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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 resources, institutional constraints regarding rent sharing, and low productivity of labor in other sectors. 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.

JEL codes: C73, D74, F51, O12, Q34.

Keywords: Mass Killings, Civil War, Natural Resources, Rent Sharing.

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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 for 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 be determinant to predict mass killing events. We examine whether decisions to exterminate the opponents can be explained as the result of strategic, rational calculation,

[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.

independently of how these decisions had been framed.

A recent case can illustrate the key features of mass killings that we wish to capture: the mass killings in Sudan's Darfur region that started in 2003. 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; De 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;[7] in every period of a potentially infinite time horizon, the group in power decides the sharing of the current surplus (from agricultural or industrial production and from extraction and export of

[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; De 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.

[7] For the main objectives of this paper it is not important whether a group controls power democratically or dictatorially, but we will discuss below the different interpretations of some variables that could be invoked in different regimes.

natural resources) between the two groups; the powerless group can accept such sharing decisions or initiate a rebellion if they wish, aiming to become the group controlling power from the next period onwards; Finally, and most importantly, we allow the group that consolidates power to decide whether to eliminate civilians of the opponent group, focusing on the dynamic incentives.

The decision about how to share the current surplus is constrained by the rebellion outside option (referred to as "endogenous constraint" henceforth), and at the same time there may be international, normative, or institutional constraints (referred to as "institutional constraints" in what follows) against unfair surplus sharing. The degree of (un)fairness with which a minority group is treated in the status quo – as far as surplus sharing is concerned – is the first determinant of the decision to rebel or not against the status quo.[8] The second ingredient for the motivation to rebel in the model is, of course, the potential presence of mass killing incentives by the group in power. While the latter "shadow of mass killings" cause of war is an endogenous trigger of war in all versions of our model, the former trigger of war, the degree of unfairness in surplus sharing, has different effects depending on whether it is determined by the endogenous constraint from relative strength or by some institutional constraint like external pressure or internal norms or checks and balances. Depending on the regime, the population size and relative strength of groups and the relative importance of the different economic sectors, one of these two types of fairness constraints is the binding one for government surplus sharing decisions. We will first analyze a two-period (present and future) truncation of the game in which the surplus sharing exploitation of the minority group finds its binding constraint in some type or another of institutional lower bound on the level of unfairness; we will then extend the model to allow for an infinite horizon and for the consequent realistic possibility of future rebellions, hence giving prominence to the endogenous constraint.

When the binding constraint is an institutional lower bound to the surplus share for minority groups, we find that the likelihood of mass killings is increasing (resp. decreasing) in the share of GDP derived from natural resources (resp. labor intensive production). The elimination of minority members in the present reduces the effects of the institutional 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 exoge-

[8] 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.

nous increase in institutional constraints to unfairness obviously reduces the motivations to rebel; on the other hand, such a change in the institutional constraints affects the calculations in the trade-off mentioned above in the direction of making mass killings more likely.

In the absence of external institutional constraints (or, equivalently, when they are not binding given the equilibrium endogenous constraints), the trade-off involved in the mass killing decision is similar, and can be summarized as follows: on the one hand, a reduction of the size of the opponent group reduces the expected share of the surplus to be given to such group in the future, due mainly to the reduced fighting power and hence reduced outside option threat; on the other hand, the surplus itself will be negatively affected by mass killings, since the murdered civilians can no longer produce output. Hence, we confirm that the larger the windfalls like oil rents with respect to the production from labor, the greater will be at the margin the first of the two effects in the trade-off, leading therefore to a higher likelihood of mass killings. In addition, the dynamic model with endogenous fairness constraints allows us to obtain predictions about expected duration of conflict: in the shadow of mass killings, the groups fight for power precisely to avoid being decimated in case the other group consolidates power, and the expected length of the war is increasing in the degree of polarization, i.e. in the similarity of the population size of the two groups.[9]

Inspired by our theoretical model and by its predictions, we also 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, the ratio of natural resource rents over GDP is found to have a strong and robust positive effect on mass killings. Looking at the separate effects of natural resource rents, GDP and population size, we find that natural resources in absolute value have a strong positive effect on mass killings,[10] while GDP per capita and population tend to have a negative effect on mass killings, as the theory predicts.[11]

Further, we find that ethnic groups are more likely to be massacred if they

[9] Ethnic polarization has been found in the literature to fuel civil conflict (see e.g. Montalvo and Reynal-Querol, 2005; Esteban, Mayoral, and Ray, 2012). We point out that when the minority group is large, the shadow of mass killing in the presence of large natural resources induces the minority group to rebel for a wider set of parameter values with respect to smaller groups, and the duration of conflict is also higher because the more balanced is the groups' fighting strength, the longer it takes in expectation to reach power consolidation by one of the two groups.

