Strategic Mass Killings*

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Abstract

We provide a model of conflict and mass killing decisions, to identify the key variables and situations that make mass killings more likely to occur. We predict that mass killings are most likely in countries with large amounts of natural resource rents, polarization, institutional constraints regarding rent sharing, and low productivity of labor. The role of resources like oil, gas and diamonds and other key determinants of mass killings is confirmed by our empirical results based on country level as well as ethnic group level analysis.

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1 Introduction

Mass killings of civilians are obviously a serious problem.[1] Since World War II some 50 episodes of mass killings have led to between 12 and 25 million civilian casualties (Political Instability Task Force 2010)[2] and by 2008 have induced the displacement of 42 million people (UNHCR, 2009).

Surprisingly, while there is an increasing number of formal models of civil and interstate wars,[3] the issues of mass killings and forced displacements of civilians have so far been largely neglected as far as formal rational explanations are concerned. Mass killings may have different causes, motivations and implications with respect to other forms of violent confrontation, and may well be regarded as the manifestation of the worst of the human being. Even though hatred and uncontrolled passion can certainly play a big role, in Mann's (2005: 9, 31) words, "to understand ethnic cleansing we need a sociology of power more than a special psychology of perpetrators as disturbed or psychotic people —though some may be. (...) All cases of cleansing involve material interests. Usually, members of an ethnic group come to believe they have a collective economic interest against an out-group." Also Chirot and McCauley (2006: 5) argue "that most political massacres are quite deliberate, are directed by or at least approved by the authorities, and that they have a goal (...)." These authors "take the position that mass killing is neither irrational nor in any sense 'crazy'" (2006: 7). Like the explanation of wars, the explanation of some mass killing episodes requires reference to history, ideological clashes, religious cleavages and alike but the presence of such cleavage-related motivations alone cannot explain why in their presence there are cases in which mass killings take place and other cases in which they do not. A rationalist explanation of mass killing decisions can be crucial for this type of positive analysis even when material incentives are not the sole motivations. One of the points of this paper is to also show that indeed the quantitative significance of material interests (mostly related to natural resource rents, as we will see) can predict mass killing events. We examine whether decisions to exterminate the opponents can be explained as the result of strategic, rational calculation, independently of how these decisions

[1] We adopt the definition in Charny (1999: 7) and Easterly, Gatti and Kurlat (2006: 132): "Mass killings are the killings of substantial numbers of human beings, when not in the course of military action against the military forces of an avowed enemy, under the conditions of the essential defenselessness and helplessness of the victims". In the literature this class of phenomena is referred to sometimes as genocide, democide or politicide, but each of these words takes a more specific meaning, and we have opted for the more encompassing term mass killing.

[2] The estimates of how many civilian fatalities have fallen in this category vary a lot because of the difficulties in identifying degrees of intentionality and targeting, but they are substantial by any standard. In contrast with the estimate by the "Political Instability Task Force", Bae and Ott (2008) use even larger numbers: The conflict-related deaths in the 20th century were as large as 109.7 millions, corresponding to 4.35 percent of the world population. Of these, 60 percent were civilian non-combatants.

[3] See Blattman and Miguel (2010) for a survey on civil war, while the classic article by Fearon (1995) and the more recent survey by Jackson and Morelli (2011) cover the rationalist explanations of war more generally.

had been framed.

The recent case of mass killings in Sudan's Darfur region that started in 2003 illustrates the key features we wish to capture. Two features are essential: 1) *Identifiable groups:* The primary perpetrators of the killings and expulsions in Darfur are government-backed "Arab" militias. The main civilian victims are black "Africans" (Straus, 2005: 123). 2) *Resource wealth and low productivity in other sectors*: The early 21st century was characterized by natural resource shocks (Sudan becomes an increasingly important oil producer). At the same time productivity and state capacity of Sudan remained very low. These two factors[4] led to an explosive blend that made the mass killings in Darfur possible. The estimates of the death toll vary between 70,000 and 400,000 fatalities, with an estimated 1.8 million people displaced (Straus, 2005, 2006; Waal, 2007). This corresponds to a significant fraction of the total population in this region, which was about 6.5 million before the outbreak of the crisis. The killings were clearly strategic, "directed by the state, targeted at a particular ethnic population, and intended to destroy that ethnic population in substantial part" (Straus, 2006: 43). We are going to stress the importance of ethnic group size and natural resources in general for this type of extreme strategic mass killings, both theoretically and empirically.

Reducing the population size of the opponent group – by extermination and/or exile[5] – allows the perpetrator to obtain a larger share in the future distribution of surplus. This incentive is particularly relevant within countries with well defined ethnic groups and where the government is basically controlled by one of them.

Given the above motivation, we introduce a formal model with the following characteristics: the population is divided in two identifiable groups[6] and one of them initially controls the government. In every period of the game the two groups decide whether to go to war with each other or not, and peace obviously prevails if and only if both groups choose to maintain peace. Whoever is in power at the end of a period, power conquered or kept, decides unilaterally the distribution of the surplus of that period's production as well as whether or not

[4] Among the other factors, an unfortunately crucial one is that it became increasingly clear that the international community would be hesitant to rapidly and forcefully intervene (Straus, 2005; 2006; Waal, 2007).

[5] Mass killings have the multiplier effect of triggering massive refugee flows. Hence, while the focus of our paper is on the incentives and logic behind mass killings, the possibility of a larger multiplier effect, caused for example by the vicinity of a country expected to keep open borders, could constitute an incentive amplification factor, to be considered in future work about the dynamics of forced migration. However, if a government tries to displace minority groups without killings, the underlying logic is somewhat different (as clarified below), because killings are irreversible, while displaced populations are often looking for opportunities to return or retaliate.

[6] These groups could be identified by any of the dividing lines in society, ethnicity, religion, race. We abstract from these distinctions. Also, we will not explicitly deal with more fractionalized societies. The countries with two large identifiable groups are empirically by far the most dangerous places in terms of likelihood of the events we aim to rationalize (see below), hence we consider the difficult extension to more than two groups to be a low priority in the research agenda.

to commit mass killings. In other words, each period's key stages are a *war-peace* decision and the subsequent *exercise of power* by the group that either conquered or kept power, with or without war. We will analyze first the *unlimited power* benchmark, where the only limits to exploitation and elimination of opponents are endogenous ones, determined by an explicit consideration of the continuation game. The analysis will then be generalized to include the possibility of *exogenous bounds* to the exercise of power, both in terms of restrictions in revenue sharing, and in terms of mass killing consequences and feasibility.

The decision about how to share the current surplus is constrained by the rebellion outside option (the endogenous constraint),[7] and at the same time there may be international, normative, or institutional constraints against unfair surplus sharing. The fact that mass killings is one possible exercise of power creates an additional reason to rebel, in the "shadow of mass killings". The fear of exploitation or mass killings play different roles in different contexts, and our goal is to characterize the precise conditions on regime, population size, group polarization, and economic structure that could induce even the best possible equilibrium to include conflict and violence against civilians.

We characterize the best Subgame Perfect Equilibrium of the infinite horizon game between the two groups for every set of parameters, and we obtain the robust prediction that the likelihood of mass killings is increasing in natural resource abundance and decreasing in labor productivity and destruction costs of war. Moreover, we find that group polarization increases the likelihood of mass killings, whereas an increase in population size (keeping polarization constant) reduces the probability of such events. Finally, we find that a tightening of institutional constraints to distributive power increases the probability of mass killings whenever the constraint binds, whereas the effects of a tightening of the constraints on the power to kill are ambiguous.

The main trade-off for a group holding power when deciding about the pros and cons of using the power to kill is as follows. The elimination of minority members in the present reduces the future constraints on future surplus sharing, but on the other hand reduces future production in labor intensive sectors, hence the trade-off is intuitively affected by the relative preponderance of natural resources.

Starting from a situation in which the institutional constraints to unfairness in surplus sharing are limited (for example starting from an effective dictatorship), an increase in the institutional lower bound to unfairness (for example caused by greater checks and balances typical of a democratization process) can have ambiguous effects on violence: on the one hand, an exogenous increase in institutional constraints to unfairness obviously reduces the motivations to rebel; on the other hand, such a change in the institutional constraints affects

[7] Like in Powell (1996), unfair treatment can cause war if combined with the expectation (here due to the possibility of a government decision to eliminate opponents) that in the future the group's ability to rebel and overturn the power relationship will be lower. The main difference with respect to Powell's "declining State" argument is that in our model the minority group's expected future weakening depends directly on actions that the group in power will take if power remains in their hands.

the calculations in the trade-off mentioned above in the direction of making mass killings more likely.

Inspired by our theoretical model and by its predictions, we present an empirical analysis of mass killings, studying the effects of natural resource rents and all the other key variables of the theory, at the country and ethnic group levels. To the best of our knowledge, there has not been a comprehensive study in the literature before ours of the impact of natural resources on mass killings at the country level, and we are also the first ones to study massacres with an ethnic group panel.

As suggested by the theory, our empirical analysis confirms that natural resource rents are a robust and very significant predictor of mass killings,[8] while a high labor productivity is found to discourage massacres. Mass killings are also significantly more likely in small,[9] ethnically polarized countries.

Further, we find that –when controlling for the country characteristics– ethnic groups are significantly more likely to be massacred if they are relatively small and resource-rich, which is in line with our theory. In contrast, these findings are not easy to reconcile with alternative mechanisms suggesting for example that oil may fuel mass killings by making oil-rich groups more powerful. If this alternative explanation were driving the correlation between oil and mass killings, we should expect oil-poor groups to be the main targets, which contradicts our empirical results.

The paper is organized as follows: In section 2 we discuss the main elements that need to be considered in the analysis of mass killings and we relate our predictions and findings to the existing literature; in section 3 we introduce our model; in sections 4 and 5 we present all our theoretical findings and predictions. Section 6 contains the empirical analysis, and section 7 concludes. As usual, technical and supplemental materials are relegated to the appendix.

2 Important Patterns of Mass Killings and Relation to Literature

Before diving into the analysis, it is useful to highlight the main patterns of mass killings and discuss some of the predictions and findings in the literature.

The first fact to highlight is that almost all mass killing episodes in history were perpetrated by governments or dominant groups (see Harff, 2003; Valentino, Huth and Balch-Lindsay, 2004; Eck and Hultman, 2007). In order to be able to carry out mass killings, evidently a group needs to handle power and control the military.[10] A quote from Krain (2000: 43) illustrates this well:

[8] See also Querido (2009) for an early finding of this, limited to Africa.

[9] It is interesting that we find population size to have a negative effect on mass killings, both theoretically and empirically, while for civil wars as dependent variable several empirical studies have found a positive effect of population (e.g. Fearon and Laitin, 2003; Collier and Hoeffler, 2004; Montalvo and Reynal-Querol, 2005; Collier and Rohner, 2008; Collier, Hoeffler and Rohner, 2009; Esteban, Mayoral, and Ray, 2012).

[10] The exceptions confirm the rule: rebel groups are responsible for a very small part of mass

"Military victories by definition enable the winner to set the terms of the post-internal war period. This may include the decision to punish the losing side by eradicating them, thereby eliminating the problem of having to live side by side with the enemy in the post-internal war state. This was the solution chosen by the Congolese rebels who took control of what would become Zaire in the mid-1960s". Or in the words of Chirot and McCauley (2006: 2), "conflict can become genocidal when powerful groups think that the most efficient means to get what they want is to eliminate those in the way."

Rummel (1994, 1995) points out that "power kills, absolute power kills absolutely" (1994: 1), and gives a strong quantitative idea of the preponderance of government decided killings, when he states that "political regimes — governments— have probably murdered nearly 170,000,000 of their own citizens and foreigners in this century — about four times the number killed in all international and domestic wars and revolutions." (Rummel, 1995: 3). Most of the time mass killings are present towards the end or after many guerrilla wars (Krain, 2000; Valentino, Huth and Balch-Lindsay, 2004),[11].

A second stylized fact to keep in mind is that not all forms of war are equally likely to be accompanied by mass killings. A substantial fraction of civil wars entail deliberate mass killings of civil non-combatants on a large scale perpetrated by the dominant group, while there is almost no record of mass killings of this sort in post-WWII interstate wars. Between 1960 and 2000 roughly a third of all civil wars (50 out of 152) featured mass killings, while in none of the interstate wars (23) were there mass killings.[12] In interstate disputes there is no supranational government budget to fight for in terms of entitlements or alike, and hence interstate wars typically take the form of territorial wars.[13]

One distinctive feature of mass killings that clearly separates this deadly option from other forms of weakening the opposition group (e.g. imprisonments, internments, expropriations and disenfranchisements) is that mass killings are designed to reduce the size of the opponent groups, either directly or by causing refugee outflows and displacements (multiplier effect). Or in Krain's (2000: 41) words: "The goal of state-sponsored mass murder is to eliminate the opposition from existence".[14]

killings of civilians, and they are more likely to engage in killings if they are militarily strong relative to the government (Hultman, 2009) and after having won a military battle (Schneider, Bussmann, and Ruhe, 2012). Usually killings by rebels take the form and objectives of terrorism, which is beyond the scope of this paper (for this separate literature, see e.g. Azam and Hoeffler, 2002; and Bueno de Mesquita, 2010).

[11] The usual sequence of events is indeed that there is first a civil war and mass killings only take place after victory. To put it in Krain's (2000: 46) words, "internal wars are lethal twice over–in the actual bloody conflict, and in the enhanced potential for state-sponsored mass murder subsequently".

[12] To compute this, we took data on mass killings in wars from Valentino, Huth and Balch-Lindsay (2004), civil wars data from Collier, Hoeffler and Rohner (2009), and data on interstate wars from Gleditsch and Ward (2007). According to Valentino, Huth and Balch-Lindsay (2004) the only mass killings during interstate war in recent decades took place during the Korean War, 1950-53 (which shared many features with civil wars).

[13] Caselli, Morelli and Rohner (2013) display theoretically and empirically the territorial nature of interstate resource wars.

[14] The Holocaust provides us with the saddest and most well known example that im-

At the theoretical level, the logic behind mass killings is very different from the logic behind government appropriation or expropriation strategies, since they have opposite dynamic incentive effects: appropriation, expropriation and imprisonment are reversible and create extra motivation for future revenge, while killings are irreversible. Softer forms of weakening opposition groups, like disenfranchisement strategies, would induce higher relative incentives to rebel, whereas the logic of mass killings is precisely the reduction of future threats. Acemoglu and Robinson (2001) give a perspective of enfranchisement as commitment to fair surplus sharing in the future in order to avoid the risk of rebellion, and this can be captured in our model by an increase in the institutional lower bound on the unfair treatment of minority groups. What we show is precisely that while such a lower bound certainly reduces the probability of unfairness related motivations to rebel for minority groups, it may increase the dominant groups' incentives to decimate them. By the same token, if the government controlling group is looking for strategies to weaken the future claims on resources by minority groups, disenfranchisement could work only conditional on being sure that no rebellion could ensue, while eliminated players cannot fight in the future. An extreme form of disenfranchisement is slavery and forced labor (see e.g. Domar, 1970; Lagerlöf, 2009; Acemoglu and Wolitzky, 2011). As we show in the paper (see lemma 4 and the subsequent discussion) it is possible even in our model that the group in power may prefer distributive exploitation (conceptually similar to slavery) over the option of mass killings, but *only* when natural resource rents are not larger than the destruction costs of war and when there are binding limits to the exercise of power. At the time of the Peloponnesian war (see e.g. Thucydides, 1956), the Sparta rulers chose to repress the Hilots rather than killing them because (1) the Hilots were the majority and were providing most of the productive work and (2) the technology of control through the strong military was simply less costly than the alternatives. The importance of Hilots for production and the absence of crucial natural resources are already two factors that our model would deem sufficient to explain the ruler's lack of interest in the option of mass killings.

