incumbent and opposition, have an equal chance of winning (holding office.) The victor group wins control over a fixed amount of government revenue (R) but the way R is distributed is constrained by sharing rules (or institutions.) Such a rule states that the victor (incumbent) receives $(1-\theta)\,2R$ and the loser group (the opposition) receives $\theta 2R$, where $\theta \in [0, 1/2]$. It is important to note that higher values of θ indicate better institutions: when θ equals ½ it implies a fair sharing with each of the two groups receiving their full per capita share of revenue and when θ equal to zero meaning there are no institutional constraints on sharing this prize. Each member of the total population supplies a unit of labor and is rewarded with a real wage of w. The incumbent finances its army through taxation, while the opposition does not. This is a key asymmetry here: the challenger group has to bear the full cost of its army while each of the two groups bears half the cost of financing the government's army. The opposition moves first by deciding whether or not to challenge the incumbent. The incumbent moves next by choosing how to react to this challenge and chooses whether or not to use its army, with or without the opposition launching an actual attack. These two decisions and the linear conflict technology determine the winner, and the winner determines the distribution of the prize (R) subject to the institutional constraints. The expected payoff for the incumbent government in per capita terms is given by the expected return from holding office plus the net wage (the second and first terms below):

$$w\left(1-\frac{\delta^I}{2}\right)+\left(\frac{1}{2}-\frac{1}{\mu}[\delta^O-\delta^I](1-2\theta)\right)2R \qquad (2)$$

Similarly, the expected payoff for the opposition group in per capita terms is given by

$$w\left(1-\delta^O-\frac{\delta^I}{2}\right)+\left(\frac{1}{2}-\frac{1}{\mu}[\delta^O-\delta^I](1-2\theta)\right)2R \qquad (3).$$

Three possible sub-game perfect Nash equilibria are identified for the sequential game described above and they are labelled: peace, repression and civil war. These represent situations in which: neither group fights, only the government fights (repress), and the two groups fight, respectively. Peace occurs when $\delta^I=\delta^J=0$, that is if $4R(1\text{-}2\,\theta)\,/\,w \leq \mu$. Repression occurs when $\delta^I=A^I$ and $\delta^J=0$, when $2R(1\text{-}2\,\theta)\,/\,w \leq \mu < 4R(1\text{-}2\,\theta)\,/\,w$. And civil war occurs when $\delta^I=A^I$ and $\delta^J=A^0$, with $\mu < 2R(1\text{-}2\,\theta)\,/\,w$. This makes it clear that a crucial role is played by $2R(1\text{-}2\,\theta)\,/\,w$, the ratio of "size of the prize" to the real wage.

There are various interesting results one can highlight. The greater the size of the prize (consider the case of a country with abundant natural resources), the more likely the outcome will be violent conflict. The same conclusion obtains if wages are lower. Lower wages imply that the opportunity cost of fight is low.

In countries for which political institutions are sufficiently inclusive, this model predicts peace. Sufficiently inclusive in the sense that the sharing rule is more egalitarian. By the same token, civil war emerges for extremely low values (of θ), while repression emerges for middle values, all else equal.

Last, but not least, political violence is less likely to occur if the conflict technology is ineffective (low values of μ) in delivering a high probability of change of the group in power. It is rather intuitive to think of an extension in which the government invests in weaponry and military personnel as a deterrence strategy.

As mentioned, the model sketched above is the simplest possible version of the theoretical models fully worked out by Besley and Persson in a long sequence of influential papers. Yet there is one final point we need to make which refers to the empirical implementation of these models. Besley and Persson successfully take them to data and find support for the main predictions. However, they explicitly recognize that a key aspect of the model is unobservable for their estimations, namely the effectiveness of the conflict technology (μ). Our paper's main contribution, below, is to start addressing this gap by offering the first sufficiently detailed (e.g., number of attack helicopters in addition to military expenditures as a share of GDP) measures of the technology of conflict. Furthermore, we make use of a new, ordinal measure of civil war developed by Bluhm et al. (2016). This new measure allows us not only to test for the effect of the military composition (i.e. state capacity) on the onset and duration of civil wars, but also to look at how the probabilities of escalation and de-escalation to different intensities of civil war are affected.

In doing so, we complement the theoretical model of Besley and Persson by additional states of conflict as compared to peace, repression and civil war. In addition, we allow the conflict technology (μ) to exhibit a varying effect on conflict, depending on a country's conflict history. For example, a meaningful weapon technology might have a de-escalating effect when a country starts out at peace as potential rebels become discouraged by the government's overwhelming fire-power (provided the rebels can adequately observe the government's military capacity). If the country already starts out at some kind of conflict, the same weapon system might then prolong civil war, e.g. because the government has higher chances to defend itself against the insurgency, even if it is not able to end the fighting completely.

3. Data

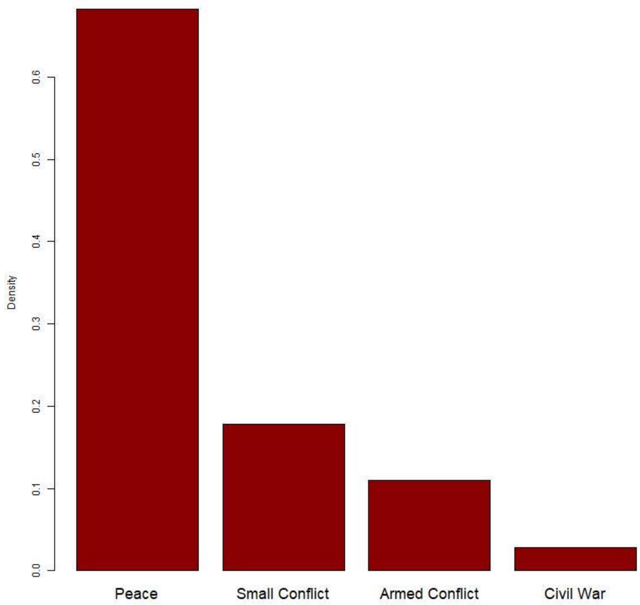
Our ordinal measure of civil war is based on two sources of data and follows the procedure detailed in Bluhm et al. (2016). First, we use the UCDP/PRIO Armed Conflict Dataset published by the Peace Research Institute Oslo (PRIO) to identify whether a country *i* in year *t* experiences a civil war according to the established definitions of battle-related deaths (BD). The UCDP/PRIO dataset defines a civil conflict as a violent dispute about the government or a territory in which armed forces of at least two parties, one of which is the government, are involved. For open disputes that suffice this definition, they add up a country's yearly fatalities that can be ascribed to battles associated with this dispute. In the literature so far, a country *i* has been coded to experience civil war in a year *t* if its number of battle-related deaths surpasses one of two thresholds, either 25 or 1,000. In order to hold the measure comparable to the existing industry standard, the conflict variable takes a maximum value of 3 if an observation's BDs exceed the threshold of 1,000 ("civil war"). If the threshold of 25 annual BDs is surpassed, but the higher threshold of 1,000 fatalities is not reached, we code the country's conflict level with a value of 2 and call it "armed conflict".

We define a third category which further distinguishes armed conflict and civil war from peace. For this purpose, we incorporate additional data from the Cross-National Time-Series Data Archive (CNTS). This dataset collects a variety of data, among others the presence of government purges, assassinations, riots or guerilla warfare in a country in a given year (Banks & Wilson, 2015). Whenever a country is mentioned to have seen at least one of these four expressions of civil unrest but does not have at least 25 BDs in a given year *t*, we code this country as having experienced a "small conflict" and assign it a value of 1. All remaining observations are coded as being at "peace" with a value of 0.