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

[11] 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).

are relatively small and resource-rich. This is in line with the conditions in our theory under which the incumbent group is more likely to achieve consolidated power and to have incentives for perpetuating mass killings. In contrast, these findings are less easy to reconcile with alternative mechanisms suggesting for example that oil could 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 the set up of the model and the main assumptions; in section 4 we analyze the two-period version of the model, highlighting in the simplest possible way the main forces when institutional constraints are the binding distribution constraints; in section 5 we consider the infinite horizon version of the model, in which the distribution constraints are endogenous; section 6 highlights the combined theoretical results as well as the implications for the evaluation of various types of external policies; section 7 contains an empirical analysis, and section 8 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 relation with 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 do mass killings, evidently a group needs consolidated power and military strength.[12] A quote from Krain (2000: 43) illustrates this well: "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

[12] The exceptions confirm the rule: rebel groups are responsible for a very small part of mass 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 (Bussmann, Haer and Schneider, 2009). 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).

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). While mass killings are present towards the end or after many guerrilla wars (Krain, 2000; Valentino, Huth and Balch-Lindsay, 2004),[13] there are also sometimes episodes of mass killings perpetrated by the government in the absence of any armed opposition or rebellion. This was for example the case in several communist countries (e.g. Cambodia, China during the Cultural Revolution, Stalinist USSR) or countries governed by military juntas (e.g. Myanmar) where the state controls most of the economy.[14]

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) there were mass killings.[15] This stylized fact is consistent with the logic of our theory, given that the objective of a civil war is to impose a new social arrangement or new social contract, as desired by the ethnic group that rebels[16], while interstate wars do not challenge any status quo *social contract*. There is no supranational government budget to fight for in terms of entitlements or alike, and hence interstate wars take the form of territorial wars.[17]

The importance of power consolidation and internal claims of different groups to present and future resources can both be seen at work in the most well known cases of genocides. One distinctive feature of mass killings that clearly separates this deadly option from other forms of weakening of the opposition group (e.g.

[13] The usual sequence of events is indeed that there is first a civil war and mass killings only take place after victory and once power is consolidated. 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".

[14] There is also a literature on purges of perceived conspirators in dictatorships, which abstracts from rent-sharing between groups, but links for example the changing intensity of Stalinist purges to the quality of information about regime enemies (Gregory, Schröder, and Sonin, 2011) and to external threats (Harrison, 2008).

[15] 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).

[16] To be precise, this is the objective of a "centrist" civil war. Morelli and Rohner (2011) study the distinction between centrist and secessionist civil wars, introducing the role of geography and group concentration, which we do not need to consider in this paper.

[17] Caselli, Morelli and Rohner (2012) display theoretically and empirically the territorial nature of interstate resource wars.

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".[18]

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 of 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 incentives of dominant groups 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). If we allowed in an extended framework for the possibility to invest in repressive power, a state of slavery could emerge in our setting as well for some parameter values. While in the models of Lagerlöf (2009) and Acemoglu and Wolitzky (2011) repression costs are of a magnitude that makes slavery and serfdom possible, we focus in the current paper on situations where the per-period costs of the massive policing needed to destroy all winning chances of a rebelling opposition are prohibitively high, and where consequently the ruler has only the choice between spending a substantial rent share to buy-off the opposition, or alternatively exterminating them.[19]

[18] The Holocaust provides us with the saddest and most well known example that imprisonments, 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, hence with consolidated power over them. 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.

[19] 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, their numerosity, and the absence of crucial natural resources are already three factors that our model would deem sufficient to explain the lack of interest by the ruler in the option of mass killings. As pointed out in the robustness discussion in section 4.3, the mass

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 7 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 existing quantitative literature focuses almost exclusively on the *level* of democracy rather than the *process* of democratization, which according to our model should play a role. 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."[20]

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

killing choice dominates the slavery choice not only when the per period costs of maintaining it are prohibitively high, but also when the non-extraction sectors are particularly unproductive. Hence, the history of Sparta is broadly consistent with our framework.