Our empirical results confirm that democratization can have ambiguous effects, as suggested by the theory. In the literature non-democratic regimes are found to be more likely to commit mass killings than democracies, especially when the autocrats are powerful (Rummel, 1994, 1995; Harff, 2003; Valentino, Huth and Balch-Lindsay, 2004; Easterly, Gatti and Kurlat, 2006; Eck and Hultman, 2007; Colaresi and Carey, 2008). We find in section 6 that autocracy does not remain a significant explanatory variable for mass killings when one addresses the autocorrelation of the dependent variable, reduces the omitted variable bias and accounts for unobserved heterogeneity. Unfortunately, the

prisonments, internments and expropriations may not suffice when the intention of a group controlling the means of violence is hegemony over the other group down into the future. The "final solution" was decided in 1942, after the capture of all Jews. The Jewish population had already been expropriated and were living in ghettos and camps. Even though the most pressing problem Germany faced was the attack of the allied troops, they decided to increase the focus on the extermination of the Jews, as evident in 1943. See also Valentino (2004).

existing quantitative literature focuses almost exclusively on the *level* of democracy rather than the *process* of democratization. However, there is ample case study evidence available. Based on extensive historical examples, Mann (2005) argues that "regimes newly embarked upon democratization are more likely to commit murderous ethnic cleansing than are stable authoritarian regimes."[15]

Among the other papers in the empirical literature studying mass killings, Krain (1997), Heger and Salehyan (2007), Bae and Ott (2008) and Querido (2009) find that large levels of ethnic fractionalization reduce the risk of mass killings, while Montalvo and Reynal-Querol (2008) show that ethnic polarization increases the risk of mass killings; richer countries tend to display less mass killings (Scully, 1997; Bae and Ott, 2008);[16] inequality (especially human capital inequality) tends to increase the risk of mass killings (Besançon, 2005), while trade openness reduces the risk of mass killings (Harff, 2003).[17]

We shall also briefly discuss the factors that have been found to increase the risk of *forced displacements*. Refugee flows are larger in conjunction with mass killings, in wars, under dissident repression, in non-democracies and in countries with low agricultural productivity per worker (Schmeidl, 1997; Azam and Hoeffler, 2002; Davenport, Moore and Poe, 2003; Moore and Shellman, 2004).

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[15] Mann (2005) sees the process of democratization as the main cause of ethnic cleansing: "Stably institutionalized democracies are less likely than either democratizing or authoritarian regimes to commit murderous cleansing. (...) But their past was not so virtuous. Most of them committed sufficient ethnic cleansing to produce an essentially mono-ethnic citizen body in the present. In their past, cleansing and democratization proceeded hand in hand." (p. 4)

Looming democratization has also been noted to have critical effects on the risks of civilian massacres by Mansfield and Snyder (2005): "The 1993 elections in Burundi–even though internationally mandated, free, and fair–intensified ethnic polarization between the Hutu and Tutsi ethnic groups, resulting in some 200,000 deaths" (2005: 5). Further, Mansfield and Snyder refer to "power sharing and pluralism as precursors to the Rwandan genocide. In Rwanda, as in Burundi, the pressures to democratize applied by the international donors that were the source of 60 percent of the Rwandan government's revenue played a central role in triggering ethnic slaughter" (2005: 255). Further, "in East Timor, a favorable vote on independence from Indonesia in an internationally mandated 1999 referendum spurred Indonesian-backed Timorese militias to unleash large-scale backlash violence, creating an international refugee crisis" (2005: 6). Regarding the case of Darfur discussed in Section 1, peace agreements in other parts of Sudan brought the expectation of "looming elections" and democratization (Straus, 2005), and this may have played a role in the decision to eliminate the minority group.

Also in ex-Yugoslavia at the beginning of the 1990s the prospects of democratization and rent-sharing according to group sizes played a role in the slaughtering. "Less than six months after the first democratic elections were held in former Yugoslav republics, the country was at war" (Woodward, 1995: 17), and soon thereafter there were the biggest massacres of civilians in recent European history. "The basis of this policy of ethnic cleansing lay not with primordial hatreds or local jealousies, but with political goals. (. . .) Their objective (was) to consolidate ethnically pure territories that would vote correctly in a referendum on sovereignty and in future elections and to justify government administration by their national group." (Woodward, 1995: 242).

[16] Easterly, Gatti and Kurlat (2006) find that mass killings are most likely for countries with intermediate income levels.

[17] We focus on large-scale one-sided mass killings episodes, hence the literature studying battle-related, two-sided violence in civil wars is complementary to our work. See e.g. Humphreys and Weinstein (2006) and Kalyvas (2007). In the latter, violence is due primarily to compliance objectives rather than extermination.

Davenport, Moore and Poe (2003) find that when regimes start democratizing, this can lead to more refugee flows.

Finally, we should mention the literature about the desirability of intervention in order to tighten the constraints to the exercise of power: Since the end of the Cold War, the question of whether to intervene to stop states from committing atrocities, especially mass killings, has become central (Hoffman et al. (1996), Holzgrefe and Keohane (2003), Rotberg (2010), Teson (1997), Weiss (2007), and Wheeler (2002)). In our analysis this issue is only briefly discussed when evaluating the effects of changing the single parameter capturing the bound on the power to kill, while an interesting theoretical analysis of third party strategies can be found in Kydd and Straus (2013). There is also evidence of ambiguous effects of such tightening of the power to kill: Hultman (2010) finds that UN interventions mandated to protect civilians do reduce civilian deaths, but other UN interventions increase rebel targeting of civilians.

3 Model

There are two groups, i and j, with initial population sizes N_i, N_j. Without loss of generality, let j be the group in power in the initial period in the analysis. There are two sources of wealth to be shared in each period: a constant per-period amount R comes from the exploitation of a natural resource; the other source of income is output produced by labor, for which we assume a rigid labor supply, so that the output of production at time t is $\beta N^t = \beta(N_i^t + N_j^t)$. We can think of $\beta > 0$ as individual productivity determined by education as well as by technology.[18] Hence, the surplus to be shared in the first period is

$$S = \beta(N_i + N_j) + R.$$

In the following periods in the infinite horizon game the only potential alteration of such a per period surplus can come via changes in the population size.[19]

We assume that if a period displays conflict, the winner seizes the entire surplus of that period, minus a loss d caused by the conflict. We also assume that the probability of victory in war at time t for group h, $h = i, j$, is equal to the relative population size in that period, $\frac{N_h^t}{N^t}$.[20]

The common discount factor is denoted as usual by $\delta \in [0, 1]$. The last piece of notation is the fairness level λ_h^t chosen by h when in power at time t: if h is in power and offers a share x of the surplus to group $k \neq h$, such a share x is decomposed as a fairness parameter λ_h^t times the relative group size of group k at the time of surplus sharing. Thus, $\lambda_h^t \in [0, N^t/N_k^t]$.

[18] The results of this paper extend to the case in which heterogeneous βs are allowed. Since this generalization does not add any non-trivial insights, we opted to leave it out.

[19] A natural extension to a world with stochastic productivity and/or stochastic resource rents is left for future research.

[20] In a previous version of the paper the model allowed for endogenous probabilities of winning, depending on the resources contributed by each group. This enrichment however does not alter the qualitative predictions on the determinants of mass killings, and hence for the sake of conciseness and focus we abstract from this.

Whoever is in power at the beginning of time t, $h = i, j$, the time line in period t is as follows:

1. Production takes place, the surplus is collected and the group in power announces a distribution of this surplus between the two groups.

2. *Peace or Conflict*: The two groups decide simultaneously whether to have conflict or peace, where peace prevails only if both choose peace. In case of conflict an amount d of the surplus is destroyed. Group h remains in power in case of peace and in case it wins the war, whereas group $k \neq h$ obtains power only by winning the civil war.

3. *Exercise of power.* This has two dimensions. First, the group in power keeps all the surplus in case of victory or carries out the announced distribution in case of peace.[21] Second, the ruler may decide to eliminate members of the other group, without surpassing a total over time upper bound $\bar{M}$.

4. *Consumption*: Consumption takes place.

The exercise of power stage of each period is where institutions, regimes, and perhaps third parties, can enter the picture: in the *unlimited power* benchmark, the group in power has full discretion to choose the division of the surplus of that period and the number of killings to perpetrate. However, power is usually limited or constrained, by institutions or social norms, and we will capture these limits to the exercise of power by means of two parameters: $\underline{\lambda}$ and $\bar{M}$.

The first of these two constraints can be interpreted as a constraint to the exploitation of the powerless group: saying that in peace the share of the surplus going to group k cannot be lower than $\underline{\lambda}\frac{N_k^t}{N^t}$ implies that the democratic institutions, checks and balances, or general tolerance of unequal treatment in society, do not permit a degree of exploitation represented by any $\lambda < \underline{\lambda}$, and hence implies that if the group in power violates that constraint the standing institutions are violated.

For the upper bound on allowable mass killings $\bar{M}$ to be binding, it has to be lower than the minimum between N_i and N_j, whereas otherwise the full extermination of a minority group is possible.

We organize the analysis as follows: first, in the coming section, we study the benchmark *unlimited power* case, where $\bar{M}$ and $\underline{\lambda}$ are not binding, i.e., when the degree of exploitation of the powerless group finds its binding constraint in the need to make sure that such a group does not rebel, rather than in exogenous institutions or social norms. Then, in section 5, we will characterize the best Subgame Perfect Equilibrium (SPE henceforth) even for the more complex case in which $\underline{\lambda}$ and $\bar{M}$ can be binding, emphasizing the differences in terms of predictions with respect to the unlimited power benchmark.

[21] During a civil war the normal time institutions and social norms are abandoned, and hence in that period it is possible for the winner to appropriate the entire $S^t - d$ surplus.

4 Equilibrium Analysis with Unlimited Power

In this section we characterize the best SPE in the unlimited power case. In order to do so, we first need to characterize the worst SPE, which can then be used as punishment phase in the construction of the best SPE.

We shall start with a series of claims that will be used for constructing the lemma characterizing the worst SPE.

Claim 1 *Because of the simultaneous move war declaration stage, there always exist equilibria with war at the very start of the game. The punishment phase of a grim trigger profile always starts with a war.*

However:

Claim 2 *In the unlimited power case, war forever can never be sustained as SPE.*

Proof. In the unlimited power case, the winner of the first war can choose the level of mass killings M and λ without constraints. Let us show that choosing $M = 0$ in anticipation of more periods of war and no mass killings cannot be rational.

Suppose first that group i would never want to do mass killings. Consider a subgame after a war that ended with a victory of j, at a history with no prior mass killing. Group j's trade-off at that node is as follows: When exterminating the opponent it obtains:

$$S - d + \frac{\delta}{1-\delta}(S - \beta N_i);$$

when renouncing to do mass killings, continuing the war path, it obtains[22]

$$\left[1 + \frac{\delta}{1-\delta}\frac{N_j}{N}\right](S - d).$$

It is easy to see that mass killings are always preferred to continued conflict in the punishment phase. A fortiori, if group i allowed itself to do mass killings, group j would have an even larger relative gain from mass killings at the node of exercise of power after victory in a civil war. The same logic applies if i is in power after the first war of the punishment phase. ■

[22] To see this, consider the value for j to be in power when entering a new period, denoting it by V_j^j:

$$V_j^j = \frac{N_j}{N}\left[(S-d) + \delta V_j^j\right] + \frac{N_i}{N}\delta V_j^i,$$

where V_j^i is the value for j after giving up power to i. Under permanent conflict, the value of being in opposition is identical to that of being in power because power doesn't give any strategic advantage, so that $V_j^j = V_j^i = V_j$. Hence, $V_j = \frac{N_j}{N}\frac{S-d}{1-\delta}$. Consequently, the payoff from winning and not exterminating the opponent is $(S-d) + \delta V_j$.

Claim 3 *In the case of unlimited power, there exists a SPE strategy profile Σ^* in which (1) both groups always choose war in any period where they both exist, and (2) there is full extermination of the opponent by whoever is in power at the first occasion.*

Proof. Deviating by not selecting war is not a worthwhile deviation, as war will occur as long as at least one of the players selects it. The only one-period deviation to be evaluated is the decision by a winning group h to choose $M < N_k$, $k \neq h$. After such a one-period deviation from full extermination, in the following period a new war takes place, followed by extermination by the winner. When doing full extermination, group h obtains:

$$S - d + \frac{\delta}{1-\delta}(S - \beta N_k).$$

In contrast, when doing $M < N_k$ group h obtains after reformulation the expected payoff

$$S - d + \frac{N_h}{N-M}\delta \left[S - \beta M - d + \frac{\delta}{1-\delta}(S - \beta N_k) \right],$$

which is always smaller than the payoff from doing full mass killings right away. Hence, there cannot be a worthwhile deviation, and the strategy profile Σ^* with full extermination by whoever is in power at the first occasion must be an equilibrium. ■

The above three claims allow us to state the following lemma:

Lemma 1 *In the unlimited power benchmark, Σ^* is the worst SPE of the game, consisting of strategies by the two players with immediate war followed by full mass killings by the winner.*

We are now ready to characterize the best SPE, obtained by reverting to Σ^* after any deviation.

Consider a candidate stationary SPE path in which j remains in power forever, there is never war nor mass killings, and the fairness level is λ_j every period, whereas after any deviation from this path the two players enter the punishment phase, constituted by the worst SPE continuation characterized above.

Conditional on having had peace before, the value for group i from continuing on path is

$$\frac{1}{1-\delta}\lambda_j \frac{N_i}{N} S,$$

while when rebelling (hence switching to the worst path) it obtains

$$\frac{N_i}{N}\left(S - d + \frac{\delta}{1-\delta}(S - \beta N_j) \right).$$

Thus, i prefers the stationary peaceful path as long as

$$\frac{1}{1-\delta}\lambda_j S > S - d + \frac{\delta}{1-\delta}(S - \beta N_j),$$

that is

$$\lambda_j \geq \lambda_j^* \equiv \frac{S - d(1-\delta) - \delta\beta N_j}{S}. \tag{1}$$

Note that λ_j^* is increasing in R, meaning that the more natural resource rents there are, the more difficult it is to keep the minority group peaceful.[23] Further, λ_j^* is decreasing in d, which is due to the fact that high destruction costs of war deter rebellion.

Now that we have computed the λ_j^* that, if chosen every period, eliminates the incentives to deviate for group i, we need to check the incentives to deviate by group j.

Group j's payoff of buying peace in all periods is

$$\begin{aligned} & \left(1 - \frac{N_i}{N}\lambda_j^*\right)\frac{S}{1-\delta} \\ = & \left(1 - \frac{N_i}{N}\frac{S - d(1-\delta) - \delta\beta N_j}{S}\right)\frac{S}{1-\delta} \\ = & \frac{\frac{N_j}{N}S + \frac{N_i}{N}(d(1-\delta) + \delta\beta N_j)}{1-\delta}. \end{aligned}$$

Two types of deviations are possible: *mass killings* or *exploitation*, where by the latter we mean the decision by group j to give $\lambda_j = 0$ in the deviation period. With the mass killings deviation, group j obtains

$$S + \frac{\delta}{1-\delta}(S - \beta N_i). \tag{2}$$

With the exploitation deviation, on the other hand, group j obtains

$$S + \delta\frac{N_j}{N}\left[S - d + \frac{\delta}{1-\delta}(S - \beta N_i)\right]. \tag{3}$$

It is immediate that the payoff from mass killings is always larger than the payoff of exploitation alone. Hence, the most profitable deviation to consider is mass killings.

Peace is preferred by j to mass killings iff

$$\frac{\frac{N_j}{N}S + \frac{N_i}{N}(d(1-\delta) + \delta\beta N_j)}{1-\delta} > S + \frac{\delta}{1-\delta}(S - \beta N_i).$$

After some manipulations, the condition can be written as follows:

[23] Note also that if $d > (<)\beta N_j$, then λ_j^* is increasing (resp. decreasing) in δ. Intuitively, when the (immediate) loss of war weights heavier than the (future) production loss from having a decimated population, then an impatient opposition is less inclined to rebel.

$$R < R_j^* \equiv (d - \beta N)(1 - \delta) + \delta\beta N_j. \tag{4}$$

This is the "No-MK IC" condition. Similarly, the No-MK IC condition when i is in power is $R < R_i^* \equiv (d - \beta N)(1 - \delta) + \delta\beta N_i$.

All the above analysis leads to the following lemma:

Lemma 2 *(I) If $R < R_j^* \equiv (d - \beta N)(1 - \delta) + \delta\beta N_j$, the best SPE in the unlimited power case is a peaceful steady state with fairness level λ_j^*, which is increasing in R.*

(II) If $R > R_j^* \equiv (d - \beta N)(1 - \delta) + \delta\beta N_j$, the best SPE in the unlimited power case involves war, and extermination at the first occasion, perpetrated by whoever is in power at the end of the war.

We remark that there are no parameter values under which the best SPE involves exploitation:

Remark 4 *In the unlimited power benchmark there are no parameter values under which the best SPE can display exploitation ($\lambda_j = 0$) without mass killings.*

To see this, note that the immediate effects of exploitation and mass killings in terms of distributive consequences are the same, as far as the payoffs for the governing group in that period are concerned. Further, we know that in both cases j would trigger a punishment phase with war and mass killings, where j would risk to be the one killed. This is always dominated by killing right away, as follows from equations (2)-(3).[24]

Proposition 1 below displays the comparative statics from the equilibrium characterization obtained above.

Proposition 1: *Assuming the groups always select the best SPE behavior, peace is more likely (and hence mass killings less likely) when:*

– *R is lower*;
– *d is larger*;
– *N_i/N is smaller*;
– *the size of the group in power is larger (smaller) if $\delta > (<) 1/2$*;
– *the higher is β or N*, for *δ sufficiently high*;
– *the higher is δ, unless d is very large.*

In summary, for sufficiently high δ, the probability of war and mass killings is increasing in R and polarization,[25] and decreasing in d, β and N.