Figure 1 shows the distribution of our ordinal conflict variable. As can easily be seen, with about 70 per cent the majority of country-year-observations experience peace. In this regard our variable does not deviate so much from other papers since conflict observations usually constitute the minority. It becomes more interesting however when looking at the next adjacent category, namely small conflict. In our dataset, close to 20 per cent of country-year-observations are assigned to this category. Note that this category is new in the conflict measure we use here and has hence been omitted in other studies. Including it thus makes an important distinction to earlier papers – almost one of five country-years have so far been falsely coded as being at peace while actually experiencing a small, lingering conflict.

Our main explanatory variables of interest measure the composition of the governments' armed forces. In particular, we employ detailed variables on the amounts of different heavy weapon systems in operation in the national military.

Figure 1: Distribution of Conflict Intensities



These measures are provided in the yearly publications of 'The Military Balance' (Hackett 2014). More precisely, we have data on the amounts of following weapon systems: Armored personnel carriers, attack helicopters, combat aircrafts, multiple launch rocket systems, self propelled artillery, towed artillery, submarines, battle ships, light tanks, and main battle tanks. The values reported correspond to the inventories on January 1. As such, our values could be considered to be lagged values. In addition to these detailed variables, we also have data on the military expenditures (as a share of GDP) and military personnel per capita (both taken from the World Bank 2013).

Unfortunately, these data suffer from a large number of missing values. More precisely, for most countries annual inventories are only reported in irregular periods, frequently missing up to five years or more of observations. Between these periods, there usually is not much change in the inventories, probably due mostly to the fact that new heavy weapon systems are rather seldom ordered, need some years for delivery, and wear off quite slowly as long as the country is not involved in a large scale war. In order to preserve the completeness of our dataset and allow for the empirical model of our choice, we decided to linearly impute the missing data. We deliberately decided against the various possibilities of multiple imputation using e.g. predictive mean matching or Bayesian linear regression as these approaches would contaminate our data with too much artificial variance with respect to the slow expected changes in a country's military inventory across adjacent years. Note further that the pattern of missing data is not correlated with the emergence of civil war as indicated in Table A1.

Our covariates are taken from the empirical literature on the determinants of civil wars. Our baseline specification includes population size (logged), GDP per capita in PPP terms, lagged GDP per capita growth (all taken from the World Bank 2013), measures for the political system from the Polity IV project (Marshall et al. 2017), and a measure for ethnic tensions (taken from the International Country Risk Guide). We further control for international wars and internationalized civil wars as defined by UCDP. An internationalized civil war differs from a national civil war as soon as another country than the one where battles take place is involved. For our question of interest, this distinction is crucial. As we want to study the effect of a nation's military capacities on civil war, any involvement of another state and their weapon systems, either on the side of the government or the side of the rebels, would severely taint the results we find. Hence, we decided to only include truly national civil wars in our coding, while controlling for internationalized civil wars on the right hand side of the equation. Next, we do also control for the threat of civil war, which we code as a country's average likelihood of experiencing a civil war across the past ten years. We construct this variable similar to the one provided by the Major Episodes of Political Violence (MEPV) dataset provided by the Center for Systemic Peace, but use our own civil war dummy indicating civil wars at a 25 casualties threshold for coding (see Marshall 2017).

This variable is also crucial for our specification as it controls in part for a government's incentive to specialize their military for civil war purposes because it faces a higher probability of a civil war to break out.

4. Estimation Results

We hypothesize that military equipment which allows for easy reconnaissance of rebel hotspots and/or weapon systems that facilitate high precision attacks in rough terrain or urban city centers are detrimental to civil wars. As such, we expect attack helicopters and multiple launch rocket systems (MLRS) to turn out as significant components of a government's army when it comes to fighting insurgencies. Attack helicopters have the unique advantage of exploring rebels' preferred hideouts like forests or mountains and caves. MLRS allow quick and precise strikes against detected rebel hideouts, even in urban or mountainous terrains where e.g. large main battle tanks or artillery have no chance to access. Military equipment like submarines should show no significant effects in civil wars as insurgents quite rarely make use of large battle ships. To test our hypothesis, we employ a dynamic ordered probit model with correlated random effects. In order to assure that we actually pick up the effect of military composition and not just military size per se, we control for military expenditures in every regression.

Before outlining our empirical model in detail, let us first explain what aspect of civil wars specifically we are analyzing. While we will use a simple ordered probit model regressing our ordinal conflict measure with its four conflict intensities on the military data, we also want to have a closer look at the dynamics of civil war. Therefore, we are not only interested in a country's odds of experiencing a certain intensity of conflict. Rather, we also want to capture our variables' effects on a country's probability of experiencing a certain intensity of conflict, *given* its one-year conflict history. What we mean exactly by conflict histories is shown more precisely in table 2.

Table 1 – Raw Transition Probabilities of Conflict

	Peace	Small Conflict	Armed Conflict	Civil War
Peace	85.99	10.19	2.37	0.15
Small C.	47.36	47.60	8.86	1.60
Armed C.	14.86	15.25	62.36	8.11
Civil War	2.84	5.67	31.21	57.45

Notes: Raw Transition probabilities between four phases of civil war. Columns represent state in year t, rows represent state in year t-1. The Diagonal represents the probabilities of continuation.

Table 2 shows the raw transition probabilities of our conflict variable. Each column captures the probability for a country-year-observation in our sample to end up in one of our four conflict categories – peace, small conflict, armed conflict, or civil war. These probabilities however are conditional on the conflict intensity the same country experienced in the prior year t-1, displayed in the rows of table 2. Hence, the matrix' diagonal gives the probabilities of continuation of a given state of conflict, e.g. keeping up a civil war another year. From this diagonal, each cell to the right displays the probability of escalation into one of up to three higher conflict intensities, while cells to the left are associated with the possibilities of de-escalation. As can easily be seen, each intensity is more likely to continue for another year rather than (de)escalating to another category. Especially peace turns out to be a remarkably stable state. Whenever a country experienced a year of peace in year t-1, it has a chance of about 86 per cent to enjoy peace for another year. Furthermore, the odds of escalating from peace directly into a civil war are rather low, i.e. close to zero percent, according to our data. In fact, only four observations in our sample show this quite fierce kind of escalation[1]. Even a direct escalation from peace to the state of armed conflict, identified by at least 25 BDs in our data, happens rather seldom, namely for only 2.4 per cent of our data. Note at this point that the conflict literature so far was looking at the pure escalation process into one of these two

[1] These are Libya (2011), Yemen (1998) and Romania (1994/1999)

states of conflict, however unlikely this escalation is. This shows quite clearly the importance of an ordinal measure of conflict as we apply it here. The category of lingering conflicts as well as a slow transition from peace to a higher order of conflict constitute non-negligible facets of conflict, which should not, but have been, discarded in the conflict literature so far.

Let us turn now to our empirical specifications. Our goal is first to estimate the average partial effects of our military variables on the transition probabilities from any of the four conflict states to another. Ergo, we aim to provide estimates of e.g. an additional attack helicopter's effect on escalation, de-escalation or persistence of conflict starting in peace, small conflict, armed conflict or civil war.