[20] 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 polatization 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).

killings (Scully, 1997; Bae and Ott, 2008);[21] 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).[22]

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

3 Model Set Up and Main Assumptions

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 first period. There are two sources of wealth to be shared: one is output produced by labor and the other, denoted by R, comes from the exploitation of a natural resource. We assume a rigid labor supply, so that the output of production is $\beta N = \beta(N_i + N_j)$. We can think of $\beta > 0$ as individual productivity determined by education as well as by technology.[23] Hence, the surplus to be shared in the first period is

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

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. To avoid negative payoffs, we assume that conflict does not destroy more than the total surplus, i.e. that $d < S$. We also assume that the probability of victory in case of rebellion is equal to the relative population size of each group, $\frac{N_h}{N}, h = i, j$.[24]

The two policies that a group holding power can choose are: the distribution of the surplus between the two groups, and the elimination of opponents. In all versions of our model, wars are indeed determined by a rebellion against the expected implementation of one (or both) of these policies chosen by the group in power. If the rebels are defeated, the incumbent group sees its power *consolidated*. If the rebels win, they conquer power. If the new ruling group is peacefully accepted next period or smashes a subsequent rebellion, they consolidate the power just conquered. If the new ruler is challenged and defeated, the

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

[22] We focus on large-scale one-sided mass killing 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.

[23] 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.

[24] 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.

winner occupies power again and we go back to the initial situation, and the game continues.

As far as the first of the two policies (i.e. distributive policy) is concerned, we say that the distribution displays a level of fairness $\lambda \geq 0$ if the share allocated to group i is $\lambda \frac{N_i}{N}$. We thus take as a benchmark the nondiscriminatory allocation of the surplus that gives each group its relative population share and measure fairness by the ratio of the actual share to the nondiscriminatory share.

Why should the group in power allow any level of fairness at all? The first reason is that being too abusive may induce the group out of power to rebel. Hence, even after victory, any viable policy that would consolidate her power cannot go beyond making the opposition indifferent between acceptance and rebellion in the future. This establishes a lower bound on the degree of fairness that a viable distributional policy has to display.

The second potential bound on the exploitation of the loser is "institutional". It may come either from the international community imposing sanctions on excessive unfairness of a political regime, or from the checks and balances of a democratic system.

The cap on the possible distributive abuse –caused by whichever of the two constraints just discussed – may make the group in power consider the other policy, i.e. the elimination of opponents. In the model, a ruling group can eliminate any number of members of the subject group, but only when power is *consolidated*: we say that a group has *consolidated power* at the end of a period if either their power was unchallenged during that period or if they were challenged by a rebellion but the rebels were defeated.

In the cost-benefit calculation when a group in consolidated power ponders whether to eliminate opponents or not, on the cost side there is the loss in production, while on the benefit side elimination may yield two types of benefits for the perpetrator:

- the relative size of the own group is increased and this yields a larger share of the —smaller— cake for any fairness level; and
- the opponents, being fewer, become a lesser threat of future rebellion and this permits the group in power to be more abusive in the distribution of the surplus in the future if the binding constraint to unfairness is the endogenous constraint.

In order to provide a clear explanation of the forces at work we shall analyze these two sources of potential benefits sequentially. Whether a larger share of a smaller cake might be profitable to the group in power for any fairness level can be understood with a two-period model with exogenous fairness λ. Then we shall extend the model to a fully dynamic game in order to capture the effect of the reduced threat of future rebellions on the endogenously determined equilibrium fairness of the surplus distribution.

4 Two-Period Game

We consider first a game with two periods, present and indefinite future. The variables without a time subscript relate to the initial (present) period, which will be denoted as time 0 in the dynamic model of the subsequent section.