[24] Note also that full extermination (which is feasible only in this unlimited power benchmark) is chosen for sufficiently high R over any intermediate level of mass killings. This was true even in other versions of the model displayed in previous working papers, even when considering the Markov equilibrium rather than the best SPE.

[25] On average, we should expect larger groups to be more frequently in office than smaller groups. In the frequent case where the group in power is the larger group, an increase in the size of the group out of power corresponds to greater polarization.

We now turn to the general case with potential bounds on the exercise of power discretion, with the goal of confirming the validity of the above insights and to see which types of limitations to the exercise of power are most effective in different circumstances.

5 Equilibrium Analysis with Bounds on Power

Let us now allow in the analysis that the limits to the exercise of power $\underline{\lambda}$ and $\bar{M}$ may be binding, recalling first the meaning of such bounds.

If a State respects the constitution and the rule of law, it needs to offer at least $\underline{\lambda}$ to the powerless group. This may correspond to the minimum level of income needed for respecting the international human rights conventions, i.e. right for shelter, right for education, covering the basic needs and not letting people die in the street, or minimum levels of income and/or welfare services prescribed by the local institutions and laws. On the other hand, if the State suspends constitutional rights and the rule of law, calls a State of emergency with Martial law, then there are no boundaries to exploitation. In such a lawless situation it is not possible to guarantee any transfers to the powerless group as the state slips in a situation of anarchy. An alternative interpretation of $\underline{\lambda}$ is simply that this is the common knowledge minimum level of fairness below which the powerless group is expected to rebel and trigger the punishment phase, even if $\underline{\lambda} > \lambda_j^*(R)$. In other words, the incentive compatibility constraint $\lambda_j^*(R)$ computed in the previous section represents the trigger in a society in which the powerless group evaluates the possibility to rebel only on the basis of their relative chances to win but without any cultural or social or legal reference point; whereas the possibility that the trigger of rebellion could be $\lambda < \underline{\lambda}$ with $\lambda > \lambda_j^*(R)$ represents the reality of groups and societies in which a social and/or legal norm of higher fairness exists, such that its violation is enough to trigger rebellion, even if not justified by the pure calculations of convenience captured in the SPE continuation equilibrium logic of $\lambda_j^*(R)$.

When $\bar{M} < \min\{N_i, N_j\}$ is binding, it means that no group in power can kill (or displace) more than $\bar{M}$ members of the other group (or that the cost of doing so would be infinity). $\bar{M}$ has to be understood as a total upper bound over time.[26]

5.1 Binding constraint on exploitation only

Let us first analyze what happens when $\underline{\lambda} > \lambda_j^*(R)$, i.e., when the limit to exploitation is binding, while for now let us keep the constraint on mass killings not binding.

Note first that when offered $\underline{\lambda}$, group i is willing to keep peace, given that $\underline{\lambda} > \lambda_j^*$. The incentive constraint that matters is therefore the one concerning the group in power: under what conditions does j offer $\underline{\lambda}$ rather than deviating to full exploitation, abandoning all constitutional constraints, or to mass killings?

[26] The analysis with per-period upper bounds is analytically much more difficult to handle.

The payoff for j from peace is

$$\frac{(1-\frac{N_i}{N}\underline{\lambda})S}{1-\delta}.$$

The payoff for j from deviating and exterminating group i is

$$S+\frac{\delta}{1-\delta}(S-\beta N_i).$$

Thus, group j will remain peaceful and refrain from mass killings iff

$$\underline{\lambda} < L(R) \equiv \delta\frac{\beta N}{\beta N+R}. \tag{5}$$

Note that $L(R)$ is decreasing in R and equals $\lambda_j^*(R)$ exactly at $R = R_j^* = (d-\beta N)(1-\delta)+\delta\beta N_j$. Recall that exploitation alone ($\lambda = 0$ in the deviation period) is dominated by the extermination deviation, something that is going to be revisited below, in the general case in which bounds exist to both types of exercise of power.

Remark 5 *If $\bar{M}$ is not binding, the comparative statics of Proposition 1 continue to hold even in the presence of a binding $\underline{\lambda}$. The additional result is that the probability of peace is (weakly) decreasing in $\underline{\lambda}$.*

5.2 Worst equilibrium with binding constraints on all forms of power

The next lemma characterizes the worst SPE of the game when on top of bounds on exploitation we also add the bound $\bar{M} < \min\{N_i, N_j\}$ on killings.

Lemma 3 *For any $\bar{M} < \min\{N_i, N_j\}$, and for any $\underline{\lambda}$, the worst SPE is as follows:*

1. *If $R \geq d$, then the worst SPE for the punishment phase involves war every period, with both groups killing $\bar{M}$ opponents at the first occasion of power;*

2. *on the other hand, if $R < d$, the worst SPE involves war forever but without mass killings.*

Proof. Consider a subgame in which one group h has already killed $\bar{M}$ opponents in the past, and hence can no longer access to additional killings. If at the beginning of this subgame h is out of power, then the trade-off for the group k that just conquered power becomes as follows.

If k kills, it obtains

$$\frac{N_k-\overline{M}}{N-2\overline{M}}\frac{S-2\beta\overline{M}-d}{1-\delta},$$

since after the revenge killings the continuation worst SPE involves war forever without further killings allowed.

If k does not kill,[27] it obtains

$$\frac{N_k - \overline{M}}{N - \overline{M}} \frac{S - \beta \overline{M} - d}{1 - \delta}.$$

Thus, performing mass killings is preferred if $R > d$.

Further, if h had the option to still do mass killings in the future, then a fortiori k would have incentives to do mass killings when $R > d$.

In contrast, for $R < d$, when h does indeed not want to kill, then k does not want to kill either, as shown above. This fully characterizes the worst SPE, which always involves war, and hence $\underline{\lambda}$ never matters. ■

Armed with this lemma, we can now characterize the best SPE in the bounded power setting.

5.3 Best equilibrium characterization when both types of power may have binding constraints

In this section, we are going to characterize the best SPE with peace or with conflict by separately examining the cases where $d \geq R$ and $d < R$.

Lemma 4 *Let $d \geq R$. The best SPE involves peace if and only if*

$$d \geq \frac{1 - \delta}{1 + \delta \frac{N_j}{N_i}} S \quad \text{and } \underline{\lambda} \leq \delta \left[1 + \frac{d}{S} \frac{N_j}{N_i} \right].$$

Otherwise, the best SPE involves conflict.

Proof. Consider any equilibrium strategy profile involving peace, assuming it exists, with group j in power offering λ_j every period. From Lemma 3 we know that when group i deviates from peace and engages in rebellion it triggers the punishment phase with conflict in every period but without mass killings. Hence, group i's payoff from rebellion is

$$\frac{N_i}{N} \frac{S - d}{1 - \delta}.$$

In contrast, group i's payoff from peace is

$$\lambda_j \frac{N_i}{N} \frac{S}{1 - \delta}.$$

Thus, group i (weakly) prefers peace if

$$\lambda_j \geq \max \left\{ \underline{\lambda}, 1 - \frac{d}{S} \right\}.$$

[27] Note that if postponing the killings for the future is a preferred strategy, this has to continue to be preferred in any future occasion k is in power. Hence, the relevant strategy alternative to do the killings is to never kill, as we do here.

Now turn to the trade-off for j. Consider first the case in which $\underline{\lambda} < 1 - \frac{d}{S}$. In this case j's payoff from peace is

$$\left(1 - \left[1 - \frac{d}{S}\right] \frac{N_i}{N}\right) \frac{S}{1-\delta}.$$

Both "exploitation" (i.e. grabbing all the pie, but not doing any mass killings) and mass killings will trigger the punishment phase. Group j's payoff from "exploitation" is

$$S + \frac{\delta}{1-\delta} \frac{N_j}{N} (S - d).$$

The payoff of group j from mass killings is

$$S + \frac{\delta}{1-\delta} \frac{N_j}{N - \overline{M}} (S - \beta \overline{M} - d).$$

Checking which constraint is binding shows that for $R < d$ exploitation is preferred to mass killings, and hence exploitation is the relevant outside option.

Group j prefers peace to exploitation iff:

$$d \geq \frac{1-\delta}{1 + \delta \frac{N_j}{N_i}} S.$$

(Note that for $d < S$ this threshold is always bounded between 0 and 1.)

If instead $\underline{\lambda} > 1 - \frac{d}{S}$, the condition under which j prefers peace (having to give $\underline{\lambda}$) over exploitation is

$$\left(1 - \underline{\lambda} \frac{N_i}{N}\right) \frac{S}{1-\delta} > S + \frac{\delta}{1-\delta} \frac{N_j}{N} (S - d).$$

i.e.,

$$\underline{\lambda} \leq \delta \left[1 + \frac{d}{S} \frac{N_j}{N_i}\right].$$

■

The above lemma tells us that there is an important difference between the unlimited power benchmark and the analysis when both types of power can be limited:

Remark 6 *In the presence of effective bounds on power it is no longer the case that exploitation of minority groups is always dominated by mass killings. In fact, when $d \geq R$ it is the opposite.*

As long as the non-produced rents R are small relative to the cost of conflict d, there will be no mass killings.[28]

However, for $R > d$ the worst SPE is similar to the one in the unlimited power case, hence the characterization of the best SPE will again involve thresholds below which mass killings will occur, and once again, most importantly, the probability of such a scenario is increasing in R.

[28] This is why in the statement of Lemma 4 we need not refer to whether $\overline{M}$ is larger or smaller than the population of either group.

Lemma 5 *Let $\overline{M} < \min\{N_i, N_j\}$ and $d < R$. There exist thresholds R_h^*, λ_h^* and L_h^*, $h = i, j$, such that (i) the best SPE involves peace if and only if $R \leq R_j^*$ and $\underline{\lambda} \leq \max\left\{\lambda_j^*, L_j^*\right\}$.*

(ii) When $R > R_j^*$ and/or $\underline{\lambda} > \max\left\{\lambda_j^*, L_j^*\right\}$, the best SPE involves war in the first period, and if group j wins it commits mass killings $\overline{M}$. If group i wins it commits mass killings $\overline{M}$ iff $R > R_i^*$ and/or $\underline{\lambda} > \max\{\lambda_i^*, L_i^*\}$, while for $R \leq R_i^*$ and $\underline{\lambda} \leq \max\{\lambda_i^*, L_i^*\}$ the best SPE involves peace ever after. When mass killings occurred at the end of the first period, there exist thresholds R_i^{**}, R_j^{**}, L_i^{**} and L_j^{**}, such that (A) if the winner of the first war is $h = i, j$, and $R \leq R_h^{**}$ (and $\underline{\lambda} \leq L_h^{**}$, in case $\underline{\lambda}$ is binding), then peace follows ever after; while (B) if $R > R_h^{**}$ (and/or $\underline{\lambda} > L_h^{**}$, in case $\underline{\lambda}$ is binding), then war continues until power shifts, at which point the second mass killing $\overline{M}$ takes place, and peace follows after that.

We relegate the (tedious) proof of this crucial characterization lemma to appendix A (the proof also contains the definitions of all thresholds used in lemma 5).

One important punchline of the above lemma is that when $R \leq \min\left\{R_i^*, R_j^*\right\}$ the best SPE involves peace in all periods, while for $R > \max\left\{R_i^*, R_j^*\right\}$ mass killings $\overline{M}$ occur at least once. In the zone in-between the two thresholds R_i^* and R_j^* the occurrence of mass killings depends on the identity of the winner of the war in the first period.

Below we shall display graphically in Figure 1, in the space $(R, \underline{\lambda})$, the different zones derived under the lemmas 4 and 5, for particular parameter values ($d = 50$, $N_i = 50$, $N_j = 50$, $\beta = 1$, $\bar{M} = 5$, and $\delta = 0.6$). Hence, regular non-resource production (βN) has a value of 100, and the destruction of war (d) corresponds in this example to half of the non-resource production. Other parameter values lead to different sizes of the zones, but qualitatively the picture looks the same.

Using the bounds of lemma 4 we can display what happens when $R < d$. In this case, mass killings never occur, and there is peace below the downward sloping green line and exploitation above. Moving to the region where $R > d$, i.e. where the value of natural resource production is more than half of the value of the non-resource economy, we need to apply the bounds from lemma 5. For values of $R < R^* = 114$ and $\underline{\lambda} < L^*(R)$ (which corresponds to the downward sloping red line), there is still peace.[29] Then there is a small corridor between R^* and $R^{**} = 118$, and between the downward sloping red $L^*(R)$ and the blue $L^{**}(R)$ lines where only the winner of the first period conflict performs mass killings, and from then on successfully "buys off" the opponent group. For all other values of R and $\underline{\lambda}$ (i.e., to the right of R^{**} and above the $L^{**}(R)$ line), there will be mass killings of the maximum possible amount at the earliest occasion by both groups. In other words, in that zone the equilibrium path involves mass killings and then revenge mass killings at the first time power switches. Note

[29] Note that given that in this numerical example there is $N_i = N_j$, we have $R_i^* = R_j^*$, $R_i^{**} = R_j^{**}$, $L_i^* = L_j^*$, and $L_i^{**} = L_j^{**}$, which simplifies the graphical exposition.

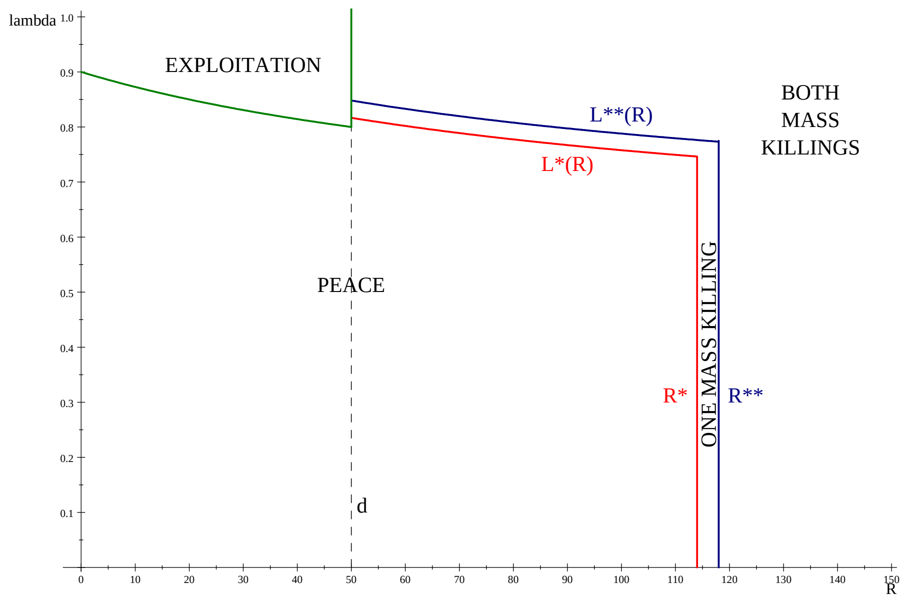

Figure 1: Zones of Peace, Exploitation and Mass Killings

that in this numerical example mass killings only occur in countries where the natural resource sector is larger than the non-resource economy, and/or where there are extremely tight egalitarian distribution rules.

The substantive predictions of the model are contained in the next proposition:

Proposition 2: (I) *Like in the unlimited power benchmark, it continues to be true that the probability of mass killings in the best SPE is, for sufficiently high* δ: *increasing in* R and in N_i/N and *decreasing in* d, β and N.

(II) *The probability of mass killings in the best SPE is (weakly) increasing in* $\underline{\lambda}$.

(III) *If* δ *is sufficiently high, then the value of* $\bar{M}$ *that minimizes the probability of mass killings is always interior (i.e., the probability of peace is a concave function of* $\overline{M}$*), and the peace likelihood is maximized by* $\overline{M} = \frac{\beta N - d}{4\beta}$.

The proof is relegated to appendix A.

Proposition 2(I) confirms the validity of the comparative statics of the benchmark proposition 1 even for the limited power case, while part (II) establishes that for third parties interested in minimizing the probability of mass killings or even the probability of war, it is never advisable to generate effective lower bounds on distributive exploitation. On the other hand, part (III) establishes that the design of optimal limits to elimination of citizens may be effective, but the desirability of how much to tighten such a constraint depends on the

	Rj*	Rj**
CAP ON MASS KILLINGS		
Low maximum mass killings level (M=5)	114	118
Medium maximum mass killings level (M=10)	125	138
Medium-high maximum mass killings level (M=20)	141	183
High maximum mass killings level (M=30)	143	246
Very high maximum mass killings level (M=40)	131	380

Table 1: Effects of caps on mass killings

population size, the productivity of the economy, and the cost of war.[30]

Table 1 provides an overview of what happens for different constraints on $\overline{M}$, keeping all other parameter values as before. Given that the value of the non-resource economy (βN) equals 100, the values of R_j^* and R_j^{**} in this table correspond to the resource abundance as percentage of the non-resource economy. Hence, a value of R_j^* of, say, 200 would mean that the threshold lies at a level of resource rents being twice as large as the non-resource economy.