In our preferred specification, conflict enters the left hand side of the equation in the form of an ordered variable, taking values between 0 and 3. To control for conflict dynamics in our model, we apply first-order Markov switching processes by including a vector of one period conflict histories $h_{j,i,t-1} = 1[c_{i,t-1} = j], (h_{1,i,t-1}, \dots, h_{j,i,t-1}, \dots h_{J,i,t-1})$ on the equation's right hand side. We interact this conflict history with our military variables of interest one by one to test for differences in those weapon systems' effects depending on the state of conflict in which a country starts. Our preferred model hence reads as follows:

$$c_{it}^{*} = x_{it}'\beta + h_{i,t-1}'\rho + \left(x_{it} \otimes h_{i,t-1}\right)'\gamma + \mu_i + \lambda_t + \varepsilon_{it} \qquad (1)$$

Where c_{it}^{*} indicates our ordered outcome of conflict, x_{it} includes the model's regressors, and $h_{i,t-1}$ incorporates the conflict history as defined above. The Kronecker product between x_{it} and $h_{i,t-1}$ accounts for the different interactions between our regressors and the conflict history. With μ_i we also include unobserved heterogeneity between countries, λ_t accounts for common shocks to all countries during a given year. Hence, with the Markov switching processes indicated by the inclusion of the vector of conflict histories $h_{i,t-1}$ as well as its interaction with the variables of interest, we can have a detailed glance at the variables' effect on the transition probabilities. To get a better intuition, consider again the transition probabilities displayed in table 2. Note that this matrix only reports the *raw* transition probabilities between different intensities of civil war. Hence, the probabilities stated in each row of table 2 report the likelihood to end up between two intensity-thresholds of a distinct conflict cumulative distribution function (cdf), which is conditioned on last year's intensity of conflict, and *net* of the effects of any of our explanatory variables. By estimating the model proposed in equation 1, we can incorporate the effects of the explanatory variables on the distribution of our conflict variable, again conditioned by the conflict intensity in year t-1. Taking the derivative of each part of any of the cdfs with respect to our main variable of interest allows us to compute the average partial effects of that variable on a given transition probability.

Table 2: Marginal Effects. DV: Attack Helicopters

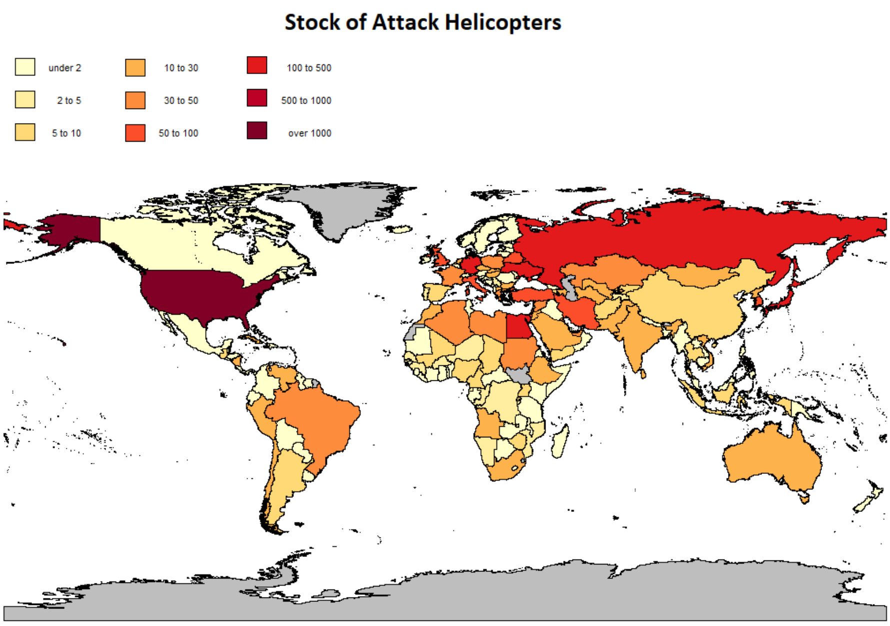
From.To	Peace	Small.C.	Armed.C.	War
Peace	0.000211**	-0.00013***	-0.000072**	-0.000009
	(2.572014)	(-2.5998)	(-2.436801)	(-1.575445)
Small C.	0.00028**	-0.000154**	-0.000106**	-0.000021*
	(2.176214)	(-2.169251)	(-2.085058)	(-1.795892)
Armed C.	0.000266***	-0.00009**	-0.000139**	-0.000036***
	(3.08925)	(-2.365337)	(-2.449635)	(-2.701665)
War	0.000457***	0.000161	-0.000449***	-0.000169***
	(4.235745)	(0.827695)	(-4.98835)	(-3.781665)

Notes: The table reports marginal effects from an ordered probit estimation. We control for Military Expenditures, LogGDP, LogPopulation, Ethnic Tensions, Polity2 Score, International Wars, Internationalized Civil Wars, Civil War Threat, and all other Weapon Categories. We also include year fixed effects and country-means for variables following Mundlak (1978). T-Values in Parentheses. Significant at: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 2 reports these average partial effects of our main military variable of interest: attack helicopters. The underlying regression model follows equation (1) and specifies a dynamic ordered probit model with correlated random effects (CRE). To take fixed country effects into account as good as possible, we follow the Mundlak-approach proposed in Wooldridge (2005) and include year-average values of all our regressors. Actually including country dummies is impossible due to the incidental parameter problem.

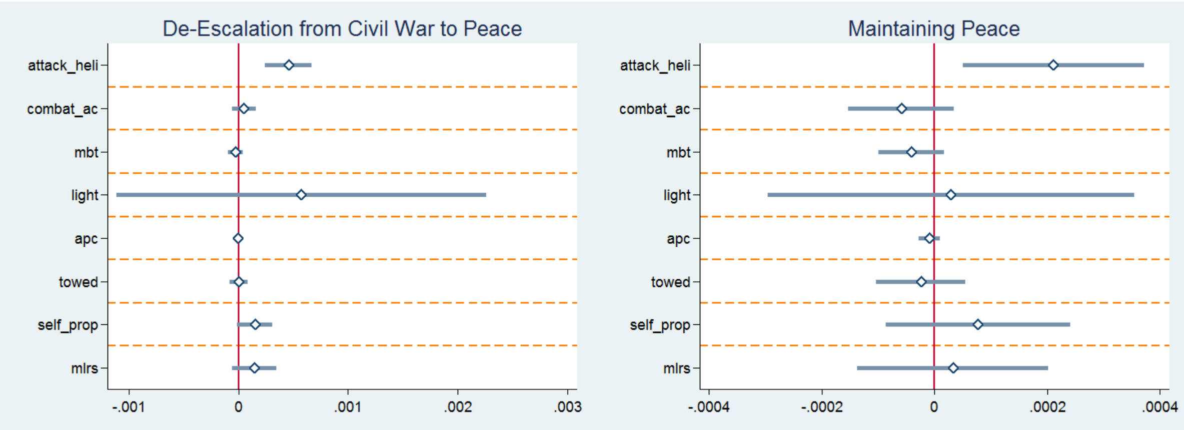
The results emphasize that the number of attack helicopters a country owns plays an important role for conflict (de)escalation. For almost any state of conflict a country starts in, a higher number of attack helicopters in their army increases the odds of de-escalation. The first row of table 2 reports the marginal effects of one additional attack helicopter on the likelihood that a country escalates from peace to any higher category. First, the significant and positive effect in the top left cell tells us that the higher the number of attack helicopters in a nation's army, the higher is the likelihood to maintain peace for another year. Quantifying the effect, we must consider the variation in countries' military stocks. Figure 2 displays the cross-country variation for attack helicopters. There is indeed some large variation across countries. While unexpectedly, the US and Russia belong to the countries with the highest numbers of attack helicopters in their armies, figure 2 also shows that there is some sizeable variation within Africa, Asia, or Latin America. Note also that the temporal variation, despite not being visualized here but shown in the appendix, is of equal extent.