4.1 Description of the two-period game

In this section we consider an exogenous surplus sharing rule in case of peace, with fairness level λ. The only decision for group j (if they manage to consolidate power) is the number of opponents to eliminate at the end of the first period. We will denote the number of opponents eliminated by group j if j consolidates power by $M^j \in [0, N_i]$. The reduction of group i's size down to $N_i - M^j$ will affect production in the future, which will be reduced by βM^j.[25]

Anticipating the incentives of group j in terms of elimination strategy, group i can either accept their fate or rebel. By accepting, group i obtains a present value payoff of

$$U_i^a = \lambda \frac{N_i}{N} S + \delta \lambda \frac{N_i - M^j}{N - M^j} \frac{S - \beta M^j}{1 - \delta}, \tag{1}$$

where $\delta \in [0, 1]$ is the time discount factor. In the initial period group i receives $\lambda \frac{N_i}{N} S$; however, if i accepts peacefully the power relation, at the end of the first period group j has the feasible choice to eliminate members of group i, which is why the second term representing the continuation value has $N_i - M^j$ instead of N_i.[26]

If group i rebels, they win with probability $\frac{N_i}{N}$. If i wins, the present payoff of group i is $S - d$ —where d is the aggregate cost of conflict; while the payoff for the indefinite future is $(1 - \lambda \frac{N_j}{N}) \frac{S}{1-\delta}$. If group i is defeated, group j retains $S - d$ in the present and proceeds to the choice of M^j. Therefore, by rebelling group i obtains an expected payoff of

$$U_i^r = \frac{N_i}{N} \Big[(S - d) + \delta \big(1 - \lambda \frac{N_j}{N}\big) \frac{S}{1 - \delta} \Big] + \frac{N_j}{N} \delta \lambda \frac{N_i - M^j}{N - M^j} \frac{S - \beta M^j}{1 - \delta}. \tag{2}$$

The payoffs of group j are, respectively:

$$U_j^a = \big(1 - \lambda \frac{N_i}{N}\big) S + \delta \big(1 - \lambda \frac{N_i - M^j}{N - M^j}\big) \frac{S - \beta M^j}{1 - \delta} \quad \text{if } i \text{ accepts, and} \tag{3}$$

[25] Given that we assume that the elimination of the opponents can be organized from consolidated power only, in this section – where there are only two periods – the initially powerless group will never have the opportunity to commit mass killings, but in the dynamic version the situation will be symmetric. Hence the complexity of the dynamic extension comes from two sources, namely the possibility for both groups to have mass killing incentives and the endogenization of λ.

[26] As highlighted in the sixth *thesis* on ethnic cleansing by Mann (2005), mass killings and forced displacements occur most frequently at the end of wars. We chose this sequential structure but similar results can be obtained if one adds the possibility of simultaneous fighting and civilian targeting.

$$U_j^r = \frac{N_j}{N}\Big[(S-d) + \delta\big(1-\lambda\frac{N_i - M^j}{N - M^j}\big)\frac{S-\beta M^j}{1-\delta}\Big] + \frac{N_i}{N}\delta\lambda\frac{N_j}{N}\frac{S}{1-\delta}, \quad (4)$$

if i rebels.

We are interested in the *Subgame Perfect Equilibrium (SPE)* of this game.

4.2 Equilibrium analysis

We start by solving for the optimal M^j in case player j is still in power at the end of the first period —either because i has accepted the status quo or because her rebellion has been defeated— and hence has to choose $M^j \in [0, N_i]$ to maximize

$$\delta\big(1-\lambda\frac{N_i - M^j}{N - M^j}\big)\left[\frac{S-\beta M^j}{1-\delta}\right]. \quad (5)$$

This maximization captures the basic static trade-off: reducing the population size of group i has positive payoff consequences for group j through the round parenthesis (reduction of the share going to the other group) but a negative effect through the square bracket (reduction of total surplus). The maximand is convex in M^j, hence $M^j = N_i$ or 0, where the first corner (elimination) is chosen iff $\lambda > \lambda^o \equiv \frac{\beta N}{\beta N + R} = 1 - \frac{R}{S}$.[27]

Lemma 1 *The best strategy for player j is to choose $M^j = N_i$ if $\lambda > \lambda^o$, and $M^j = 0$ if $\lambda \leq \lambda^o$.*

This Lemma establishes the relationship between the composition of the surplus and the degree of fairness that makes the elimination of the opponent the preferred strategy by the group in power. For any given composition of the surplus, if the exogenous fairness constraint λ is too high, annihilation of the opponent becomes desirable. The intuition is straightforward: the fairer to minorities are the institutions, the smaller the benefit from controlling the distribution. Hence, the only possible way for the group in power to increase their surplus share is by reducing the number of opponents.