The effect of the level of the cap $\overline{M}$ on mass killings is ambiguous even for interior values of δ. Increasing $\overline{M}$ from a low to a medium level, makes mass killings less likely to occur, while increasing $\overline{M}$ further to a very high level results in an increase of the mass killings risk. This means that in examples like this the probability of mass killings is minimized by some interior level of $\bar{M}$, like established formally for the case of $\delta \to 1$ (cf. proof of Proposition 2).

Note that for many of the parameter constellations where mass killings are the most likely, i.e. for relatively high polarization and relatively low $\overline{M}$, the thresholds of R_j^* and R_j^{**} are relatively close together, meaning that with a uniform distribution of parameters, and of R in particular, the probability that the best SPE involves mass killings on both sides (with a sequence of wars between the first and the last mass killings episode) may be on average higher than the probability of observing mass killings on one side only. Hence, for many contexts one could observe serial correlation of mass killings.

5.4 Discussion

The characterization of the best SPE for every pair of constraints to the exercise of power allows us to draw some broad theoretical conclusions, before turning to the empirical evaluations of the comparative statics predictions with respect to the observable parameters.

The first remark is about robustness: as established in proposition 2(I), at least for high δ, the *sign* of the effects of R, β, N, d and polarization on the

[30] It goes without saying that of course, trivially, if it was possible to costlessly enforce a complete ban of any killings, selecting $\overline{M} = 0$ would be optimal.

probability of mass killings remains the same for every amount of power that a government controlling group can exercise. Thus, in the empirical evaluation that follows we do not need to assume anything about power limitations.

However, there are substantively interesting differences between the unlimited power benchmark and the rest of the analysis. Lemma 4 establishes that in an economy with very little resource rents, the best SPE can never display mass killings. The worst case scenario in such an economy is repeated conflict, which may happen when players are sufficiently impatient. The presence of this region of values of $R < d$ where mass killings cannot occur for any values of the other parameters is partly responsible for the fact that the effects of changes in polarization are ambiguous for interior values of δ. Lemma 5 tells us about the conditions for conflict and mass killings in resource rich countries, with $R > d$. We shall have peace if two conditions are satisfied. One is that non-produced rents are not too large, $R \leq R_j^*$. The other is that the imposed level of fairness is not too strict, that is, $\underline{\lambda} \leq \max\{\lambda_j^*, L_j^*\}$. Proposition 2 is based on how these thresholds vary with the basic parameters of the model.

In order to have an intuition for the comparative statics results in Proposition 2, let us start by stressing the differences in terms of strategies between the two worlds, with and without constraints. Consider first the case with no constraints to power. We have obtained in Lemma 2 that if $R > R_j^*$ the best SPE involves war and extermination. The critical point is that in this case, the game ends with the extermination of the opponent. Extermination has a cost but it grants full appropriation of the remaining surplus. The introduction of a binding cap $\overline{M}$ induces different considerations, because the victorious group will have to take into account that the game will continue with the surviving rival population. Furthermore, when a group does all the mass killings permitted by the cap, it cannot threaten with further mass killings after that, and hence the sharing conditions that it can impose on the loser will be less exploitative than if they could retain the future threat.

Consider now the effect of a minimum fairness norm. If $\underline{\lambda}$ is very high, the victorious group will not be able to impose a sufficiently advantageous share of the surplus when avoiding mass killings (using them as a future threat only). Hence, too high a $\underline{\lambda}$ may induce immediate assassinations. This means for example that historical moments in which a group in power expects some serious reduction in their ability to extract surplus from other groups' production or from natural resources, e.g. moments of expected democratization pressures, may be the most dangerous moments in terms of mass killings incentives. This observation could therefore contribute to explain the particular instability of economies that are transitioning towards democracy.[31]

Finally, the non monotonic effects of $\overline{M}$ deserves some discussion. Mass killings have multiple effects: (1) for any given level of fairness, the reduction in the number of people in the other group increases the share of the surplus that the group in power will obtain, and (2) mass killings increase the probability

[31] See Baliga, Lucca and Sjöström (2011) and references therein for additional reasons for the instability of transitioning regimes.

of winning for the group in power in future wars; but (3) mass killings reduce the overall surplus size. How important this reduction is, depends of the weight of the non-produced rents. If the non-produced rents are small, the third effect dominates and mass killings are avoided. But if R is sufficiently large, mass killings become more attractive as the surplus shrinks relatively less after massacres. The non-monotonic effect of the bound on the power to kill depends on the importance of effect (2). The level of unfairness depends on the threat to the loser of doing mass killings if this group triggers conflict in the future. As we have argued, the threat power is inversely related to the current use of mass killings. Hence, the less a player discounts the future payoffs, the higher the weight it will give to this indirect threat effect, which can keep the future share high. In contrast, the more the future is discounted, the more prominent will be the weight given to the more direct, immediate gains. Putting the effects together, the cap $\overline{M}$ that makes mass killings least attractive is intermediate, at least when the players are patient enough. When δ is sufficiently low, the direct effect dominates and we may have mass killings in the best SPE for all levels of $\overline{M}$, provided that R is large enough.

6 Empirical Analysis

In this section we shall confront some of our predictions with data.

One of the main purposes of the country level regressions in subsection 6.1 is to assess how robust the existing empirical evidence on mass killings is when important econometric issues are taken into account. Further, we want to include in the analysis several new variables, in particular on natural resource abundance, which plays a crucial role in our model, but has been largely neglected in the existing literature on mass killings.

The ethnic group level analysis performed in subsection 6.3 examines for the first time what kind of ethnic groups are targeted in mass killings. Surprisingly, the existing literature has only studied mass killings on either a very aggregate level (i.e. with cross-country panels) or on a very disaggregate level (i.e. case studies of single countries). Studying victimization in massacres with a global panel of ethnic groups is useful, as decisions to commit massacres are strategic decisions *at the group level* (as emphasized in our model).

6.1 Country level evidence on the determinants of mass killings

We start by assessing the explanatory factors of mass killings using panel data for a cross-section of countries. Like in most of the existing literature reviewed in the introduction, we use a dummy variable for the incidence of mass killings and we run logit regressions. For the dependent variable in Tables 2 and 3 we rely on the most widely used dataset on mass killings, collected by the "Political Instability Task Force" (PITF) under the direction of Barbara Harff. They define mass killings as events that "involve the promotion, execution, and/or implied consent of sustained policies by governing elites or their agents – or in the case of civil war, either of the contending authorities – that result in the deaths of a substantial portion of a communal group or politicized non-communal group." By this definition, 268 country-years (3.5 percent of all observations) experience mass killings between 1955 and 2007. These killing episodes take place in 28 different countries, and include all of the most notorious historical instances of large-scale massacres like for example the ones in Sudan, Rwanda, Bosnia or Cambodia. Countries that have experienced mass killings differ on various dimensions emphasized in our theory. Notably, they are much more natural resource dependent, poorer and more ethnically polarized.[32] Determining whether these differences hold up in a regression analysis with various controls will be the task to which we turn below.

Our sample contains all countries that are in the Correlates of War system, i.e. all countries that have some minimum size and international recognition, and covers the years 1960-2007 (most key explanatory variables start in 1960). This leaves us in Table 2 with between 2257 and 4771 observations depending on the specification. In the Appendix B all variables are explained in detail and summary descriptive statistics are provided.

Most of the existing empirical literature on mass killings suffers from three weaknesses that we try to address:

1) There is usually an important omitted variable problem. Most studies use a pooled panel without controlling for unobserved heterogeneity. This is a serious issue, as the variation between countries that experience mass killings and countries that do not can be driven by various factors that are difficult to observe. A good way to address these concerns would be to include country fixed effects. However, we cannot do this as some key explanatory variables like ethnic polarization are not time-varying measures, and some of the natural resource variables like the measures of diamond and gold production vary relatively little over time. Further, removing all cross-sectional variation would also result in a very small sample.[33] Hence, as a reasonable compromise we will cluster standard errors by country, which will already eliminate part of the problem. We also include as a robustness check six regional (i.e. continent) fixed effects. This is also the approach adopted by Montalvo and Reynal-Querol (2008).

2) The second problem is that the dependent variable, i.e. mass killings, is auto-correlated over time. Put differently, if in a given year mass killings occur, it becomes more likely that they will also occur in the next year. This is mainly due to the fact that our unit of observation is the country-year, while most mass killings episodes last for several years. In fact, in the list of mass killings episodes from "Political Instability Task Force" (PITF) that we use for our analysis, the

[32] In countries with mass killings natural resource production amounts to on average 10% of their GDP while for the rest of the country sample this is 5%, their GDP per capita averages 1220 US$ as compared to a the rest of the sample where it is 6150 US$, and ethnic polarization equals 0.6 compared to 0.5 in the rest of the sample. All three differences are statistically significant at the 1% level.

[33] The inclusion of country fixed effects would lead to a drop in the sample size by over 85%, and would only leave us with 16 countries in the sample.

duration of mass killings episodes ranges from a minimum of 1 to a maximum of 20 years, with an average duration of 6.6 years. Most existing studies ignore this and focus on current incidence without controlling for lagged incidence. There are two ways to address this: Adding the first lag of mass killings incidence as explanatory variable, or coding a mass killing onset variable (that only takes a value of 1 if mass killings newly start, and where ongoing mass killings are coded as missing). We use both of these approaches.[34]

3) The existing studies also use only a rather limited number of control variables, which aggravates the omitted variable problem. We add a range of new control variables and annual time dummies.

The main reason for running our own regressions is that the existing literature only devotes very little attention to the effect of natural resources on mass killings, which play a crucial role in our model. The only paper we are aware of that links natural resources to mass killings is by Querido (2009). However, it only studies a sub-sample of countries (Africa) for a short time period (1989-2005), which leads to a sample size of barely above 200 observations. Further, it only uses data on the existence but neither on the value nor abundance of natural resources. To address these issues, we use in our global sample several standard measures of the value of oil production from various sources, as well as data on diamond, gold, and timber production.

Let us briefly recapitulate what predictions of the model will be confronted to the data. The punchline of the theoretical analysis was that (at least for large δ) we should expect more mass killings for large R, high polarization, small β, small N, small d, and high $\underline{\lambda}$. Our primary focus in the empirical analysis will be on R, because providing the first comprehensive empirical analysis on the effects of natural resources on mass killings is a priority, regardless of whether the theoretical predictions on all other variables work in the data. For this reason we will include in the analysis various measures of quantity of natural resources. A second important evaluation is that of the role of polarization, hence we will include in the analysis an index of ethnic polarization. When controlling for natural resource abundance, as we do, the coefficient of GDP per capita becomes a good proxy for productivity, which allows us to capture the impact of β. We also include as variable a country's population size, which captures N.

The parameter d, i.e. the cost of war, is more difficult to capture with observable variables. Typically in richer countries the potential for destruction is larger in absolute terms, hence one can also think of GDP per capita as a (admittedly very imperfect) proxy for d. Finally, also $\underline{\lambda}$ is hard to proxy. Our variable democratization can be seen as a proxy for $\underline{\lambda}$.

In addition to these variables of direct interest, our specifications also include the typical control variables included in the existing literature, as displayed below.

[34] Note that in the literature on civil wars (see e.g. Fearon and Laitin, 2003, and Collier and Hoeffler, 2004) the same issue arises, as the unit of observation is also typically in most papers the country-year, while wars usually last for several years. The typical way of addressing this issue in that literature is to use the same two approaches as we do here.

We consider the following benchmark logit model:

$$\log\left(\frac{\mathbb{P}(Mass\_killings_{c,y}=1)}{1-\mathbb{P}(Mass\_killings_{c,y}=1)}\right)=\alpha+\mathbf{W}'_{c,y}\boldsymbol{\beta}+\mathbf{X}'_{c}\boldsymbol{\gamma}+\mathbf{Z}'_{y}\boldsymbol{\delta}, \tag{6}$$

where the left hand side is the logarithm of the ratio of the probability of mass killings over the probability of no mass killings, with the mass killings variable varying at the country (c) and year (y) level. Coefficient α denotes the constant, $\mathbf{W}'_{cy}$ a vector of variables that vary at the country and year level, $\mathbf{X}'_{c}$ a vector of variables that vary at the country level, and $\mathbf{Z}'_{y}$ a vector of annual time dummies. $\boldsymbol{\beta}$, $\boldsymbol{\gamma}$, and $\boldsymbol{\delta}$ are vectors of coefficients. Among them the coefficients of interest are the ones corresponding to the main variables of the theory listed above.

Table 2 displays our results, with on the top line for each variable the coefficient and below in the parenthesis the robust standard errors. In the first column we include the variables that have attracted most attention in the existing literature: GDP per capita, ethnic polarization, democracy, and civil war incidence. Like in most of the existing literature, in that benchmark column we do not control for auto-correlation of the dependent variable, we do not allow for clustered standard errors and we add no further controls. The results are in line with the existing studies and all variables have the expected sign and are highly significant: High GDP per capita and democracy reduce the risk of mass killings, while ethnic polarization and the presence of civil war increase the risk.

From column 2 on, we now allow in all columns the robust standard errors to be clustered at the country level to address concerns of unobserved heterogeneity between countries leading to over-stated significance levels. Further, we now include the lagged mass killings variable to take into account potential auto-correlation of this variable, and add several additional control variables to reduce omitted variable bias. To account for potential concerns of reversed causality, we lag the explanatory variables by one period where appropriate.

It is interesting to see how these uncontroversial changes affect the significance levels of the four explanatory variables of column 1. While the effects of economic output, ethnic polarization and civil war incidence on mass killings continue in most of the columns 2-8 to be statistically significant in the presence of more controls and clustered standard errors, democracy becomes insignificant in all but one of these columns.

Given that traditionally many papers in the related literature on civil wars have used a variety of measures of natural resource abundance relative to GDP (e.g. Fearon and Laitin, 2003; Collier and Hoeffler, 2004), it makes sense to use Oil production / GDP as well as other measures. Hence, in the baseline regression of column 2 we include our main measure of natural resource abundance, the ratio of the value of oil production over GDP (from British Petroleum, 2009). Its mass killings inducing effect is significant at the 1% level. Note also that trade openness, population size, and mountainous terrain are found to decrease the risk of mass killings.

In column 3 we use as natural resource variable the relative size of rents (i.e. total market value minus total production costs) of oil, natural gas, and coal

	Dependent variable: Mass killings incidence								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Oil production/GDP (t-1)		6.71***				6.09***			
		(1.59)				(1.69)			
Energy rents (t-1)			8.85***						
			(2.19)						
Oil prod. (t-1) (in 100 mio. tons)				1.36***					
				(0.49)					
Oil prod.(t-1) (in 100 bill. US$)					2.60***				
					(0.87)				
Diamonds production dummy						1.40*			
						(0.83)			
Gold production dummy						-0.87			
						(0.69)			
Forest rents (t-1)						-12.96			
						(20.29)			
Total resource depletion (t-1)							7.53***		
							(2.11)		
Oil reserves/GDP (t-1)								0.19***	
								(0.05)	
Oil res. (in 100 bill. barrels)									3.57***
									(0.97)
Incidence mass killings (t-1)		7.89***	7.77***	8.16***	8.14***	7.54***	7.78***	10.05***	9.09***
		(0.75)	(0.78)	(0.79)	(0.78)	(0.71)	(0.77)	(1.66)	(1.18)
GDP per capita (t-1)	-0.24***	-0.15*	-0.13	-0.20*	-0.18	-0.10	-0.11	-1.63***	-0.48**
	(0.09)	(0.08)	(0.08)	(0.12)	(0.14)	(0.08)	(0.08)	(0.54)	(0.25)
Ethnic polarization	1.77***	3.41*	3.98*	3.28	2.86	2.68	3.74*	7.71**	6.82**
	(0.42)	(2.06)	(2.28)	(2.26)	(2.05)	(2.04)	(2.16)	(3.29)	(2.74)
Democracy (t-1)	-0.11***	0.01	-0.02	0.01	-0.00	0.02	-0.02	-0.08	-0.09*
	(0.02)	(0.06)	(0.07)	(0.06)	(0.06)	(0.05)	(0.07)	(0.06)	(0.06)
Civil war incidence	2.65***	1.78**	2.11**	2.03**	1.93**	1.94*	2.08**	3.22***	3.46***
	(0.19)	(0.82)	(0.85)	(0.80)	(0.80)	(1.00)	(0.84)	(1.22)	(1.08)
Democratization (t-2)		0.14	0.13	0.11	0.12	0.14	0.12	0.09**	0.08
		(0.14)	(0.13)	(0.15)	(0.16)	(0.14)	(0.14)	(0.04)	(0.06)
Trade / GDP (t-1)		-3.75***	-3.43***	-1.16	-1.28	-4.19***	-3.07***	-2.04**	-0.06
		(1.19)	(1.06)	(0.81)	(0.80)	(1.38)	(0.99)	(1.04)	(1.15)
Chief executive military		1.20	1.09	1.40	1.20	1.24*	1.04	0.72	1.10
		(0.81)	(0.75)	(0.90)	(0.84)	(0.75)	(0.76)	(0.81)	(0.74)
Population (t-1)		-0.04***	-0.04***	-0.04***	-0.04***	-0.05***	-0.03**	0.00	0.01
		(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
Mountainous Terrain		-2.41*	-2.81*	-2.62	-2.28	-0.39	-2.97*	-3.99*	-3.57
		(1.37)	(1.50)	(1.62)	(1.47)	(1.84)	(1.52)	(2.31)	(2.29)
Population density (t-1)		0.66	-0.00	-1.01	-1.94	1.87	-0.64	3.53	2.03*
		(3.31)	(4.14)	(4.91)	(5.16)	(2.73)	(4.40)	(2.25)	(1.09)
Std. Err. clustered by country	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4771	3068	3136	3086	3086	2257	3105	2629	2734
Pseudo R-squared	0.264	0.842	0.840	0.841	0.839	0.822	0.837	0.905	0.891

Note: The unit of observation is a country in a given year. The sample covers all countries of the Correlates of War list and the years 1960-2007. Logit regressions with intercept in all columns. Significance levels *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parenthesis. All specifications control for unreported annual time dummies.