Figure 2 **Global Distribution of Attack Helicopters in 2010**



In total, this leaves us with a rather high standard deviation of about 185 attack helicopters across countries and across time. Taking this large variance in military stocks into account, we find that a one standard deviation increase in a country's number of attack helicopters can be associated with a 0.04 percent increase in the likelihood to experience peace one more year. Going from this cell to the right, we see that the odds of de-escalating from peace to any state of conflict decrease with the number of attack helicopters in a country's army. This pattern is repeated for the following rows. A higher number of attack helicopters are always associated with a significantly increased chance to de-escalate towards peace, starting from any conflict category (column one of table 2).

Figure 3 **Coefficient Plots for all Weapon Systems**



Further, the likelihood to maintain a higher level of conflicts significantly decreases with the number of attack helicopters in the national army. For this, have a look at the last row of table 2. While a one standard deviation increase in a country's stock of attack helicopters increases the country's chances to de-escalate from a full-scale civil war directly to peace by about 0.08 percent (first cell in bottom row), it at the same time decreases the odds of spending another year in this maximum conflict category by 0.03 percent (bottom right cell). Of the other weapon systems, none shows a significant effect on escalation or de-escalation. Figure 3 displays coefficients for all weapon systems in our sample from two dynamic patterns:

maintaining peace (top-left cell in table 2) and de-escalating from civil war to peace (bottom-left cell in table 2). Only the coefficients for attack helicopters are significantly different from zero.

5. Extensions

So far, we found that attack helicopters are associated with a higher likelihood of de-escalating severe civil conflicts. This however is only one of several interesting dimensions when studying how civil wars get resolved. In this section, we propose two further dimensions of interest: the interplay with geography and the degree of indiscriminate violence.

Geography. For most of the weapon categories, there are certain types of terrain where each of them performs best and worse. Take a military's navy as an illustrative example. Battle ships are obviously helpful in open waters. As long as fighting takes place on land however, even the strongest submarine would be useless. Extending these thoughts, we make two further propositions. First, depending on where fighting takes place, some weapon categories are more useful than others. More to the point, we argue that attack helicopters are more useful to the incumbent's military once fighting takes place in rough terrain, i.e. forests and mountains. In this terrain, it is hard to navigate and fight with battle tanks or artillery. Attack helicopters on the other hand can easily access these areas from above. Further, as most attack helicopters nowadays are equipped with infrared cameras etc., they enormously facilitate detecting rebel hideouts in forests and mountains. Second, we expect rebels to adapt in their fighting choice to the incumbent's military composition. Therefore, we argue that when rebels know about the effectiveness of attack helicopters in battles over rough terrain, they will decide against hiding there. A lot of anecdotal evidence lets us suggest that rebel armies that face airborne attacks prefer to hide in populated urban areas instead of mountains or forests. Surrounded by civilians, they are harder to detect by infrared cameras and other tools. Further, while in unpopulated forest or mountain areas random and preemptive attacks by government troops yield a small chance of accidentally destroying a rebel base at only a small material cost, such attacks would be associated with very high civil casualties in populated areas. Hence, we expect a substitution in fighting locations from forest or mountain areas towards urban centers as soon as the government possesses a large number of attack helicopters.

To test these two propositions, we add data from two sources to our dataset. First, we make use of the MODIS landcover dataset provided by Channan et al. (2014) to distinguish between urban areas, forests, open field, and water. Between 2001 and 2012, the MODIS landcover dataset provides yearly information on the type of landscape at a resolution of 5x5 arc minutes (around 9.25x9.25 kilometers at the equator). We overlay this landscape raster with geocoded conflict events provided by the UCDP Georeferenced Event Dataset (GED) (Sundberg & Melander 2013). This dataset collects single events associated with a civil war identified by UCDP (i.e. with at least 25 battle deaths). For each event, the dataset supplies further information, e.g. on the combatants and number of battle deaths, as well as geographic coordinates that identify the battle region. By overlaying the UCDP GED dataset with the MODIS landcover dataset, we can assign to each point whether the event took place in urban area, a forest, or an open field (e.g. savannas or grasslands). For identifying fights in mountainous terrain, we make use of the dataset provided by Nunn & Puga (2012). The authors make use of the GTOPO30 dataset on the elevation of the earth (U.S. Geological Survey 1996) and calculate the slope of a given grid cell on earth following the terrain ruggedness index developed in Riley, DeGloria & Elliot (1999). For our main specifications, we choose a cutoff value of a 2 degrees slope to determine a given point in space as rugged.

We then again overlay the UCDP GED point data with this ruggedness dataset to determine whether a battle event took place in mountainous terrain. Aggregating the information to the country-year level, we receive the share of battle events that took place in either mountainous, urban, forest or open terrain. To keep the interpretation of our estimation results simple, we use a dummy variable indicating the major region, i.e. the type of terrain where the highest share of battles took place in a given country in a given year.

With these data at hand, we extend our main specification to include a triple interaction:

$$c_{it}^{*} = x_{it}'\beta + h_{i,t-1}'\rho + \left(x_{it} \otimes h_{i,t-1} \otimes terrain_{i,t-1}\right)'\gamma + \mu_i + \lambda_t + \varepsilon_{it} \quad (2)$$

Hence, we interact our conflict history and weapon category now additionally with the information on where most of the battles took place in the year before. Note that due to the nature of the UCDP data, this will only give us additional information for either category 2 or category 3 conflict events, i.e. for civil conflicts with at least 25 battle deaths in the year before. The results from this exercise are presented in tables 3 and 4, with attack helicopters as the dependent variable.

Table 3: Marg. Effects, Mountain/Forest Interaction. DV: Attack Helicopters.

From.To	Peace	Small.C.	Armed.C.	War
Peace	0.000247***	-0.000152***	-0.000086***	-0.00001
	(2.748538)	(-2.738155)	(-2.648163)	(-1.53944)
Small C.	-0.000563	0.000319	0.0002	0.000044
	(-0.304911)	(0.30383)	(0.306869)	(0.300642)
Armed C.	0.000357***	-0.000143**	-0.000167**	-0.000047***
	(2.766532)	(-2.170986)	(-2.449207)	(-2.652221)
War	0.000252**	0.000079	-0.00024***	-0.000091***
	(2.154372)	(0.812341)	(-2.724554)	(-2.642936)

Notes: The table reports marginal effects from an ordered probit estimation. We control for Military Expenditures, LogGDP, LogPopulation, Ethnic Tensions, Polity2 Score, International Wars, Internationalized Civil Wars, Civil War Threat, and all other Weapon Categories. We also include year fixed effects and country-means for variables following Mundlak (1978). T-Values in Parentheses. Significant at: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 3 introduces a dummy indicating that most of the battle events took place in mountainous or forest terrain. Table 4 displays the marginal effects when adding a triple interaction with a dummy for urban areas as the main battlegrounds instead. At the first sight, we find that the effects are qualitatively quite similar to the baseline effects presented in table 2. Only the coefficients in the second row, indicating the (de)escalation effects for countries starting out at lingering conflicts, turn insignificant. The results shown in table 4 confirm in part our expectation towards fighting in urban areas. Even though attack helicopters remain significantly associated with a higher likelihood of de-escalation, the effects decrease in magnitude. This becomes especially apparent in the bottom row, where the size of the coefficients is almost split by have as compared to table 2, where we used the simple interaction. Contrary to our expectations however, the effects did also not increase, but rather decrease in magnitude when we introduce fighting in forests or mountainous areas into the triple interaction. This again becomes especially clear when comparing the final row, which indicates the de-escalating effects of attack helicopters, in table 2 and in table 3. Instead of increasing in magnitude, the coefficients are almost split by half when the triple interaction is added. While puzzling at first, a possible explanation for this observation can be found when looking at the behavior of rebel groups in civil wars.