The larger is the share of GDP due to resource rents, the lower is the cost of mass killings in terms of the loss of future production coming from a reduction in the labor force. On the other hand, in economies that are poor in natural resources or with a high level of technological development – large β— the model predicts that we should not observe killings of civilian population for the opposite reason. Note that the condition for no mass killings in Lemma 1 can be rewritten as $(1-\lambda)S > R$. This inequality means that the group in power will refrain from exterminating the opponents if the exogenous level of fairness is sufficiently low to allow them to appropriate also part of the surplus produced by the subjected group i. If the benefit to the ruler from production is less than

[27] These incentives for complete elimination of the opponent are illustrated well by the following quote of Thomas Jefferson (taken from Mann, 2005: 70): *"If ever we are constrained to lift the hatchet against any tribe, we shall never lay it down till that tribe is exterminated, or driven beyond the Mississippi."*

the non-produced rent R, then the elimination of the opponent will increase the surplus they can appropriate.

We now solve for the optimal strategy by player i at the beginning of the game as a function of λ. By inspection of (1) and (2) it can be easily verified that the value of λ that makes group i indifferent between accepting the situation and rebelling is lower when M^j is expected to be equal to zero than when it is expected to be equal to N_i. Denoting the former indifference threshold by λ^* and the latter by λ^{**}, they are:

$$\lambda^* \equiv 1 - \frac{(1-\delta)d}{S}$$

and

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

We define a country or situation as *resource rich* (respectively, *resource poor*) if and only if the present value of resource rents $\frac{R}{(1-\delta)}$ is greater than (respectively, less than or equal to) the destruction costs d.[28]

Note that $1 - \frac{(1-\delta)d}{S} = \lambda^* < \frac{1-\frac{(1-\delta)d}{S}}{1-\frac{\delta N_i}{N}} = \lambda^{**}$ always holds. Further, $\frac{R}{(1-\delta)} > (\leq) d$ implies that $\lambda^o = 1 - \frac{R}{S} < (\geq) 1 - \frac{(1-\delta)d}{S} = \lambda^*$. With these bounds in mind, and noting that the maximum feasible value of λ is $\frac{N}{N_i}$, we can establish the following result:

Proposition 1 *1. In resource rich economies, $\lambda^o < \lambda^*$ must hold, and it is impossible to avoid both civil war and mass killings. Specifically:*

*(a) **(Civil war with no mass killings)** Any exogenous constraint $\lambda \leq \lambda^o$ will induce no mass killings but there will be war in the first period;*

*(b) **(Civil war plus mass killings)** Any exogenous constraint $\lambda \in (\lambda^o, \min\left\{\lambda^{**}, \frac{N}{N_i}\right\})$ will induce group i to rebel, hence the equilibrium will display civil war and, in case of victory of group j, mass killings;*

*(c) **(Mass killings alone)** Any exogenous constraint $\lambda \in [\lambda^{**}, \frac{N}{N_i})$ will induce group i not to rebel in spite of the looming expectation of mass killings.*

2. In a resource poor economy $\lambda^o \geq \lambda^*$ must hold, and the equilibrium behavior depends on the exogenous fairness constraint λ in the following way:

[28] Countries vary in R as much as in d. A country with large amounts of natural resources but also a very large cost of a one-period decisive conflict may count, in this classification, as resource poor. Clearly, if a country has lots of oil but the rest of the country is desert, the destruction cost d is low, making the country count for sure as resource rich; but in a country with the same amount of oil but a very developed country surface, the destruction costs may outweigh the value of resource rents to fight over.

(a) ***(Civil war with no mass killings)*** *Any exogenous constraint* $\lambda < \lambda^*$ *will induce no mass killings but there will be war in the first period;*

(b) ***(Peace)*** *Any exogenous constraint* $\lambda \in [\lambda^*, \lambda^o]$ *will induce no rebellion and no killings;*

(c) ***(Civil war plus mass killings)*** *Any exogenous constraint* $\lambda \in (\lambda^o, \min\left\{\lambda^{**}, \frac{N}{N_i}\right\})$ *will induce group* i *to rebel, hence the equilibrium will display civil war and, in case of victory of group* j*, mass killings;*

(d) ***(Mass killings alone)*** *Any exogenous constraint* $\lambda \in (\max\{\lambda^{**}, \lambda^o\}, \frac{N}{N_i})$ *will induce group* i *not to rebel in spite of the looming expectation of mass killings.*