Table 2: Main regressions on mass killings on the country level

production in percent of the Gross National Income (from World Bank, 2010). Also this measure increases the mass killings risk at a significance level of 1%.

Despite the fact that our main measure of oil abundance is lagged and mainly driven by exogenous geographical conditions, there may persist concerns that it could be affected by omitted variables that we do not appropriately control for. Hence, we use as main explanatory variables in columns 4 and 5 the lagged value of oil production in terms of absolute amount (in 100 million tons), respectively in terms of market value at current prices (in 100 billion US$). In both cases natural resource abundance remains significant at the 1% level.

In column 6 we add natural resources other than fuels. As diamonds have been linked to civil wars (e.g. in Lujala, Gleditsch and Gilmore, 2005; Ross, 2006), this resource is a natural candidate. Given that diamond quality varies widely, it is much harder to obtain precise estimates of the value of production on the country level than for oil. Hence, we follow the approach from Lujala, Gleditsch and Gilmore (2005), and use their dummy variable of whether production took place in a given country and year. In addition we include variables of gold production and forest rents (both from World Bank, 2010). We find that the point estimate of the main oil variable varies only little when these other resources are included, and the relative value of oil production remains significant at the 1 % level. Diamond production has also a positive and significant effect on the risk of mass killings, while gold and forests are found to be insignificant. In the light of our model it is unsurprising that timber rents create lower mass killing incentives than rents from oil production, as timber extraction needs much more local workforce.

In column 7 a measure of total resource depletion per Gross National Income is used (from World Bank, 2010). This captures the total rents from energy, mineral and forest exploitation. It has a positive sign and is significant at the 1% level.

While the extent of oil depletion can react to local and international conditions, the amount of reserves under the ground is mainly driven by geological factors. Hence, in column 8 we use oil reserves / GDP as alternative natural resource abundance measure. It is found to increase the risk of mass killings at a statistical significance level of 1%. Note as well that in this specification democratization has a positive and significant effect on the mass killings risk.

In column 9 we take as natural resource abundance variable the absolute amount of oil reserves (in 100 billion barrels), which has the expected sign and is statistically significant at the 1% level. Note that also other resource measures such as for example an oil producer dummy or fuel exports as percentage of GDP are found to increase the risk of mass killings at a significance level of 1% (not reported).

Let us briefly discuss the quantitative importance of the key variables of our analysis. In what follows we discuss the marginal effects based on Table 2, column 2. The unconditional baseline risk of mass killings is 3.5% and the average value of oil production in percent of GDP is 5.8% in our sample (note that all means and standard deviations of all variables are displayed in Table 6 in the Appendix B). The marginal effect of an increase from 0% to 100% of the size of oil production with respect to GDP corresponds to an increase of 3.5 percentage points of mass killings risk. Put differently, while a country with all average characteristics but no oil has an annual mass killings risk of 3.3%, a country with exactly the same characteristics but an oil production value of 75% of its GDP (which is about the level for Angola, Iraq or Libya) would have a mass killings risk of 5.9%, i.e. almost double.

Other variables have also sizeable effects: An increase in GDP per capita by 10000 US$ would reduce the mass killings risk by 0.7 percentage points, while an increase of ethnic polarization from 0% to 100% would increase the mass killings risk by 1.7 percentage points. Further, if a completely autarkic country were to open up to trade flows with a volume of 100% of GDP the mass killings risk would drop by 1.8 percentage points. In the presence of a civil war the mass killings risk increases by 0.9 percentage points, and a population increase by 100 million people decreases the mass killings risk by 0.2 percentage points. Finally, if a country was fully covered by mountains instead of having no mountains this would decrease the mass killings risk by 1.1 percentage points.

Table 3 is devoted to a series of further robustness checks, with respect to the sample, the estimation and the treatment of the dependent variable. In column 1 the sample is restricted to country-years that experience a civil war, as our theory predicts that mass killings typically occur at the end of civil conflict. As this restriction leads to a very substantial drop of the sample size, we only include explanatory variables that have been statistically significant in at least two columns of the last table, in order to minimize further missing observations. Remarkably, oil abundance remains significant at the 10% level for this severely reduced sample.

In column 2 we use the rare events logit (ReLogit) estimator from Tomz, King, and Zeng (2003), which adjusts the estimation for the fact that the dependent variable takes much more often a value of 0 than of 1.[35] In column 3 we run a probit rather than logit regression. In both columns 2 and 3 oil abundance is found to increase the risk of mass killings at the 1% level of significance.

In column 4 we construct as dependent variable a mass killings onset variable, which is coded as 1 when mass killings newly start, as missing during a mass killings episode, and as 0 otherwise. Resource abundance is still found to increase the mass killings risk. In column 5 we include regional fixed effects, in order to alleviate potential omitted variable bias. Oil abundance has still a positive sign and is significant at the 5% level.

In columns 6 and 7 we make use of the mass killings intensity information contained in the "Political Instability Task Force" (PITF) dataset. PITF distinguishes 11 different intensity levels ranging in steps of 0.5 from 0 to 5. Given that the intensity steps are not of the same magnitude, this information can only be used to create a dummy variable for some threshold, or alternatively as ordinal variable. In column 6, we create a dummy variable of mass killings incidence, where all mass killings with at least intensity level 3 (at least 16,000-32,000 deaths) are coded as one, and all other observations as 0. Oil production

[35]Note that this estimator does not allow for the inclusion of time effects.

is found to increase the risk of mass killings at the 1% significance level. Note that the results are very similar if other cut-off levels, like for example intensity 2, are used to construct the dependent variable (not reported). In column 7 the intensity scale of mass killings is used as ordinal dependent variable, and an ordered logit regression is run. Natural resource abundance is still found to be significant at the 1% level.

Finally, in column 8 we display an additional result on democratization and mass killings. In our theory the $\underline{\lambda}$ constraint only affects the mass killings likelihood for small levels of natural resources R. To see whether the data is broadly consistent with this pattern, we first binarize our oil production / GDP measure into a dummy variable for relative oil abundance and then interact this oil abundance dummy with democratization. More than half of the observations in the sample have zero oil production, and only a small number of countries account for the lion's share of worldwide petrol output. This means that our oil production / GDP measure has a median of 0 and its 75th percentile lies at 0.01 (i.e. oil production accounting for 1% of GDP). Here we take as threshold the 75th percentile, and accordingly code as oil abundant observations above the 75th percentile.

The coefficient of democratization in column 8 thus indicates its impact in oil poor economies, while the sum of the coefficients of democratization and of the interaction term captures the impact of democratization for oil abundant countries. In line with our theory, we find that democratization increases the mass killings risk for oil poor countries (the coefficient of 0.32 is significant at the 1% level), while the sum of the coefficients of democratization and of the interaction term is not jointly significantly different from zero. Note that the results are very similar if we take the median as threshold instead (i.e. democratization still has a coefficient of 0.32 and is statistically significant at the 1% level).

Let us summarize the extent of consistency of our empirical findings with our theoretical predictions:

Remark 7 *The country level empirical evidence strongly confirms the prediction that mass killings are the more likely the larger the role of natural resources R in the economy (highly significant in all specifications).*

When controlling for natural resource abundance, GDP per capita proxies β and d. This variable has in all specifications the expected mass killing reducing sign and is significant in many of the columns.

Ethnic polarization is found, as expected, to increase the risk of mass killings. This variable has a positive sign in all columns and is often statistically significant.

The population size N has in most of the specifications the expected negative and significant effect on the mass killings likelihood.

The results on democratization are also consistent with our theory.[36]

[36] While this (unfortunately imperfect) proxy for $\underline{\lambda}$ has in all specifications the expected positive sign, it is only twice significant, although sometimes missing the significance threshold

Dependent variable	Incid. M.K.	Incid. M.K.	Incid. M.K.	Onset M.K.	Incid. M.K.	Large M.K.	Ord. M.K.	Incid. M.K.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Oil production/GDP (t-1)	3.91*	5.63***	2.73***	3.28*	6.16**	7.36***	6.97***	
	(2.36)	(1.42)	(0.75)	(1.99)	(2.64)	(2.85)	(2.43)	
Incidence mass killings (t-1)	6.54***	6.34***	4.01***		7.65***	9.33***	7.87***	8.31***
	(0.93)	(0.53)	(0.32)		(0.79)	(1.00)	(1.27)	(0.98)
GDP per capita (t-1)	-0.50	-0.05	-0.07*	-0.09	-0.13	-1.07	-0.16	-0.40
	(0.48)	(0.07)	(0.04)	(0.11)	(0.11)	(0.80)	(0.11)	(0.27)
Ethnic polarization	1.78	2.85*	1.35	2.14	3.28*	3.74	2.27	4.10*
	(1.58)	(1.48)	(0.86)	(1.85)	(1.98)	(5.37)	(1.80)	(2.13)
Democracy (t-1)	0.01	-0.03	0.01	0.04	0.08	0.04	-0.02	-0.00
	(0.07)	(0.04)	(0.02)	(0.04)	(0.08)	(0.06)	(0.09)	(0.06)
Civil war incidence		1.67**	0.75**	2.13*	2.15***	4.40***	2.11***	2.25***
		(0.66)	(0.32)	(1.15)	(0.77)	(1.64)	(0.47)	(0.81)
Trade / GDP (t-1)	0.14	-3.69***	-1.63***	-3.04	-3.82**	-2.35	-3.25**	-1.92**
	(1.77)	(0.92)	(0.48)	(2.28)	(1.82)	(1.62)	(1.41)	(0.79)
Chief executive military		0.82	0.50	1.87*	1.72**	1.73	0.93*	1.02
		(0.55)	(0.33)	(0.96)	(0.85)	(1.38)	(0.49)	(0.72)
Population (t-1)	-0.10	-0.02**	-0.02**	-0.04	-0.05**	-0.02	-0.02	-0.06***
	(0.13)	(0.01)	(0.01)	(0.07)	(0.02)	(0.02)	(0.02)	(0.01)
Mountainous Terrain	2.04	-1.20	-1.02**	0.14	-2.32	-6.83***	-4.17*	-2.36
	(1.89)	(0.75)	(0.51)	(1.23)	(1.85)	(2.57)	(2.26)	(1.70)
Population density (t-1)		3.08	0.53	2.76	-4.38	4.50	-5.68	2.70**
		(2.23)	(1.05)	(2.89)	(5.67)	(3.07)	(8.10)	(1.16)
Democratization (t-2)		0.11	0.07	0.11	0.14	0.34*	0.11	0.32***
		(0.09)	(0.05)	(0.08)	(0.11)	(0.20)	(0.11)	(0.10)
Democratiz. * Oil prod.>75 perc.								-0.45***
								(0.17)
Oil prod. >75 percentile dummy								2.59***
								(0.65)
Estimator	Logit	Relogit	Probit	Logit	Reg.FE Logit	Logit	Ord. Logit	Logit
Sample	Civ.War	All	All	All	All	All	All	All
Observations	237	3161	3068	632	2463	2701	3161	3068
Pseudo R-squared	0.723	0.8156	0.841	0.205	0.853	0.843	0.601	0.853

Note: The unit of observation is a country in a given year. The sample covers all countries of the Correlates of War list and the years 1960-2007, unless in column 1 where it is restricted to all country-years with civil war. Intercept in all columns. Significance levels *** p<0.01, ** p<0.05, * p<0.1. All columns contain robust standard errors clustered at the country level in parenthesis (unless in column 5, where the estimator used does not allow for clustering). Columns 3-8 control for unreported annual time dummies.

Table 3: Robustness checks and additional results on mass killings on the country level

6.2 Country level evidence on the effects of mass killings

One feature of our theory is that natural resource rents R are not affected by mass killings, while the non-resource production decreases in the aftermath of mass killings by $\beta\overline{M}$. Hence, after mass killings the economy becomes relatively more resource dependent, with a larger share of GDP being accounted for by natural resource production.

The assumption that R is not affected by mass killings is based on the view that oil production is very capital-intensive and requires very little local labor, and in many developing countries the whole resource extraction process is carried out by big multinational firms, and the state and local population just receive taxes and royalties (see e.g. the discussion in Ploeg and Rohner, 2012).

If our assumptions are valid, we should observe that in the aftermath of mass killings the amount and value of oil production is largely unaffected, while the share of oil production in GDP should increase, given that the non-resource sectors are harmed by the killings.

To assess this, we perform a very simple analysis, where we compare the average values of various oil revenue measures in the 10 (resp. 5) years before a mass killings (MK) episode starts and compare them with the averages of the same measures in the 10 (resp. 5) years after the end of a mass killings episode. We include the same countries experiencing mass killings and the same sample period as in the regression analysis of the previous subsection.

Table 4 below displays the results. We first consider measures of resource abundance in terms of weight and current market value. Consistent with our model assumptions, the difference between the mean after mass killings and the mean before mass killings is statistically not different from zero (if anything, it seems that the values of these variables increase rather than decrease after mass killings). Then we look at three measures of resource abundance relative to the GDP, resp. Gross National Income (GNI), namely the oil production / GDP, the energy rents (as a share of GNI) and the total natural resource depletion (as a share of GNI). In line with our assumptions, there is an increase in the average values of these variables, given that the economy becomes more resource dependent (in five out of six comparisons the difference is statistically significant, and only for energy rents in a 10 year window the significance threshold is not quite reached).

One of the reasons why one could doubt our assumption of natural resource production being unaffected by mass killings is that it may be conceivable that in the aftermath of massacres countries suffer from export embargoes. While this may have been the case in a few exceptions, it does not seem to be the rule. As shown for the last two variables in the table, both Fuel exports / GDP and Trade / GDP if anything seem to increase, rather than decrease on average in the years following a mass killings episode.

There is a general explanation for why sanctions may not be applied once the

by not too much. Interestingly, when interacting democratization with oil abundance (as done in column 8 of Table 3) we find, as predicted by the theory, that democratization only increases the mass killings risk in resource poor economies.

	10 year window			5 year window		
	Mean after MK minus mean before MK	Standard error	Number observations	Mean after MK minus mean before MK	Standard error	Number observations
Oil prod.(in 100 mio. tons)	0.064	0.054	418	0.071	0.065	247
Oil prod. (in 100 bill. US$)	0.018	0.018	418	0.014	0.025	247
Oil production/GDP	0.044***	0.017	350	0.045*	0.023	211
Energy rents	0.016	0.01	311	0.031**	0.015	192
Total resource depletion	0.023**	0.01	285	0.034**	0.014	179
Fuel exports / GDP	0.101***	0.037	247	0.059	0.045	140
Trade / GDP	0.066***	0.025	392	0.063**	0.03	235
Note: Significance levels *** p<0.01, ** p<0.05, * p<0.1.						

Table 4: Comparing oil abundance before and after mass killings

killing is over: As established in the literature on economic sanctions, sanctions are seen as coercive tools (i.e., meant to change the behavior of a target), rather than punitive tools (i.e., meant to punish past behavior). See e.g. Pape (1997) and Hufbauer et al. (2009).

There are also important case studies that we can now mention in support of the above findings. Consider for example the case of Sudan[37], a place with multiple mass killings in recent history. In the midst of a civil war between the central government and the SPLA in the south that had been raging since 1983, characterized by large-scale killing of civilians, in 1999 Sudan started producing and exporting oil, which significantly reduced Khartoum's international isolation (International Crisis Group, 2002). The opening of oil fields pushed some European governments to adopt a friendlier attitude towards Khartoum and brought about deeper economic ties with China and Malaysia. In addition, Khartoum's cooperation with US counter-terrorism efforts (in particular after the September 11th attacks) determined a substantial improvement of its relations with Washington. In the late 1990s and early 2000s, Khartoum resorted to scorched-earth tactics to displace populations residing around existing and potential oil fields, thus making these areas more defensible. The Sudan case thus illustrates how it is not necessarily the case that large scale victimization of civilians (in particular if occurred in the past) would prevent the perpetrating country from attracting investments by international energy companies.