Table 4: Marg. Effects, Urban Interaction. DV: Attack Helicopters.

From.To	Peace	Small.C.	Armed.C.	War
Peace	0.000241***	-0.000148***	-0.000083***	-0.00001
	(2.73854)	(-2.720607)	(-2.666242)	(-1.533781)
Small C.	-0.000436	0.000247	0.000155	0.000034
	(-0.193164)	(0.193116)	(0.191941)	(0.198419)
Armed C.	0.000348***	-0.000139**	-0.000164**	-0.000046***
	(2.754715)	(-2.167521)	(-2.451599)	(-2.623795)
War	0.00024**	0.000089	-0.000238***	-0.000091**
	(2.106119)	(0.896183)	(-2.74598)	(-2.55413)

Notes: The table reports marginal effects from an ordered probit estimation. We control for Military Expenditures, LogGDP, LogPopulation, Ethnic Tensions, Polity2 Score, International Wars, Internationalized Civil Wars, Civil War Threat, and all other Weapon Categories. We also include year fixed effects and country-means for variables following Mundlak (1978). T-Values in Parentheses. Significant at: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 5 presents the results from a linear probability model with the indicator variable for urban areas as the main battle grounds as the dependent variable. This exercise shows that there is a significant reaction of rebel groups towards the composition of the government's military. According to column 6, rebels are almost eight percentage points more likely to substitute fighting from any other area towards urban areas when the government's stock of attack helicopters increases by one standard deviation. We interpret this as sizeable evidence that combatants do *i)* observe the military composition of the incumbent and *ii)* respond to it by changing the areas where they attack. This may explain part of the finding noted above, i.e. that attack helicopters do not become more efficient once fighting takes place in mainly forests or mountainous areas. If rebels adapt to the government's inventory, and only those who maintain their comparative advantage of fighting in mountains or forests against the military do not relocate while the rest moves fighting to urban areas, the most vulnerable rebel groups might select themselves out from fighting in areas where attack helicopters prove especially efficient. This out-selection in turn might keep us from finding an increase of attack helicopters' de-escalating capabilities when terrain is accounted for in the regressions.

Table 5: FE Regression. DV = Main Battle Scene is Urban

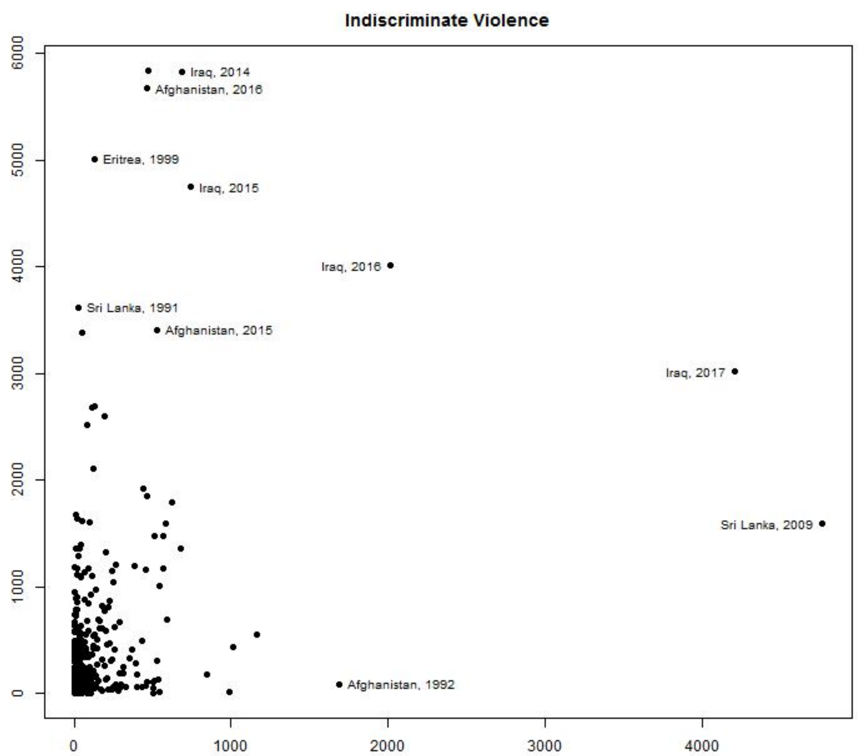
	(1) urban	(2) urban	(3) urban	(4) urban	(5) urban	(6) urban
attack heli	0.000537*** (0.0000326)					0.000421*** (0.000137)
light tanks		0.0000667 (0.000150)				0.000173 (0.000264)
apc			0.0000129*** (0.00000390)			-0.0000268* (0.0000150)
towed				-0.0000278*** (0.00000897)		-0.0000714* (0.0000414)
self prop					-0.0000408*** (0.00000495)	-0.0000452 (0.000124)
Observations	2286	2286	2286	2286	2286	2286
Countries	127	127	127	127	127	127

[Notes] Standard errors in parentheses
Controls: Major Fight Region, Rebel Deaths, Conflict-Dummy, Threat, Mil.Expenditures, LogPop, LogGDP, Polity2, Ethnic-ICRG, International War, Internationalized Civil War.
We also use Year and Country Fixed Effects. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Indiscriminate Violence. Next, we turn to having a closer look at the actual process of de-escalation. More precisely, we will look at the degree of indiscriminate violence in civil wars, and how this might be affected by the weapons in the incumbent's inventory.

For this, we again make use of the UCDP GED conflict data. The dataset provides for each recorded battle event the 'best estimate' for the casualties on either side of the battle: rebels, government troops, and civilians. We aggregate this information by the country-year level for each of these three categories. Indiscriminate violence is an important component of civil wars (Schutte 2017, Lyall 2009, Kalyvas 2006). As e.g. the occurrences during the recent civil war in Syria have shown, there are several weapons that allow to heavily hurt the rebel army, but at a high price. Weapons like poisoned gas that is disbursed over cities has a high chance of injuring or killing rebel fighters. At the same time however, this type of weapon does not allow to distinguish between rebel fighters and civilians.

Figure 4: **Rebel vs Civilian Casualties**



To illustrate the correlation between the government's weapon choice and indiscriminate violence, we plot yearly rebel casualties over yearly civilian casualties per country in figure 4. There, the big outliers show the big variance in collateral damages in civil wars. Take the Iraq as an illustrative example. In 2017, indiscriminate violence was quite severe. In total, 3017 rebellion battle deaths were account for in this one year, while there were 4712 casualties among the civil population. In this year, the ratio of civil vs. rebel deaths was hence around 1.4. Two years earlier however, the government troops seem to have been more 'efficient' in targeting rebel fighters. A total of 4747 rebel casualties was contrasted by 'only' 744 civilian deaths.