To see that 1.b and 1.c must hold, note that, given lemma 1, when $\lambda > \lambda^o$ the expected payoff for i from accepting a distribution of surplus according to the fairness level λ is

$$U_i^a(\lambda > \lambda^o) = \lambda \frac{N_i}{N} S,$$

while rebelling yields

$$U_i^r(\lambda > \lambda^o) = \frac{N_i}{N}\left[S - d + \delta\big(1 - \lambda\frac{N_j}{N}\big)\frac{S}{1-\delta}\right].$$

Hence, we can easily obtain that

$$U_i^a > U_i^r \iff \lambda > \frac{1 - \frac{(1-\delta)d}{S}}{1 - \frac{\delta N_i}{N}} = \lambda^{**}.$$

Given that $\lambda^o < \lambda^{**}$ in resource rich economies, 1.b and 1.c follow, where the latter simply says that if the lower bound on the share of surplus for the group out of power is very large, then group i has the incentive to avoid civil war even though in the future the group in power will have the incentive to kill them.[29]

For $\lambda < \lambda^o$ (part 1.a), inspection of the analogous utility comparison between accepting and rebelling yields the condition

$$U_i^a > U_i^r \iff \lambda > 1 - \frac{(1-\delta)d}{S} = \lambda^*.$$

Given that in the resource rich case $\lambda^o < \lambda^* < \lambda^{**}$, any $\lambda \leq \lambda^o$ is also less than λ^*, and hence the above condition for acceptance versus rebellion implies that if the distribution of surplus conforms to a fairness level λ then war must occur even if no shadow of mass killings exists. Finally, note that region 1.c ("Mass killings alone") can be an empty set.[30]

[29] If the fear of future elimination were fear of displacement rather than killing, the range of parameters corresponding to 1.c would be larger, but qualitatively the analysis would be identical.

[30] In particular, region 1.c does not exist when $\lambda^{**} > \frac{N}{N_i}$, which corresponds to $d < \left(\delta - \frac{N_j}{N_i}\right)\frac{S}{1-\delta}$. Intuitively, when fighting costs are low enough, there will always be rebellion under the shadow of future extermination.

Regions 2.a-2.d are obtained analogously, with the difference that in resource poor economies $\lambda^o \geq \lambda^*$ holds. Note that regions 2.c or 2.d may be empty sets.[31]

In resource poor economies the complete absence of both war and mass killings is possible, as for intermediate levels of fairness λ the ruler has not enough incentives to annihilate the opponent and the group out of power does not have enough incentives to rebel based on distribution. However, it continues to be true even in resource poor economies that high λ induces mass killings, whereas conflicts without the shadow of mass killings are induced by a low λ.[32]

Whether a region of fairness values exists such that we have neither civil war nor mass killings depends on the values of the other exogenous variables, and the proposition points out that the most important variable is the relative value of natural resources. The interplay of R and λ in determining the regions of mass killings and civil war is displayed graphically in Figure 1, where the functions λ^o, λ^* and λ^{**} are drawn in the space (R, λ).[33]

Further comparative statics results can be obtained with respect to cost of conflict, population size, and productivity of labor. In particular, a large cost of conflict d lowers both thresholds λ^* and λ^{**}, and can make rebellion prohibitively costly.

An increase in the total population size N (for constant population shares N_i/N and N_j/N), increases all thresholds λ^o, λ^* and λ^{**}. Hence, in more populated societies we expect ceteris paribus more civil wars, but less mass killings. As discussed in section 7, this prediction is in line with our empirical results and the existing literature.

Also the relative population sizes matter. For a given total population N, the relative size N_i/N of group i increases threshold λ^{**} (while neither affecting λ^o nor λ^*), which means that under the shadow of mass killings larger powerless groups are more likely to rebel than smaller powerless groups.

Finally, β, the productivity of labor, raises all thresholds λ^o, λ^* and λ^{**}. While the larger size of the cake at the one hand induces bigger incentives for rebellion, on the other hand it curbs the appetite for mass killings, due to the large production loss.

4.3 Robustness discussion

Before turning to the infinite horizon game with endogenous λ, let us briefly discuss the robustness of the main insights of this section to changes in some of the simplifying assumptions.