Another important example is Iraq. As one can see from the oil data we use from British Petroleum (2009), Iraq's oil production peaked in the five years immediately after crushing the Kurdish rebels in 1975. Those years were characterized by large-scale deportations of Kurds[38] from border areas and oil-rich Kirkuk. Oil production plummeted during the Iran-Iraq war (Baghdad could not export the bulk of its oil via the Basra port) but peaked again at the end and after the war (1988/1989), in spite of new mass killings of Kurds in

[37] See e.g. the discussion in SIPRI (2000, 2004).

[38] It is estimated that as many as 1,400 villages may have been destroyed after the war, between 1975 and 1978 – see McDowall (2004).

1987-1988.[39]

6.3 Ethnic group level evidence

While in section 6.1 we carried out an analysis at the country year level, here we focus on a panel at the ethnic group year level. This allows us to study what kinds of ethnic groups become victims of military massacres of civilians.

While there have been a few papers that used similar data on the ethnic group level for assessing issues related to conflict, like e.g. Walter (2006) or Cederman, Buhaug and Rod (2009), our analysis has two main novelties: First, to the best of our knowledge we are the first ones to apply this data to the study of massacres of civilians at the ethnic group level. Second, we build a group-level variable of natural resource wealth. So far, only natural resource data on the country level has been used in related papers. Our group-level variable of petrol wealth allows us to identify more precisely whether groups in petrol-rich areas become more attractive targets for strategic elimination.

As a starting point we use the "Geo-referencing of ethnic groups" (GREG) dataset (Weidmann, Rod and Cederman, 2010). Relying on maps from the classical Soviet Atlas Narodov Mira from the 1960s, GREG contains a geo-referenced dataset with the coordinates of the group boundaries of 929 ethnic groups. One major advantage of this very comprehensive dataset is that it contains information on the geographical location of groups, which enables us to merge it with other geo-referenced group-level data using Geographical Information Systems (GIS), while this information on group boundaries is missing for the main competing datasets on ethnic groups.[40]

One obvious limitation of this data is that it is dated, which implies that in some instances the group boundaries are not fully accurate anymore in recent times, particularly because group boundaries can change in the aftermath of civil wars. However, this has both advantages and disadvantages. The fact that the data is dated lowers accuracy and hence adds noise to our estimations, which biases the magnitude of coefficients and the significance levels downwards, while there seems to be no other obvious bias of the results. This means that using GREG will tend to bias the results against us and making them appear *less* strong than they are in reality. The advantage of using group boundaries from the 1960s is that this limits concerns of reversed causality, as the massacres we study take place three decades later. Thus, what we lose in terms of accuracy we gain in terms of identification.

As dependent variable, we focus on a given ethnic group in a given year being the target of military massacres of civilians. The only high-quality measure of massacres of civilians at the ethnic group level we are aware of is from the

[39] A common opinion is that the international community was slow in accusing Iraq of mass killings, and turned a blind eye (see Hiltermann, 2007) because it was a US/west ally. Iraqi oil production was hit by sanctions only when Saddam Hussein became an international villain by occupying Kuwait.

[40] Throughout the database construction we use the country borders from the time-varying, geo-referenced "CShapes" dataset (Weidmann, Kuse, and Gleditsch, 2010).

"Minorities at Risk" (2009, MAR) project. MAR contains a panel of all ethnic minority groups that suffer from threats or discrimination. Note that 23% of all groups from GREG are included in MAR, and 4.3% of the observations in MAR are coded as being subject to military massacres of civilians. Our dependent variable of mass killings victimization at the group level is only available for the years 1996-2003, which leaves us with a short panel.

If we were to restrict our analysis to only groups included in MAR our results could suffer from sample selection as only groups at risk are in MAR and all the fully peaceful and well-treated groups are excluded. Given that MAR gives a comprehensive account of persecuted groups it is safe to assume that all groups who have been subject to massacres are included in MAR. Hence it is reasonable to include the full sample of groups in GREG in the analysis and code as having no massacres all groups absent from MAR. This is what we do in the first part (columns 1-4) of Table 5 where we have in columns 1-3 a sample of 7098 observations (resp., 1582 observations when country fixed effects are included in column 4). In the second part of this table (columns 5-7) we restrict the analysis to only groups in MAR, which results in a drop of sample size to 1299 observations, but allows us to add additional control variables that are only available in MAR.

Our main independent variable is the ethnic group's petrol abundance, which is captured by the percentage of a group's territory covered with oil and gas. To the best of our knowledge we are the first ones to construct this measure. Using GIS software (ArcGIS) we have matched the data from GREG on the geographical boundaries of ethnic groups with the geo-referenced petroleum dataset (PETRODATA) from Lujala, Rod and Thieme (2007), which tells us where oil fields lie. Combining this information, we have computed a variable measuring which part of the territory occupied by a given ethnic group contains oil. This yields a relatively precise measure of how petrol-rich the homelands of a given ethnic group are. According to our theory we expect groups that live in petrol-rich areas, but are economically relatively unproductive, to be attractive targets for the ruling groups in their country. By attacking such groups, the group in power can substantially increase its share of natural resource rents, but only marginally decreases the production output.

Several other important independent variables are included in our dataset. Using the geo-referenced DIADATA dataset on the location of diamonds (from Gilmore et al., 2005), we have created a dummy variable on whether a given ethnic group has diamond production on its territory.[41] Further, we include several geographic and demographic control variables on the ethnic group level: The group's relative population size (using Cederman, Buhaug and Rod, 2009), the group's geographic concentration, the number of countries where the same ethnic group is present (both computed with the help of the GREG data), the share of the group's territory covered by mountains, and the distance from the

[41] There is such a huge variance in production scale among the different mining observations —and production quantities are not included in DIADATA— that it is safest to code a dummy variable of production, which is also the approach chosen by Lujala, Gleditsch and Gilmore (2005).

group territory to its country's capital (both from Cederman, Buhaug and Rod, 2009). In addition, we have constructed variables capturing the group's economic potential: First, we have included the percentage of the group's territory with high-quality fertile soil, which has been constructed based on the Harmonized World Soil Database (Fischer et al., 2008). Second, we have included the average light intensity during night in the ethnic group's territory, measured with the help of meteorologic satellites. This data is from the National Oceanic and Atmospheric Administration (2010), and have been used in recent research as a proxy for economic activity (see e.g. Henderson, Storeygard and Weil (2012) and Rohner, Thoenig and Zilibotti (2013)). Finally, we have included a dummy variable taking a value of 1 for the groups that have in the same year been involved in civil conflict (from Cederman, Buhaug and Rod (2009)).

In the second half of our ethnic group analysis (columns 5-7 in Table 5) we restrict the sample to groups included in the MAR dataset, which allows us to include further, MAR-specific controls. In particular, we include variables capturing how different the language, race and religion of an ethnic group is with respect to the dominant group(s) in the country. Further, we include indicators of whether a group has autonomy grievances, and whether it occupies all its historical homeland (all from Minorities at Risk, 2009). In Appendix B all variables are explained in detail and summary descriptive statistics are provided.

In addition to these ethnic group-specific variables we control for exactly the same country-level variables as in the most inclusive specification of the country-level regressions above (column 6 of Table 2). To account for unobserved heterogeneity, all columns have robust standard errors that are allowed to be clustered at the country level.

We consider the following benchmark logit model for the ethnic group level regressions:

$$\log\left(\frac{\mathbb{P}(Massacres\_civilians_{e,y}=1)}{1-\mathbb{P}(Massacres\_civilians_{e,y}=1)}\right)=\alpha+\mathbf{U}'_{e,y}\boldsymbol{\beta}+\mathbf{V}'_{e}\boldsymbol{\gamma}+\mathbf{W}'_{c,y}\boldsymbol{\delta}+\mathbf{X}'_{c}\boldsymbol{\zeta}+\mathbf{Z}'_{y}\boldsymbol{\eta}, \tag{7}$$

where the left hand side is the logarithm of the ratio of the probability of massacres of civilians over the probability of no massacres of civilians, with the massacres of civilians variable varying at the ethnic (e) and year (y) level. Coefficient α denotes the constant, $\mathbf{U}'_{e,y}$ a vector of variables that vary at the ethnic and year level, $\mathbf{V}'_{e}$ a vector of variables that vary at the ethnic level, $\mathbf{W}'_{cy}$ a vector of variables that vary at the country (c) and year level, $\mathbf{X}'_{c}$ a vector of variables that vary at the country level, and $\mathbf{Z}'_{y}$ a vector of annual time dummies. $\boldsymbol{\beta}$, $\boldsymbol{\gamma}$, $\boldsymbol{\delta}$, $\boldsymbol{\zeta}$, and $\boldsymbol{\eta}$ are vectors of coefficients. The coefficients of interest are the ones corresponding to the main ethnic group level variables mentioned above.

Like in the country level regressions above, we code in the benchmark specification of column 1 of Table 5 the military massacres of civilians as dummy variable, taking a value of 1 if in a given year a given ethnic group has been subject to massacres, and run logit regressions. It is found that groups that are more petrol and diamond rich are significantly more likely to be targeted in terms of mass killings. Further, a given ethnic group is significantly more at risk if it is relatively small.[42] Groups that are geographically dispersed, that live in mountainous areas,[43] that live on valuable soil and that are involved in a civil conflict are also significantly more likely to be massacred.[44] The result that groups occupying valuable high-quality land are more at risk is particularly interesting. In the concluding section we will discuss how a simple extension of our framework can capture well this finding.

As in MAR the variable of military massacres of civilians is constructed as ordinal scale variable, we use this coding in column 2 and run an ordered logit regression. The results are very similar as in column 1, with all variables having the same sign, and the same variables being significant as before.

In column 3 it is shown that the results still hold when instead of all oil and gas, only oil is used for constructing the natural resource abundance variable.

In column 4 we include country fixed effects, which implies that our results are now entirely driven by variation between ethnic groups within the same country, and by variation over time. Also in this demanding specification all results from the previous columns are confirmed and all the previously significant variables remain statistically significant.

The specifications of columns 5-7 are the mirror-images of columns 1-3, with the only difference that several additional MAR-specific controls are added, which restricts the sample to MAR-groups only, and results in a drop of the sample size by about 80%.[45] It is found that oil and gas abundance on the group-level continue to statistically significantly increase the risk of being subject to massacres, while the diamond variable has still a positive sign, but is now only borderline significant. Further, relatively small groups living in mountainous

[42]Remember that we control for the country-level variables of Table 2, including ethnic polarization. Hence, the fact that –for a given level of ethnic polarization– smaller groups are more often targeted, is consistent with the feature of our model that smaller groups are more likely to be defeated in war.

[43]It may come as a surprise that while in the previous tables the country-level mountainous terrain variable has been in some of the specifications negative and significant, the group level mountainous terrain variable is now positive and significant. However, these findings are easy to reconcile: Mountainous *countries* have a slightly smaller mass killings risk, while within a given country (and controlling for all country level variables, *including the country level mountainous terrain* proportion) ethnic groups in relatively rough terrain (compared to the country average, that is controlled for) are more likely to be targeted, maybe because these groups could be on average economically relatively less productive (note that our other controls are only imperfect proxies for group productivity).

[44]Note that while we control for lagged mass killings on the country level, we do not add as standard control the lagged mass killings at the group level, as in our short group panel this would substantially reduce the sample size. However, when the lagged group level mass killings variable is included the results are very similar. Concretely, in benchmark column 1 the two most important variables of interest, "% of group's territory with oil & gas" and "Group's diamond production dummy" continue to have a positive sign and remain significant at the 10%, resp. 5% levels.

[45]Note that we cannot run a country fixed effects logit estimation like in column 4 when the MAR variables are included, as the joint inclusion of country fixed effects and the MAR variables results in such a tiny sample (i.e. even with only a subset of our MAR controls the country fixed effects sample size falls below 300) that the likelihood estimator does not converge.

	Dependent variable: Victimization by military massacres of civilians						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
% of group's terr. with oil & gas	2.11**	1.99**		3.90*	0.61***	0.56**	
	(0.91)	(0.98)		(2.13)	(0.20)	(0.25)	
% of group's territory with oil			2.56***				0.91**
			(0.86)				(0.36)
Group's diamond prod. dummy	1.33*	1.40*	1.31*	2.25*	2.88*	3.11	2.75
	(0.75)	(0.81)	(0.79)	(1.26)	(1.72)	(2.05)	(1.70)
Group's pop. / Country pop. (t-1)	-4.51*	-4.40**	-4.49*	-3.75*	-29.18**	-32.82**	-29.84**
	(2.38)	(1.72)	(2.37)	(2.13)	(13.58)	(14.74)	(13.99)
Group geographic concentration	-1.46***	-0.68*	-1.55***	-3.83**	0.43	0.43	0.30
	(0.53)	(0.40)	(0.60)	(1.50)	(0.59)	(0.58)	(0.63)
Group co-ethnics abroad	0.00	0.04	-0.01	0.62***	-0.15	-0.15	-0.15
	(0.17)	(0.15)	(0.17)	(0.21)	(0.10)	(0.10)	(0.10)
Group's share of mountain. terr.	1.84**	1.80**	1.73**	1.86*	1.35**	1.30**	1.30**
	(0.82)	(0.79)	(0.78)	(1.01)	(0.64)	(0.56)	(0.60)
Group's distance to capital	-0.52	-0.41	-0.47	-1.03	-3.25***	-3.40***	-3.26***
	(0.67)	(0.71)	(0.68)	(0.69)	(1.05)	(1.04)	(1.04)
Group's soil quality	3.68**	3.92**	3.71**	4.37***	8.22**	8.75**	8.26**
	(1.61)	(1.82)	(1.66)	(1.43)	(3.31)	(3.74)	(3.23)
Group's satellite light intensity	0.10	0.23	0.19	-1.24	-0.46	-0.50	-0.55
	(0.48)	(0.46)	(0.56)	(1.98)	(0.58)	(0.49)	(0.65)
Group involved in civil conflict	2.63***	2.48***	2.61***	3.88***	1.55***	1.60***	1.55***
	(0.82)	(0.73)	(0.82)	(0.66)	(0.50)	(0.45)	(0.51)
Group different language					0.96	0.81	0.92
					(1.78)	(1.96)	(1.81)
Group different race					2.12	2.74*	2.14
					(1.49)	(1.49)	(1.46)
Group different religion					3.57	3.41	3.48
					(2.72)	(3.14)	(2.66)
Group's autonomy grievances					0.57	0.94**	0.60
					(0.44)	(0.44)	(0.43)
Group occupies all hist. homel.					0.45	0.21	0.44
					(1.19)	(1.08)	(1.17)
Estimator	Logit	O.Logit	Logit	Cou.FE Log.	Logit	O.Logit	Logit
Sample	All	All	All	All	Only MAR	Only MAR	Only MAR
Observations	7098	7098	7098	1582	1299	1299	1299
Pseudo R-squared	0.519	0.457	0.518	0.637	0.699	0.656	0.699

Note: The unit of observation is an ethnic group in a given year. The sample covers all ethnic groups from the Geo-Referenced Ethnic Groups (GREG) list and the years 1996-2003. In columns 4-7 various control variables from Minorities at Risk (MAR) are included, which restricts the sample to MAR groups for these columns. In the columns 2 and 6 the dependent variable is left as ordinal variable and Ordered Logit regressions are run, while in all other columns the dependent variable is recoded as dummy variable, and Logit regressions are run. In column 4 a country fixed effects logit estimation is performed. Significance levels *** p<0.01, ** p<0.05, * p<0.1. All columns have robust standard errors clustered at the country level in parenthesis (unless in column 4, where the estimator used does not allow for clustering) and include intercept, annual time dummies, and all the country-level independent variables of the (most extensive) column 6 of Table 1 (not reported).

Table 5: The determinants of victimization of ethnic groups

terrain close to the capital are in greater danger. Having valuable soil and being involved in civil conflict continues to make a group more likely to be victimized. The only MAR-specific variables that are sometimes significant are the indicator of a given ethnic group having a different race from the ruling group(s), and having autonomy grievances, which both increase the risk of being massacred.