For our regressions, we define the severity of indiscriminate violence by the ratio of civilian casualties and the sum of casualties on the side of the rebels and the government. We then estimate how the severity of indiscriminate violence is affected by the composition of the government's military.

Table 6: FE Regression. DV = Civil Deaths per Rebel+Government Deaths

	(1)	(2)	(3)	(4)	(5)	(6)
attack heli	0.00272*					0.00366*
	(0.00151)					(0.00205)
light tanks		-0.000890				-0.00336
		(0.00134)				(0.00392)
apc			0.0000587*			0.000400
			(0.0000299)			(0.000254)
towed				-0.0000697**		0.000495
				(0.0000286)		(0.000485)
self prop					-0.000191***	0.000583
					(0.0000550)	(0.00185)
Observations	2286	2286	2286	2286	2286	2286
Countries	127	127	127	127	127	127

[Notes] Standard errors in parentheses
Controls: Major Fight Region, Rebel Deaths, Conflict-Dummy, Threat, Mil.Expenditures, LogPop, LogGDP, Polity2, Ethnic-ICRG, International War, Internationalized Civil War.
We also use Year and Country Fixed Effects. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6 presents the results from regressing the degree of indiscriminate violence on the weapon categories in our sample. We only find a robustly significant effect for attack helicopters. On average, our results suggest that the ratio of civil casualties to government and rebel casualties increases by around 0.68 for a one standard deviation increase in the number of attack helicopters in the incumbent's army. This means that if a significant number of attack helicopters takes part in the civil war, the likelihood that a rebel or government death is accompanied by a civil death increases by almost 70 percent – an enormous effect! From this, we derive the main result and conclusion of our paper: While attack helicopters look like a valuable help in ending a civil war earlier, this comes at a cost. Even though other types of fighting, e.g. in man-to-man combat and in-depth reconnaissance from the ground, must be associated with more years of civil war, these strategies might also be worth considering in order to keep the collateral of fighting as small as possible. Governments hence face a severe trade-off between ending a conflict fast and ending it with as little bloodshed as possible.

6. Conclusion

This paper takes a closer look on the (de)escalation of civil wars and adds several new insights into the process of pacification. First, we provide a new approach to estimating the role of state capacity in civil conflict with the use of a unique dataset on governments' military equipment. Second, we follow the novel approach from Bluhm et al. (2016) to test our hypotheses with an ordinal conflict variable in a dynamic ordered probit setting. By doing so, we can discriminate between the effects different types of weapons have on the de-escalation, escalation and prevalence of civil war. Going even further, this approach allows us to control for countries' conflict history and test for varying effects of the weapon systems, depending on the state of conflict a country starts from. We hypothesized that attack helicopters would prove as detrimental weapons in fighting civil wars. Attack helicopters are especially suited for battles in rough terrain, since they easily allow for airborne attacks where other weapon categories lack the chance of entry. Our regression results show that attack helicopters show a significant tendency to de-escalate fighting and prolong peace. While the former correlation should come for the advantage to engage in battles over rough terrain, the latter might stem from the fact that the presence of effective weapons in civil wars have deterrent effects on potential rebels. However, these channels must be analyzed more closely in the future to acquire a thorough picture of the correlates of pacification.

In addition to our baseline estimates, we look at civil wars and their (de)escalation from some other angles. Most prominently, we find that rebels seem to know about the governments' equipment, their weapons' advantages, and that they adjust their fighting behavior accordingly, e.g. by shifting the fight towards urban areas once the military possesses a higher number of attack helicopters. We also look into the topic of indiscriminate violence and find that attack helicopters, despite their advantage to maintain and bring peace more easily, must be associated with a larger number of civil casualties. This adds to the current discussion about drone strikes in civil war regions and their often indiscriminate way of liquidating enemies.

References

Abadie, Alberto, and Javier Gardeazabal. 2003. "The Economic Costs of Conflict: A Case Study of the Basque Country." *American Economic Review*, 93(1): 113-32

Acemoglu, Daron, Davide Ticchi, and Andrea Vindigni. "Persistence of Civil Wars" *Journal of the European Economic Association*, 2010a, 8(2–3), 664–676

Acemoglu, Daron, Davide Ticchi, and Andrea Vindigni. "A Theory of Military Dictatorships." *American Economic Journal: Macroeconomics*, 2010b, 2(1), 1–42

Acemoglu, Daron, Camilo García-Jimeno & James A. Robinson, 2015: "State Capacity and Economic Development: A Network Approach." *American Economic Review*, 105(8), 2364-2409

Acemoglu, Daron, Jacob Moscona & James A. Robinson (2016): State Capacity and American Technology: Evidence from the Nineteenth Century". *American Economic Review*, 106(5), 61-67

Banks, A. S. & K. A. Wilson (2015): Cross-National Time-Series Data Archive. *Jerusalem: Databanks International*.

Bayer, Resat & Matthew C. Rupert. 2004. "Effects of Civil Wars on International Trade, 1950-92". *Journal of Peace Research*, 41(6), 699-713

Berman, Nicolas & Mathieu Couttenier, 2015: "External Shocks, Internal Shots: The Geography of Civil Conflicts." *The Review of Economics and Statistics*, 97(4), 758-776

Besley, Timothy J., and Torsten Persson, 2008: "Wars and State Capacity." *Journal of the European Economic Association*. 6(2-3): 522-30

Besley, Timothy J. and Torsten Persson, 2009a: "The origins of state capacity: Property rights, taxation, and politics." *American Economic Review*, 99(4), 1218-1244.

Besley, Timothy J., and Torsten Persson, 2009b: "Repression or Civil War?" *American Economic Review*, 99(2): 292-97

Besley, Timothy J. and Torsten Persson, 2010: "State capacity, conflict, and development," *Econometrica*, 78(1), 1-34.

Besley, Timothy J., and Torsten Persson, 2011: "The Logic of Political Violence", *Quarterly Journal of Economics*, 126 (3), 1411-1446

Besley, Timothy J., and Torsten Persson, 2014: "The Causes and Consequences of Development Clusters: State Capacity, Peace, and Income." *Annual Review of Economics*, 6, 927-949

Blattman, C and E Miguel, 2010. "Civil Wars," *Journal of Economic Literature*, Vol. 48, No. 1 (March), pp. 3-57

Bluhm, Richard, Martin Gassebner, Sarah Langlotz & Paul Schaudt (2016): “Fueling Conflict? (De)Escalation and Bilateral Aid”. *CESifo Working Paper No. 6125*, October 2016

Brückner, M. and A. Ciccone (2010). "International Commodity Price Shocks, Growth, and the Outbreak of Civil War in Sub-Saharan Africa." *Economic Journal* 120: 519-534

Buhaug, Halvard, Scott Gates & Päivi Lujala 2009. “Geography, Rebel Capability, and the Duration of Civil Conflict.” *Journal of Conflict Resolution*, 53(4), 544-569

Chassang, Sylvain, and Gerard Padro-i-Miquel. 2009. "Economic Shocks and Civil War." *Quarterly Journal of Political Science*, 4(3): 211-28

Cerra, Valerie & Sweta Chaman Saxena. 2008: “Growth Dynamics: The Myth of Economic Recovery”. *American Economic Review*, 98(1): 439-457

Channan, S, K. Collins & W. R. Emanuel, 2014: “Global mosaics of the standard MODIS land cover type data.” *University of Maryland and the Pacific Northwest National Laboratory*, College Park, Maryland, USA

Collier, Paul, and Anke Hoeffler. 1998. "On Economic Causes of Civil War." *Oxford Economic Papers*, 50(4): 563-73.