[31] In particular, when fighting costs are prohibitively high ($d > \frac{R+\delta\beta N_i}{1-\delta}$) region 2.c does not exist, while for very low fighting costs ($d < \left(\delta - \frac{N_j}{N_i}\right)\frac{S}{1-\delta}$) region 2.d is an empty set. For intermediate d all regions exist.

[32] These results point to a potentially general dilemma in terms of policies to be considered by third parties interested in fairness and peace: any policy pressing for high levels of fairness may increase the likelihood of mass killings, but excessively unfair distributions of rents make rebellion desirable. We will collect all the implications of the model, in all its versions, in terms of third party policies in section 6.

[33] For this figure, the following parameter values have been used: $N = 1$, $\beta = 0.5$, $d = 0.8$, $\delta = 0.5$, and $N_i = 0.5$.

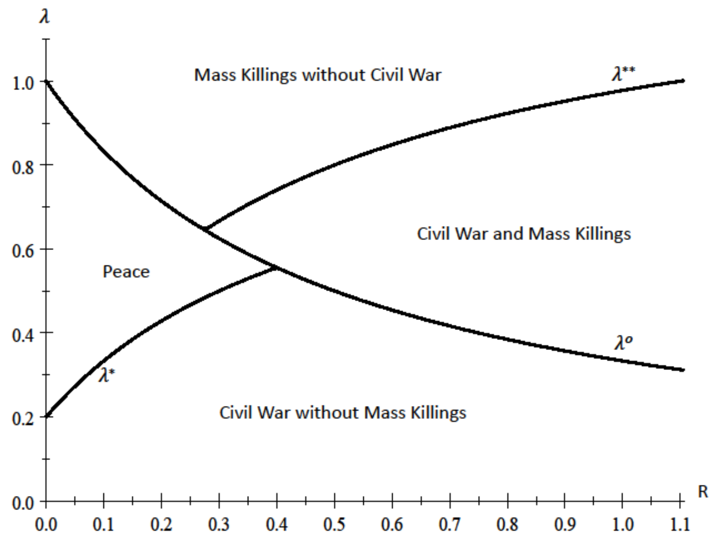

Figure 1: Regions of mass killings and civil war

First of all, in order to focus on the determinants of the mass killings choice, we have assumed a fixed λ in both periods. However, while in the second period of a two-period game there is no reason for a group in power to give to the other group a share greater than the institutional lower bound determined by λ, we could allow the group in power to buy peace in the first period with a $\lambda^j > \lambda$ if they wish to do so. The analysis of such a setting is equally simple, and the results only change quantitatively, but not qualitatively.[34]

Second, we have assumed for simplicity that mass killings have only opportunity costs (the cost of lost labor force in the future), but no direct costs (neither psychological nor physical nor in terms of third-party punishment). If we assume that there is an upper bound $\bar{M} < N_i$ to the amount of mass killings that group j can perpetrate when they reach consolidated power, the analysis is unchanged: convexity of the maximand for group j in consolidated power continues to hold, and hence, while the expression for λ^o is different, it continues to be true that the mass killing corner $M^j = \bar{M}$ is chosen in economies with high R/β. If perpetrating mass killings involves also direct costs $c(M^j)$, with $c' > 0$ and $c'' > 0$, then, for sufficient convexity of the direct cost function, an interior solution could arise, but the comparative statics with respect to R/β would be

[34] Note that the mass killings threshold λ^o and lemma 1 remain unchanged. Second, in the first period the group in power would always offer –when feasible– a λ^j that barely buys the minority group off. The characterization of proposition 1 still applies, but with quantitatively different thresholds λ^* and λ^{**}.

unchanged.[35]

The third important robustness remark is that the key comparative statics with respect to natural resource rents and productivity would continue to hold even if one wanted to enrich the strategy space by allowing for repression or slavery. The easiest way to include slavery in the two-period model would be the following: Assume that selecting slavery is only part of the choice set of the group in consolidated power. This means that the choice of slavery arises exactly in the same circumstances when mass killings are feasible. In our two-period game this can only arise when group j consolidates power at the end of period 1. Assuming that enslaving the powerless group entails giving them only the per capita subsistence amount $\underline{\beta} < \beta$, and assuming that enforcing slavery entails a per period cost z, mass killings continue to be the preferred option for $\lambda > \lambda^o$ as long as