Let us briefly discuss the quantitative importance of the effects of our main variables, based on marginal effects for the logit regression of column 1. The baseline average risk for an ethnic group to be massacred is 1% in a given year, and an average group has 6.2% of its territory covered by oil and gas wells. The marginal effect of a group moving from zero oil to having oil fields under its whole territory would be an increase of 1.7 percentage points in the risk of being subject to massacres. Put differently, an ethnic group with all average characteristics but no oil has a risk of being massacred of 0.9%, while the same group would face a massacre risk of 2.6% if its whole territory was covered with oil and gas, which corresponds to almost tripling the risk of massacres. Further, having diamonds increases the risk of being the target of mass killings by 1 percentage point. Increasing the group's share of the country population by 10 percentage points would reduce its risk of being massacred by 0.4 percentage points. If a group is fully geographically concentrated rather than completely dispersed, its risk of victimization drops by 1.2 percentage points. If a group has instead of zero mountains all its terrain covered with mountains the risk of being massacred increases by 1.5 percentage points. Further, a group having high-quality soil all over its land, rather than populating a completely deserted spot, faces a 2.9 percentage points larger risk of being massacred. Finally, groups involved in civil conflict face a 2.1 percentage points larger risk of civilian massacres.

7 Concluding remarks

This paper provides, we believe, a very robust theoretical and empirical foundation to the general claim that mass killings consistently follow from group material interests. More specifically, we have established that when a country divided in identifiable groups is very natural resource abundant and the destructive expected costs of civil war are not overwhelmingly high, the dynamic incentives to kill or displace minority groups emerge. Moreover, such material dynamic incentives to eliminate opponents generated by natural resource abundance are further enhanced when a democratization process or some other source of increasing institutional constraints to unfair distributions arise, when the productivity of labor is low and when the society is ethnically polarized.

The empirical results confirm the crucial role played by natural resources. As predicted by our theory, in contexts displaying a large abundance of natural resources, and in particular petrol and diamonds, the risk of mass killings is substantially larger. While we do find that the absolute amounts of natural resources matter, the results also indicate that the relative weight of natural resources with respect to the non-resource production counts. Hence, for a given amount of oil in the ground the mass killings risk in a country can be substantially reduced when a productive and skill-intensive economy is built.

The model could be easily extended in several interesting directions. One particularly interesting extension that could be considered relates to the description of economic activities: it is for example realistic to allow for decreasing returns in agricultural production.[46] In Rwanda, for example, the really important contestable resource is productive land, and decreasing returns from agricultural production could explain the mass killings incentives.[47] The predictions of such an extension would be consistent with our empirical finding that ethnic groups with homelands covered with very fertile land face a substantially larger risk of being massacred.

The logic of our model could also be useful to capture the essential motivations behind the mass killings of native American tribes: the American Indians were holding off the large-scale development and exploitation of the great resources of the West, and their traditional use of the land was considered much less efficient than the alternative, hence the elimination of them had both a large impact on the amount of natural resources that it became possible to extract and on the average productivity. To capture this story fully in the model, one would have to attribute a lower β_i to the Indians and consider R as $R(N_i)$, capturing the fact that the amount of productive land and other resources exploitable by the U.S. was considered decreasing in the size of Indian occupied territories. Only when the Indians accepted (or were forced to accept) the clear discrimination of reservations (low λ) the mass killings stopped.

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[46] Such an extension would require only a minor modification of the production function, which we did not want to do in the benchmark model simply for the sake of tractability.

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Appendix A: Proofs

Proof of Lemma 5

Express the value function for a given player k with population size N_k, and population size of the opponent h being N_h, as $V_k(N_k, N_h)$. The payoff of i from rebelling is:

$$\frac{N_i}{N}\left[S - d + \delta V_i(N_i, N_j - \overline{M})\right] + \frac{N_j}{N}\delta V_i(N_i - \overline{M}, N_j),$$

where

$$V_i(N_i, N_j - \overline{M}) = \frac{N_i}{N - \overline{M}}\left[S - \beta\overline{M} - d + \delta V_i(N_i, N_j - \overline{M})\right] + \frac{N_j - \overline{M}}{N - \overline{M}}\delta V_i(N_i - \overline{M}, N_j - \overline{M}), \tag{8}$$

and

$$V_i(N_i-\overline{M},N_j)=\frac{N_i-\overline{M}}{N-\overline{M}}\left[S-\beta\overline{M}-d+\delta V_i(N_i-\overline{M},N_j-\overline{M})\right]+\frac{N_j}{N-\overline{M}}\delta V_i(N_i-\overline{M},N_j), \tag{9}$$

and

$$V_i(N_i-\overline{M},N_j-\overline{M})=\frac{N_i-\overline{M}}{N-2\overline{M}}\frac{S-2\beta\overline{M}-d}{1-\delta}. \tag{10}$$

Plugging (10) in equation (8) and solving it recursively, we obtain:

$$V_i(N_i,N_j-\overline{M})=\frac{N_i\left[S-\beta\overline{M}-d\right](N-2\overline{M})(1-\delta)+\delta(N_j-\overline{M})(N_i-\overline{M})(S-2\beta\overline{M}-d)}{(1-\delta)(N-2\overline{M})\left[N-\overline{M}-\delta N_i\right]}. \tag{11}$$

Similarly, plugging equation (10) in equation (9) and solving it recursively, we obtain:

$$V_i(N_i-\overline{M},N_j)=(N_i-\overline{M})\frac{(S-\beta\overline{M}-d)(N-2\overline{M})(1-\delta)+\delta(N_i-\overline{M})(S-2\beta\overline{M}-d)}{(N-\overline{M}-\delta N_j)(N-2\overline{M})(1-\delta)}. \tag{12}$$

Plugging these expressions into the payoff function for rebellion, the peace IC condition for i becomes:

$$\begin{aligned}
& N_i(S-d) \\
& +N_i\delta\frac{\left[S-\beta\overline{M}-d\right]\left\{(1-\delta)N_i(N-2\overline{M})+\delta(N_j-\overline{M})(N_i-\overline{M})\right\}-\delta(N_j-\overline{M})(N_i-\overline{M})\beta\overline{M}}{(1-\delta)(N-2\overline{M})\left[N-\overline{M}-\delta N_i\right]} \\
& +N_j\delta(N_i-\overline{M})\frac{\left[(S-\beta\overline{M}-d)\left\{(N-2\overline{M})(1-\delta)+\delta(N_i-\overline{M})\right\}-\delta(N_i-\overline{M})\beta\overline{M}\right]}{(N-\overline{M}-\delta N_j)(N-2\overline{M})(1-\delta)} \\
= \; & \lambda N_i\frac{S}{1-\delta}.
\end{aligned}$$

Now solve in terms of λ:

$$\begin{aligned}
\lambda_j^* \;=\; & \frac{S-d}{S}(1-\delta) \\
& +\delta\frac{\left[S-\beta\overline{M}-d\right]\left\{(1-\delta)N_i(N-2\overline{M})+\delta(N_j-\overline{M})(N_i-\overline{M})\right\}-\delta(N_j-\overline{M})(N_i-\overline{M})\beta\overline{M}}{S(N-2\overline{M})\left[N-\overline{M}-\delta N_i\right]} \\
& +\frac{N_j\delta(N_i-\overline{M})}{SN_i}\frac{\left[(S-\beta\overline{M}-d)\left\{(N-2\overline{M})(1-\delta)+\delta(N_i-\overline{M})\right\}-\delta(N_i-\overline{M})\beta\overline{M}\right]}{(N-\overline{M}-\delta N_j)(N-2\overline{M})}.
\end{aligned} \tag{13}$$

Note that $\partial\lambda_j^*/\partial R>0$, like in the unlimited mass killings power case.

This expression for λ_j^* will later on be plugged into j's peace payoff. j's payoff function is

$$\frac{(1-\frac{N_i}{N}\lambda_j^*)S}{1-\delta}.$$

The payoff for j of deviating and performing mass killings is

$$S + \delta V_j(N_i - \overline{M}, N_j),$$

where

$$\begin{aligned} V_j(N_i - \overline{M}, N_j) &= \frac{N_j}{N - \overline{M}} \left(S - \beta \overline{M} - d + \delta V_j(N_i - \overline{M}, N_j) \right) \\ &\quad + \frac{N_i - \overline{M}}{N - \overline{M}} \delta \frac{N_j - \overline{M}}{N - 2\overline{M}} \frac{S - 2\beta \overline{M} - d}{1 - \delta}. \end{aligned}$$

Solving this recursively, we obtain

$$V_j(N_i - \overline{M}, N_j) = \frac{N_j(S - \beta \overline{M} - d)(1-\delta)(N - 2\overline{M}) + \delta(N_i - \overline{M})(N_j - \overline{M})(S - 2\beta\overline{M} - d)}{(1-\delta)(N - \overline{M} - \delta N_j)(N - 2\overline{M})}.$$

Our condition for j preferring peace to mass killings corresponds to

$$\frac{(1 - \frac{N_i}{N}\lambda_j^*)S}{1-\delta} > S + \delta V_j(N_i - \overline{M}, N_j).$$

Plugging in the expressions for λ_j^* and $V_j(N_i - \overline{M}, N_j)$, the condition above becomes

$$\begin{aligned} & \frac{S}{1-\delta} \\ & - \frac{S}{1-\delta} \frac{N_i}{N} \left[\begin{array}{c} \frac{S-d}{S}(1-\delta) + \delta \frac{\left[S - \beta\overline{M} - d\right]\left\{(1-\delta)N_i(N-2\overline{M}) + \delta(N_j - \overline{M})(N_i - \overline{M})\right\} - \delta(N_j - \overline{M})(N_i - \overline{M})\beta\overline{M}}{S(N-2\overline{M})\left[N - \overline{M} - \delta N_i\right]} \\ + \frac{N_j \delta(N_i - \overline{M})}{S N_i} \frac{\left[(S - \beta\overline{M} - d)\left\{(N-2\overline{M})(1-\delta) + \delta(N_i - \overline{M})\right\} - \delta(N_i - \overline{M})\beta\overline{M}\right]}{(N - \overline{M} - \delta N_j)(N - 2\overline{M})} \end{array} \right] \\ > \quad & S + \delta \frac{(S - \beta\overline{M} - d)\left[N_j(1-\delta)(N-2\overline{M}) + \delta(N_i - \overline{M})(N_j - \overline{M})\right] - \delta(N_i - \overline{M})(N_j - \overline{M})\beta\overline{M}}{(1-\delta)(N - \overline{M} - \delta N_j)(N - 2\overline{M})}. \end{aligned}$$

This, after very tedious algebra, yields condition (14):

$$R < R_j^* \equiv \frac{\begin{array}{c} d\frac{N_i}{N}(1-\delta)(N-2\overline{M})(N - \overline{M} - \delta N_j)\left[N - \overline{M} - \delta N_i\right] \\ +\delta(N - \overline{M} - \delta N_j)\frac{N_i}{N}\left(\begin{array}{c} \left[\beta\overline{M} + d\right](1-\delta)N_i(N-2\overline{M}) \\ + \left[2\beta\overline{M} + d\right]\delta(N_j - \overline{M})(N_i - \overline{M}) \end{array} \right) \\ +\delta(\beta\overline{M} + d)\left[N - \overline{M} - \delta N_i\right]\left\{ \begin{array}{c} (N - 2\overline{M})(1-\delta)\frac{N_j}{N}\left[N + N_i - \overline{M}\right] \\ +\delta(N_i - \overline{M})\left[(N_j - \overline{M}) + \frac{N_j}{N}(N_i - \overline{M})\right] \end{array} \right\} \\ +\delta^2(N_i - \overline{M})\beta\overline{M}\left[N - \overline{M} - \delta N_i\right]\left\{(N_j - \overline{M}) + \frac{N_j}{N}(N_i - \overline{M})\right\} \end{array}}{(1-\delta)^2(N - 2\overline{M})\frac{N_i}{N}(N - \overline{M})^2 + \delta^2(1-\delta)(N_i - \overline{M})N_i(N_j - \overline{M})} - \beta N. \tag{14}$$

Note that R_j^* is unambiguously positive, as both the denominator and the numerator of the fraction are unambiguously positive, and that the condition for peace is unambiguously less likely to hold for large R.

Note that it can be easily shown that for some parameters $R_j^* > d$ holds (in which case the set $\left[d, R_j^*\right]$ is non-empty), hence making case (i) of the lemma non vacuous. For other parameter values $R_j^* \leq d$. In particular, when δ is small enough we have $R_j^* < d$ (e.g. when $\delta = 0$, then $R_j^* \equiv d - \beta N < d$), while for large enough δ the inequality $R_j^* > d$ holds (e.g. in the limit when $\delta \to 1$ then R_j^* tends towards infinity).

For small enough values of $\underline{\lambda}$ (less than λ_j^*), the above computations of the two thresholds λ_j^* and R_j^* are all we need for the characterization of the region of peace.

Let us now consider the case in which $\underline{\lambda}$ binds. We know that i will be peaceful when offered $\underline{\lambda}$. The payoff for j of peace is:

$$\left(1 - \frac{N_i}{N}\underline{\lambda}\right)\frac{S}{1-\delta}.$$

The payoff for j of mass killings is:

$$S + \delta V_j(N_i - \overline{M}, N_j),$$

where

$$\begin{aligned} V_j(N_i - \overline{M}, N_j) &= \frac{N_j}{N - \overline{M}}\left(S - \beta\overline{M} - d + \delta V_j(N_i - \overline{M}, N_j)\right) \\ &\quad + \frac{N_i - \overline{M}}{N - \overline{M}}\delta\frac{N_j - \overline{M}}{N - 2\overline{M}}\frac{S - 2\beta\overline{M} - d}{1-\delta}. \end{aligned}$$

Solving this expression recursively and simplifying it yields:

$$V_j(N_i - \overline{M}, N_j) = \frac{N_j\left(S - \beta\overline{M} - d\right)(N - 2\overline{M})(1-\delta) + \delta(N_i - \overline{M})(N_j - \overline{M})(S - 2\beta\overline{M} - d)}{(N - \overline{M} - \delta N_j)(N - 2\overline{M})(1-\delta)}.$$

Hence, peace will be preferred by j iff:

$$\left(1 - \frac{N_i}{N}\underline{\lambda}\right)\frac{S}{1-\delta} > S + \delta\frac{N_j\left(S - \beta\overline{M} - d\right)(N - 2\overline{M})(1-\delta) + \delta(N_i - \overline{M})(N_j - \overline{M})(S - 2\beta\overline{M} - d)}{(N - \overline{M} - \delta N_j)(N - 2\overline{M})(1-\delta)}.$$

After reformulation this condition becomes:

$$\underline{\lambda} < L_j^* \equiv \frac{\delta N}{N_i}\left(1 - \frac{N_j\left(S - \beta\overline{M} - d\right)(N - 2\overline{M})(1-\delta) + \delta(N_i - \overline{M})(N_j - \overline{M})(S - 2\beta\overline{M} - d)}{(N - \overline{M} - \delta N_j)(N - 2\overline{M})S}\right). \tag{15}$$

Note that the peace condition is harder to satisfy when $\underline{\lambda}$ increases. Notice also that the right-hand-side is unambiguously decreasing in R, meaning that peace is only achievable when R is small enough.

The construction of the third threshold function $L_j^*(R)$ obtained above completes the proof of part (i).