Collier, Paul, and Anke Hoeffler. 2004. "Greed and Grievance in Civil War." *Oxford Economic Papers*, 56(4): 563-95.

Collier, Paul, and Anke Hoeffler. (2007), “Civil Wars,” *Handbook of Defense Economics*, Volume 2, 2007.

Condra, Luke N., James D. Long, Andrew C. Shaver & Austin L. Wright (2018). “The Logic of Insurgent Electoral Violence.” *American Economic Review*, forthcoming

Crost, Benjamin, Joseph Felter & Patrick Johnston. 2014. “Aid under Fire: Development Projects and Civil Conflict.” *American Economic Review*. 104(6), 1833-1856

Dincecco, M. & Katz, G., 2016: “State Capacity and Long-run Economic Performance.” *Economic Journal*. 126(590), 189–218

Djankov, S. and M. Reynal-Querol (2010). "Poverty and Civil War: Revisiting the Evidence." *Review of Economics and Statistics* 92: 1035-1041.

Dunne, J. Paul & Ron P. Smith. 2010. “Military Expenditure and Granger Causality: A Critical Review”. *Defense and Peace Economics*, 21(5-6), 427-441

Esteban, J, L Mayoral and D Ray,“Ethnicity and Conflict: An Empirical Study,” *American Economic Review 2012, 102(4): 1310–1342*

Fearon, James D. 2007. "Economic Development, Insurgency, and Civil War." In *Institutions and Economic Performance*, ed. Elhanan Helpman, 292- 328. Cambridge: Harvard University Press

Garfinkel, Michelle R., Stergios Skaperdas, "Economics of Conflict: An Overview," *Handbook of Defense Economics*, Volume 2, 2007, Pages 649–709

Ghobarah, Hazem Adam, Raul Huth & Burce Russett, 2003. "Civil Wars Kill and Maim People – Long After the Shooting Stops." *American Political Science Review*, 97(2), 189-202

Guidolin, Massimo, and Eliana La Ferrara. 2007. "Diamonds Are Forever, Wars Are Not: Is Conflict Bad for Private Firms?" *American Economic Review*, 97(5): 1978-93.

Hackett, James T, 2014: "The Military Balance", *Routledge*

Hegre, H. and Nicholas Sambanis. 2006. "Sensitivity Analysis of Empirical Results on Civil War Onset." *Journal of Conflict Resolution* 50(4):508-535.

Hendrix, Cullen S. 2010: "Measuring State Capacity: Theoretical and Empirical Implications for the Study of Civil Conflict." *Journal of Peace Research,* 47(3), 273-285

Holtermann, Helge, 2016: "Relative Capacity and the Spread of Rebellion." *Journal of Conflict Resolution*, 60(3): 501-529

Justino, P "War and Poverty," in M.R. Garfinkel and S. Skaperdas (eds), *Oxford Handbook of the Economics of Peace and Conflict*, NY: Oxford University Press (March 2012)

Kalyvas, Stathis N., 2006: "The logic of violence in civil war." *Cambridge University Press*

Lewbel, Arthur. 2012. Using Heteroscedasticity to Identify and Estimate Mismeasured and Endogenous Regressor Models. *Journal of Business and Economic Statistics* 30 (1):67-80.

Lyall, Jason, 2009: "Does indiscriminate violence incite insurgent attacks? Evidence from Chechnya." *Journal of Conflict Resolution*, 53(3), 331-262

Marshall, Monty G. (2017): Major Episodes of Political Violence (MEPV) and Conflict Regions, 1946-2016. *Center for Systemic Peace*

Marshall, Monty G., Ted Robert Gurr & Keith Jaggers (2017): Polity IV Project. *Center for Systematic Peace and Societal-Systems Research Inc*

Miguel, Edward, Shanker Satyanath, and Ernest Sergenti. 2004. "Economic Shocks and Civil Conflict: An Instrumental Variables Approach." *Journal of Political Economy*, 112(4): 725-53.

Miguel, Edward & Shanker Satyanath 2011: "Re-examining Economic Shocks and Civil Conflict." *American Economic Journal: Applied Economics,* 3: 228-232

Murdoch, James C, and Todd Sandier. 2004. "Civil Wars and Economic Growth: Spatial Dispersion." *American Journal of Political Science*, 48(1): 138-51.

Nunn, Nathan & Diego Puga, 2012: "Ruggedness: The Blessing of Bad Geography in Africa." *The Review of Economics and Statistics*, 94(1): 20-36

Pettersson, Therése & Peter Wallensteen, 2015: “Armed Conflicts, 1946-2015”. *Journal of Peace Research*, 52(4), 536-550

Powell, R, “Monopolizing Violence and Consolidating Power,” *The Quarterly Journal of Economics* (2013) 128 (2): 807-859.

Qureshi, Mahvash Saeed, “Trade and thy neighbor's war, 2013: ”*Journal of Development Economics*, 105, 178–195.

Ross, Michael L. 2006. "A Closer Look at Oil, Diamonds, and Civil War." *Annual Review of Political Science*, 9: 265-300.

Riley, Shawn J., Stephen D. DeGloria, and Robert Elliot, 1999: “A Terrain Ruggedness Index That Quantifies Topographic Heterogeneity,” *Intermountain Journal of Sciences*, 5(1–4), 23–27

Ross, Michael L. 2006: “A Closer Look at Oil, Diamonds, and Civil War.” *Annual Review of Political Science*, 9, 265-300

Salehyan, Idean & Kristian Skrede Gleditsch, 2006. “Refugees and the Spread of Civil War.” *International Organization*, 60(2), 335-366

Schutte, Sebastian, 2017: “Geographic determinants of indiscriminate violence in civil wars.” *Conflict management and peace science*, 34(4), 380-405

Sundberg, Ralph & Erik Melander, 2013: “Introducing the UCDP Georeferenced Event Dataset,” *Journal of Peace Research*, 50(4), 523-532

Teorell, Jan, Nicholas Charron, Stefan Dahlberg, Sören Holmberg, Bo Rothstein, Petrus Sundin & Richard Svensson. 2013. The Quality of Government Dataset, version 15May13. University of Gothenburg: The Quality of Government Institute, http://www.qog.pol.gu.se.

U.S. Geological Survey 1996: “ GTOPO30.” *Sioux Falls, SD: U.S. Geological Survey Center for Earth Resources Observation and Science*

Walch, Colin (2018). “Weakened by the Storm. Rebel Group Recruitment in the Wake of Natural Disasters in the Philippines.” *Journal of Peace Research*, forthcoming

World Bank (2017). World Development Indicators. Washington D.C.