(ii) Consider now what happens when $R > R_j^*$ and/or $\underline{\lambda} > \max\left\{\lambda_j^*, L_j^*\right\}$, where R_j^* is defined in expression (14), λ_j^* is defined in expression (13), and L_j^*

in expression (15). The best SPE definitely involves war in the first period, due to the shadow of mass killings by j. If group j wins it commits mass killings $\overline{M}$. If group i wins it commits mass killings $\overline{M}$ iff $R > R_i^*$ and/or $\underline{\lambda} > \max\{\lambda_i^*, L_i^*\}$, while for $R \leq R_i^*$ and $\underline{\lambda} \leq \max\{\lambda_i^*, L_i^*\}$ the best SPE involves peace ever after. Consider now the case where mass killings were perpetrated by the winner. Call $h = i, j$ that winning group, and let us find the condition under which group h, after killing $\bar{M}$ members of group k, is able to buy peace forever after. Compute $\widehat{\lambda}_h$ necessary for such an outcome. The payoff for k from peace from that time on is

$$\lambda_h \frac{N_k - \overline{M}}{N - \overline{M}} \frac{S - \beta\overline{M}}{1-\delta}.$$

Group k knows that if it rebels it will trigger a phase with war in every future period, and where group h cannot do any more mass killings in any period, as h has already reached its upper bound $\overline{M}$, and where at the first occasion when k reaches power it will commit mass killings of $\overline{M}$. Hence, the payoff for k from rebellion is:

$$W_k(N_k - \overline{M}, N_h) = \frac{N_k - \overline{M}}{N - \overline{M}} \left(S - \beta\overline{M} - d + \delta \frac{N_k - \overline{M}}{N - 2\overline{M}} \frac{S - 2\beta\overline{M} - d}{1-\delta} \right) + \frac{N_h}{N - \overline{M}} \delta W_k(N_k - \overline{M}, N_h).$$

Solving this recursively and reformulating it yields:

$$W_k(N_k - \overline{M}, N_h) = (N_k - \overline{M}) \frac{S - \beta\overline{M} - d + \delta \frac{N_k - \overline{M}}{N - 2\overline{M}} \frac{S - 2\beta\overline{M} - d}{1-\delta}}{N - \overline{M} - \delta N_h}.$$

Putting equal the peace and rebellion payoffs pins down the indifference $\widehat{\lambda}_h$:

$$\widehat{\lambda}_h = (N - \overline{M}) \frac{(N - 2\overline{M})(S - \beta\overline{M} - d)(1-\delta) + \delta(N_k - \overline{M})(S - 2\beta\overline{M} - d)}{(N - 2\overline{M})(N - \overline{M} - \delta N_h)(S - \beta\overline{M})}.$$

The final step is to compute the condition under which h is willing indeed to offer such a $\hat{\lambda}_h$. With peace h obtains:

$$\left(1 - \widehat{\lambda}_h \frac{N_k - \overline{M}}{N - \overline{M}}\right) \frac{S - \beta\overline{M}}{1-\delta}.$$

A deviation to exploitation would yield to h:

$$S - \beta\overline{M} + \delta W_h(N_k - \overline{M}, N_h),$$

where

$$W_h(N_k - \overline{M}, N_h) = \frac{N_h}{N - \overline{M}} \left(S - \beta\overline{M} - d + \delta W_h(N_k - \overline{M}, N_h)\right) + \frac{N_k - \overline{M}}{N - \overline{M}} \delta \frac{N_h - \overline{M}}{N - 2\overline{M}} \frac{S - 2\beta\overline{M} - d}{1-\delta},$$

which becomes, after reformulation:

$$W_h(N_k - \overline{M}, N_h) = \frac{N_h \left(S - \beta\overline{M} - d\right) + (N_k - \overline{M}) \delta \frac{N_h - \overline{M}}{N - 2\overline{M}} \frac{S - 2\beta\overline{M} - d}{1-\delta}}{N - \overline{M} - \delta N_h}.$$

Putting these expressions together, we find after reformulation that peace is sustainable iff

$$R < R_h^{**} \equiv \frac{\begin{array}{c}\beta\overline{M}(N_k-\overline{M})\left((N_h-\overline{M})(1-2\delta(1-\delta))+(N_k-\overline{M})\right)\\ +d\left((N_k-\overline{M})\left((N-2\overline{M})+\overline{M}\delta(1-\delta)\right)+\delta(1-\delta)N_h(N_h-\overline{M})\right)\end{array}}{(1-\delta)(N_k-\overline{M})\left((N-2\overline{M})-\delta(N_h-\overline{M})\right)} - \beta N.$$

Note that one can easily show that there are parameter values for which the interval $[R_h^*, R_h^{**}]$ is not empty: e.g. for the special case of $\delta = 0$ we have $R_j^* \equiv d - \beta N < R_h^{**} \equiv d + \beta\overline{M} - \beta N$.

Now we can also derive the analogous conditions when $\underline{\lambda}$ is binding. In particular, peace is sustainable iff

$$\left(1-\underline{\lambda}\frac{N_k-\overline{M}}{N-\overline{M}}\right)\frac{S-\beta\overline{M}}{1-\delta} > S-\beta\overline{M}+\delta\frac{N_h\left(S-\beta\overline{M}-d\right)+(N_k-\overline{M})\delta\frac{N_h-\overline{M}}{N-2\overline{M}}\frac{S-2\beta\overline{M}-d}{1-\delta}}{N-\overline{M}-\delta N_h},$$

which becomes

$$\underline{\lambda} < L_h^{**} \equiv \delta\frac{N-\overline{M}}{N_k-\overline{M}}\left(1-\frac{N_h\left(S-\beta\overline{M}-d\right)(1-\delta)+(N_k-\overline{M})\delta\frac{N_h-\overline{M}}{N-2\overline{M}}(S-2\beta\overline{M}-d)}{(S-\beta\overline{M})(N-\overline{M}-\delta N_h)}\right).$$

Proof of Proposition 2

(I) The effects of R on the probability of mass killings are obvious, since mass killings are surely avoided only if $R < R_j^*$, defined in (14).

For performing comparative statics with respect to d and β we can reformulate the inequality $R < R_j^*$ as follows:

$$R < \frac{d\left(\begin{array}{c}\frac{N_i}{N}(N-\overline{M}-\delta N_j)\left\{\begin{array}{c}(1-\delta)(N-2\overline{M})(N-\overline{M})\\ +\delta^2(N_i-\overline{M})(N_j-\overline{M})\end{array}\right\}\\ +\delta\left[N-\overline{M}-\delta N_i\right]\left\{\begin{array}{c}(1-\delta)(N-2\overline{M})\frac{N_j}{N}\left[N+N_i-\overline{M}\right]\\ +\delta(N_i-\overline{M})\left[(N_j-\overline{M})+\frac{N_j}{N}(N_i-\overline{M})\right]\end{array}\right\}\end{array}\right)}{(1-\delta)^2(N-2\overline{M})\frac{N_i}{N}(N-\overline{M})^2+\delta^2(1-\delta)(N_i-\overline{M})N_i(N_j-\overline{M})}$$
$$+\beta\left(\frac{\delta\overline{M}\left(\begin{array}{c}(N-\overline{M}-\delta N_j)\frac{N_i}{N}\left\{\begin{array}{c}(1-\delta)N_i(N-2\overline{M})\\ +2\delta(N_j-\overline{M})(N_i-\overline{M})\end{array}\right\}\\ +\left[N-\overline{M}-\delta N_i\right]\left\{\begin{array}{c}(1-\delta)(N-2\overline{M})\frac{N_j}{N}\left[N+N_i-\overline{M}\right]\\ +2\delta(N_i-\overline{M})(N_j-\overline{M}+\frac{N_j}{N}(N_i-\overline{M}))\end{array}\right\}\end{array}\right)}{(1-\delta)^2(N-2\overline{M})\frac{N_i}{N}(N-\overline{M})^2+\delta^2(1-\delta)(N_i-\overline{M})N_i(N_j-\overline{M})} - N\right).$$

The right-hand-side is unambiguously increasing in d, which implies that peace without mass killings is easier to achieve when the destruction costs of war are larger.

The effect of an increase in β is a priori ambiguous, as β multiplies a first, positive and a second, negative term. For high enough δ the first term is always larger than the second (i.e. in the limit when $\delta \to 1$ the first term tends toward infinity), in which case larger β makes peace easier to sustain, as in the unconstraint power case.

Further, the condition for peace is more likely to hold for very patient than for very impatient groups. Given that the condition above contains terms with higher-order polynomials of δ, we cannot express an analytical threshold in terms of δ. However, we can study the limit cases. In particular, in the limit when $\delta \to 1$ the right-hand-side goes towards infinity, and the peace condition always holds. In contrast, when $\delta = 0$, the peace condition simplifies to $R < R_j^* \equiv d - \beta N$, which never holds, as long as $d < S$.

Note that in the limit of $\delta \to 1$ the right-hand-side is also increasing in N and decreasing in N_i/N.

(II) This is the case, as both $\underline{\lambda} < L_h^*$ and $\underline{\lambda} < L_h^{**}$ are more likely to hold for small $\underline{\lambda}$.

(III) In the limit when $\delta \to 1$ threshold R_j^* (and hence the likelihood of peace) is a concave function of $\overline{M}$ and the peace likelihood is at maximum for $\overline{M} = \frac{\beta N - d}{4\beta}$.

Appendix B (Data Description)

This appendix describes the data used in section 6. Table 6 below provides the descriptive summary statistics for all variables.

Variables on the country level

Chief Executive is Military Officer: Dummy variable taking a value of 1 if the chief executive has an officer rank. From Beck et al. (2001), updated version 2007.

Civil War Incidence: Dummy taking a value of 1 when there is a civil war taking place. From Gleditsch and Ward (2007).

Democracy: Polity scores ranging from -10 (strongly autocratic) to +10 (strongly democratic). From Polity IV (2009).

Democratization: (Absolute) change in the democracy scores (cf. above).

Diamonds production dummy: Takes a value of 1 when there is diamond production in a country year, and 0 otherwise. From Lujala, Gleditsch, and Gilmore (2005).

Energy rents: Rents from energy depletion in percent of Gross National Income at market prices. Energy depletion covers crude oil, natural gas, and coal (hard and lignite). Rent = (Production Volume) x (International Market Price - Average Unit Production Cost). From World Bank (2010).

Ethnic Polarization: Continuous measure going from 0 (minimum) to 1 (maximum). From Reynol-Querol (2009).

Forest rents: Rents from deforestation in percent of Gross National Income at market prices. Rent = (Production Volume) x (International Market Price - Average Unit Production Cost). From World Bank (2010).

Fuel exports / GDP: Fuel exports per GDP. The 12 observations (=0.24% of the sample) with values of above 1 have been set to 1. From World Bank (2009).

GDP per Capita: In 1000 US$, at constant US$ (year 2000). From World Bank (2009).

Gold Production Dummy: Takes a value of 1 when there is gold production in a country year, and 0 otherwise. From World Bank (2010).

Mass Killings: Dummy variable taking a value of 1 when mass killings are reported. From Political Instability Task Force (2010). In columns 6 and 7 of Table 3, we make use of the mass killings intensity information contained in this dataset, that distinguishes 11 different intensity levels ranging in steps of 0.5 from 0 to 5.

Mountainous Terrain: Percentage of territory covered by mountains. From Collier, Hoeffler and Rohner (2009).

Oil Production(/GDP): Total value of current oil production (/ GDP). Production quantities and prices from British Petroleum (2009), GDP in current prices from World Bank (2009).

Oil Reserves(/GDP): Current market value of proved reserves (/ GDP). Reserve quantities and prices from British Petroleum (2009), GDP in current prices from World Bank (2009).

Population: In 10 million people. From World Bank (2009).

Population Density: From World Bank (2009).

Total resource depletion: Total rents from energy+mineral+forest depletion in percent of Gross National Income at market prices. Rent = (Production Volume) x (International Market Price - Average Unit Production Cost). From World Bank (2010).

Trade over GDP: Total value of trade divided by total GDP. From World Bank (2009).

Variables on the ethnic group level

Group autonomy grievances index: Variable Autlost from Minorities at Risk (2009). High values correspond to large grievances.

Group co-ethnics abroad: Number of countries in which the same ethnic group also exists. Computed with GIS based on the group boundaries from the "Geo-referencing of ethnic groups" (GREG) dataset (Weidmann, Rod and Cederman, 2010).

Group different language: Dummy taking a value of 1 if an ethnic group speaks another language than the dominant group(s) in society. From Minorities at Risk (2009) (coded as 1 if their variable Lang takes values of 2 or 3).

Group different race: Dummy taking a value of 1 if an ethnic group is of another race than the dominant group(s) in society. From Minorities at Risk (2009) (coded as 1 if their variable Race takes values of 2 or 3).

Group different religion: Dummy taking a value of 1 if an ethnic group has a different religion than the dominant group(s) in society. From Minorities at Risk (2009) (coded as 1 if their variable Belief takes values of 2 or 3).

Group geographic concentration: Corresponds to the ratio of the area where a given ethnic group in a given country is the largest group divided by the total area where the group is present in this same country. Computed with GIS based on the group boundaries from the "Geo-referencing of ethnic groups" (GREG) dataset (Weidmann, Rod and Cederman, 2010).

Group involved in civil conflict: Variable "Incidence" from Cederman, Buhaug and Rod (2009).

Group occupies all its historical homeland: Based on variable gc8 from Minorities at Risk (2009). Dummy taking a value of 1 when gc8 is either 0, 1 or 4, and taking a value of 0 otherwise.

Group's diamond production dummy: Constructed with GIS based on the group boundaries from the "Geo-referencing of ethnic groups" (GREG) dataset (Weidmann, Rod and Cederman, 2010) and the geo-referenced DIADATA dataset on the location of diamonds (from Gilmore et al., 2005).

Group's distance to capital: In 1000 kilometers. From Cederman, Buhaug and Rod (2009).

Group's population / Country population: Group population from Cederman, Buhaug and Rod (2009), country population from World Bank (2009).

Group's satellite light intensity: Average light intensity during night in the ethnic group's territory, measured with the help of meteorologic satellites. Rescaled, such that values range from 0-6.3. This data is from the National Oceanic and Atmospheric Administration (2010). Data on Average Visible, Stable Lights, & Cloud Free Coverages. In particular, we use their "cleaned" and "filtered" version of the data, which "contains the lights from cities, towns, and other sites with persistent lighting, including gas flares. Ephemeral events, such as fires have been discarded. Then the background noise was identified and replaced with values of zero."

Group's share of mountainous terrain: From Cederman, Buhaug and Rod (2009).

Group's soil quality: Part of the group's territory with high-quality fertile soil. Constructed based on the Harmonized World Soil Database (Fischer et al., 2008). Their complete global grid of nutrient availability is ranked from 1 ("no or slight constraints") to 4 ("very severe constraints"), and also including categories 5 ("mainly non-soil"), 6 ("permafrost area") and 7 ("water bodies"). Our dummy takes a value of 1 for categories 1 and 2, categories 3 to 6 get value 0, and category 7 is set to missing.

Mass Killings: Military massacres of suspected rebel supporters (on the group level). From Minorities at Risk (2009), variable Rep22. In columns 1, 3, 4, 5, and 7 of Table 5 coded as dummy, taking a value of 1 when Rep22 equals 1 or more. Coded as 0 in the columns 1-4 of Table 5 for all groups that are not classified as Minorities at Risk.

Percentage of group territory covered with oil and gas: Constructed with GIS based on the group boundaries from the "Geo-referencing of ethnic groups"

(GREG) dataset (Weidmann, Rod and Cederman, 2010) and the location of oil and gas fields from the geo-referenced petroleum dataset (PETRODATA) from Lujala, Rod and Thieme (2007).

Percentage of group territory covered with oil: Constructed with GIS based on the group boundaries from the "Geo-referencing of ethnic groups" (GREG) dataset (Weidmann, Rod and Cederman, 2010) and the location of oil fields from the geo-referenced petroleum dataset (PETRODATA) from Lujala, Rod and Thieme (2007).

Country level variables					
Variable	Obs	Mean	Std. Dev.	Min	Max
Mass Killings (dummy version)	7651	0.035	0.184	0	1
Mass Killings (ordinal version)	7651	0.086	0.513	0	5
Oil production / GDP	5715	0.058	0.151	0	1.213
Energy rents	5246	0.045	0.114	0	1.507
Oil production (in 100 mio. tons)	6440	0.184	0.616	0	5.695
Oil production (in 100 billion US$)	6390	0.053	0.209	0	3.610
Diamonds production dummy	6517	0.185	0.388	0	1
Gold production dummy	8494	0.287	0.453	0	1
Forest rents	5063	0.005	0.016	0	0.201
Total resource depletion	5038	0.052	0.102	0	1.337
Oil reserves / GDP	4138	2.667	10.514	0	212.374
Oil reserves (in 100 billion barrels)	4613	0.061	0.251	0	2.643
Fuel exports / GDP	4642	0.159	0.278	0	1
GDP per capita (in 1000 US$)	6131	5.366	8.202	0.056	59.183
Ethnic polarization	6943	0.517	0.243	0.017	0.982
Democracy	7561	0.151	7.625	-10	10
Democratisation	7312	0.024	1.583	-18	16
Trade / GDP	6076	0.700	0.417	0.015	4.625
Civil war incidence	8494	0.071	0.257	0	1
Chief executive military	5012	0.214	0.410	0	1
Population (in 10 million people)	7059	3.122	11.010	0.011	131.831
Mountainous Terrain	7559	0.176	0.209	0	0.943
Population density	6956	0.125	0.387	0.001	6.660

Ethnic group level variables					
Variable	Obs	Mean	Std. Dev.	Min	Max
Mass killings (dummy version)	11009	0.010	0.100	0	1
Mass killings (ordinal version)	11009	0.026	0.266	0	3
% of group's territory with oil & gas	11009	0.062	0.168	0	1
% of group's territory with oil	11009	0.015	0.085	0	1
Group's diamond production dummy	11009	0.090	0.286	0	1
Group's population / Country population	10390	0.118	0.247	6.3E-08	1
Group geographic concentration	11009	0.950	0.142	0.038	1
Group co-ethnics abroad	11009	2.956	2.522	1	15
Group's share of mountainous terrain	10557	0.356	0.351	0	1
Group's distance to capital	10557	0.727	0.856	0.005	6.513
Group's soil quality	11009	0.703	0.332	0	1
Group's satellite light intensity	11001	0.153	0.388	0	4.870
Group involved in civil conflict	10557	0.038	0.191	0	1
Group different language	1728	0.664	0.472	0	1
Group different race	1738	0.575	0.494	0	1
Group different religion	2760	0.580	0.494	0	1
Group's autonomy grievances	2760	1.206	0.684	0	4
Group occupies all historical homeland	1638	0.333	0.471	0	1

Table 6: Descriptive summary statistics