Table A1: Dependent Variable = Pattern of Missing Values in Weapon Category

	(1) Light Tanks	(2) APC	(3) Attack Helis	(4) Combat AC	(5) MLRS	(6) Self Propelled	(7) Towed Artillery	(8) Submarines	(9) MBT
conflict	-0.0144	0.000328	0.0142	-0.0139	0.0128	0.0140	-0.00477	0.0123	0.00971
	(0.0140)	(0.00971)	(0.0124)	(0.00945)	(0.0142)	(0.0111)	(0.0114)	(0.00913)	(0.0114)
_cons	0.541***	0.196***	0.498***	0.259***	0.607***	0.572***	0.259***	0.689***	0.420***
	(0.0248)	(0.0134)	(0.0249)	(0.0145)	(0.0247)	(0.0221)	(0.0172)	(0.0186)	(0.0195)
Observations	4096	4096	4096	4096	4096	4096	4096	4096	4096
Countries	192	192	192	192	192	192	192	192	192

Missingness-Pattern of military variables regressed on Conflict. Year Fixed Effects Included. Standard errors in parentheses, * $p<0.10$, ** $p<0.05$, *** $p<0.01$

Table A2: Descriptive Statistics

	conflict	*light*	*apc*	*attack heli*	*combat ac*	*mrls*	*towed*	*mbt*
min	0	0	0	0	0	0	0	0
mean	.5099554	49.55465	1076.251	41.94453	174.4386	113.4678	432.6986	677.9424
max	3	2200	53840	2710	9000	5100	14500	30320
sd	.8264315	171.4597	3356.145	185.4823	608.7386	417.0231	1406.212	2039.941
N	6730	3696	3696	3696	3696	3696	3696	3696

	self prop.	*logPop*	*logGDP*	*region*	*polity2*	*ethnicICRG*	*intern.war*	*threat*	*mil. exp.*
min	0	8.361475	16.02628	0	-10	0	0	0	.0349045
mean	159.5855	15.0815	22.85526	.2690223	2.909066	3.932176	.0051307	.7670817	2.606865
max	6261	21.02389	30.41327	5	10	6	1	9	117.3877
sd	559.5052	2.23834	2.478349	.9354926	6.694987	1.46733	.0714483	1.610628	3.374377
N	3696	10210	7581	10330	3684	3369	10330	3723	3401

Table A3: Marg. Effects, Urban Interaction. DV: Light Tanks.

From.To	Peace	Small.C.	Armed.C.	War
Peace	0.000023	-0.000014	-0.000008	-0.000001
	(0.142449)	(-0.142366)	(-0.142621)	(-0.141858)
Small C.	0.00606**	-0.003433**	-0.002161*	-0.000466*
	(1.984649)	(-1.971984)	(-1.894947)	(-1.731954)
Armed C.	0.000034	-0.000014	-0.000015	-0.000005
	(0.142388)	(-0.142307)	(-0.142077)	(-0.143171)
War	0.000026	0.000006	-0.000023	-0.000008
	(0.142281)	(0.13966)	(-0.142626)	(-0.142544)

Notes: The table reports marginal effects from an ordered probit estimation. We control for Military Expenditures, LogGDP, LogPopulation, Ethnic Tensions, Polity2 Score, International Wars, Internationalized Civil Wars, Civil War Threat, and all other Weapon Categories. We also include year fixed effects and country-means for variables following Mundlak (1978). T-Values in Parentheses. Significant at: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table A4: FE Regression. DV = Main Battle Scene is Mountain/Forest

	(1)	(2)	(3)	(4)	(5)	(6)
	for_rug	for_rug	for_rug	for_rug	for_rug	for_rug
attack heli	-0.000110**					0.000256*
	(0.0000540)					(0.000141)
combat ac		-0.000196**				-0.000660***
		(0.0000866)				(0.000245)
apc			-0.0000121**			0.0000322
			(0.00000512)			(0.0000207)
towed				-0.0000153**		0.0000714**
				(0.00000685)		(0.0000347)
self prop					-0.0000533**	0.0000222
					(0.0000215)	(0.0000870)
Observations	2286	2286	2286	2286	2286	2286
Countries	127	127	127	127	127	127

[Notes] Standard errors in parentheses
Controls: Major Fight Region, Rebel Deaths, Conflict-Dummy, Threat, Mil.Expenditures, LogPop, LogGDP, Polity2, Ethnic-ICRG, International War, Internationalized Civil War.
We also use Year and Country Fixed Effects. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A5: Main Regression Results

	(1)	(2)	(3)	(4)
	conflict	conflict	conflict	conflict
ATTACK_HELI	-0.000996***	-0.00145***	-0.00136***	-0.00158***
	(0.000387)	(0.000349)	(0.000346)	(0.000340)
MRLS	-0.000239	-0.000156	-0.000267	-0.000151
	(0.000382)	(0.000411)	(0.000393)	(0.000502)
APC	0.0000293	0.0000479	0.0000438	0.0000557
	(0.0000421)	(0.0000486)	(0.0000454)	(0.0000487)
TOWED	-0.0000577	0.0000167	-0.0000493	-0.0000495
	(0.000157)	(0.000178)	(0.000164)	(0.000194)
SELF_PROP	-0.000438	-0.000437	-0.000454	-0.000537
	(0.000368)	(0.000366)	(0.000372)	(0.000382)
COMBAT_AC	0.000105	0.000220	0.000119	0.000229
	(0.000168)	(0.000210)	(0.000169)	(0.000212)
MBT	0.000185	0.000165	0.000177	0.000187
	(0.000136)	(0.000134)	(0.000133)	(0.000153)
LIGHT	-0.000281	-0.000359	-0.000222	-0.0000674
	(0.000826)	(0.000921)	(0.000860)	(0.000841)
LAGGED_C_2	0.583***	0.615***	0.586***	0.613***
	(0.107)	(0.107)	(0.111)	(0.101)
LAGGED_C_3	1.233***	1.242***	1.206***	1.091***
	(0.245)	(0.248)	(0.244)	(0.250)
LAGGED_C_4	2.099***	2.060***	2.083***	2.111***
	(0.376)	(0.375)	(0.380)	(0.393)
LAG_C_HELI	-0.0000148			
	(0.000455)			
LAG_C_HELI	0.000106			
	(0.000287)			
LAG_C_HELI	-0.00116***			
	(0.000286)			
LAG_C_MRLS		-0.000297***		
		(0.000103)		
LAG_C_MRLS		-0.000124		
		(0.000210)		
LAG_C_MRLS		-0.000508**		
		(0.000215)		
LAG_C_APC			-0.00000452	
			(0.0000274)	
LAG_C_APC			0.0000193	
			(0.0000240)	
LAG_C_APC			-0.0000407*	
			(0.0000228)	
LAG_C_LIGHT				-0.000470***
				(0.000174)
LAG_C_LIGHT				0.00531
				(0.00912)
LAG_C_LIGHT				0.00113
				(0.00118)
LOGPOP	0.363	0.384	0.383	0.308
	(0.585)	(0.595)	(0.589)	(0.648)
LOGGDP	0.0190	0.00758	0.00574	0.0655
	(0.169)	(0.170)	(0.169)	(0.179)
MILEXPEND	0.0176**	0.0170**	0.0171**	0.0284
	(0.00716)	(0.00722)	(0.00719)	(0.0309)
POLITY2	-0.0318***	-0.0318***	-0.0317***	-0.0337***
	(0.0121)	(0.0122)	(0.0122)	(0.0131)
ETHNIC_ICRG	-0.184***	-0.191***	-0.189***	-0.199***
	(0.0444)	(0.0446)	(0.0446)	(0.0429)
INT_WAR	-0.182	-0.159	-0.174	-0.360
	(0.436)	(0.437)	(0.434)	(0.463)
INT_CWAR	-1.230**	-1.215**	-1.236**	-1.377***
	(0.505)	(0.499)	(0.504)	(0.471)
THREAT_UCDP	-0.202*	-0.211*	-0.209*	-0.211*
	(0.113)	(0.113)	(0.114)	(0.110)
OBSERVATIONS	2159	2159	2159	2132
COUNTRIES	127	127	127	127
	Standard errors in parentheses, * p<0.10, ** p<0.05, *** p<0.01			