$$(\beta - \underline{\beta})N_i < z.$$

Intuitively, in a country where the surplus production from the slaves is smaller than the repression costs of maintaining slavery (for example because the baseline productivity β is already very close or below subsistence), the elimination strategy dominates the slavery option. When $\lambda \leq \lambda^o$, slavery is preferred to peace if and only if $\lambda \frac{N_i}{N} S > \underline{\beta} N_i + z$. When slavery is selected at the end of the first period, then the indifference threshold between rebellion and accepting the status quo is

$$\lambda^{***} \equiv \frac{1 - \frac{(1-\delta)d}{S} - \frac{\delta \underline{\beta} N_i}{S}}{1 - \frac{\delta N_i}{N}}.$$

Given that it can be easily shown that $\lambda^* < \lambda^{***} < \lambda^{**}$, the analysis could be extended to characterize the conditions for slavery with very similar details to those of Proposition 1. However, in order to avoid carrying around too many cost parameters, we have opted to leave the slavery option out of the picture, which is equivalent to assuming that z is high.

As a final observation, we have assumed that the second and last period is different from the first, in that whoever is in power does not have a second opportunity to enact elimination of opponents. This is just for the sake of simplicity of the basic argument, and the dynamic section will now show that the arbitrary truncation of this static model is inconsequential for the main results, which extend to the fully dynamic game in which all periods have the same action spaces and λ is endogenous. As we will see, in resource poor economies we will obtain peace as a much more likely outcome when λ is endogenous.

[35] The introduction of a concave production function due to decreasing returns from labor, for sufficient concavity, could also determine an interior solution to (5). However, once again, the logic behind the key role of natural resources would not change, because R enters only in the square bracket of (5), and the larger it is, compared with the productivity costs, the larger will be the incentives to eliminate opponents, regardless of whether this means going to the corner or simply having a marginal effect on an interior solution.

5 Dynamic Game

The dynamic game is identical to the one described in the previous section, except that it is now infinitely repeated and the degree of fairness becomes a strategic choice. The shadow of future rebellions forces groups to display a minimum degree of fairness in the distribution of the surplus. Thus, λ will now denote an endogenous variable. To be clear, in this section we assume that there is *no* institutional exogenous constraint to unfairness, or that no such constraint is binding, hence the only determinant of λ is the dynamic consideration just mentioned.[36]

Notice that in the dynamic game the elimination of opponents plays an additional role with respect to the two-period model: the reduction of the population size of the opponent also diminishes their future win probability in case of rebellion. Thus, the elimination gives a permanent advantage over the opponent and hence permits to obtain additional gains via a lower fairness constraint.

5.1 Description of the dynamic game

Let S_t be the aggregate surplus to be allocated by the group in power at time t. Hence

$$S_t = \beta(N_{it} + N_{jt}) + R,$$

where the non-produced rent is assumed to be constant through time and N_{ht} is the population size of group $h = i, j$ when entering period t.

We will assume that the group in power at the beginning of each period t makes a take-it or leave-it offer to the other group on how to share the surplus of the current period and potentially plans elimination in case of consolidated power. Formally, the strategic choice by group h in power when entering period t consists of the pair (λ_t^h, M_t^h), where $M_t^h \geq 0$ denotes the number of people from the rival group that h in power plans to eliminate in this period in case of no rebellion or if rebellion is smashed. Hence, if group j is in power and i does not rebel, or rebels but loses, $N_{i(t+1)} = N_{it} - M_t^j$. Surplus in $t+1$ will obviously differ from surplus at time t if $N_{i(t+1)} < N_{it}$. Finally, λ_t^h is the level of fairness used by h in power when distributing the surplus in case of no rebellion. In other words, if the distribution of surplus planned by group h in power displays fairness λ_t^h, a peaceful group k receives a total current surplus share of $\lambda_t^h \frac{N_{kt}}{N_t} S_t$. As before, in case of rebellion the winner appropriates the entire surplus S_t minus the loss d.

We thus have an infinitely repeated game. At every period t, the state variables are (N_{it}, N_{jt}, h_t): the population size of the two groups and the identity of the group in power. We are now ready for a formal description of the time line of the game.

1. At the accession to each period t, characterized by the state N_{it}, N_{jt}, h_t, output is produced.

[36] In Section 6 we will discuss what effects a binding institutional constraint has in the dynamic game.

2. The group in power ($h_t = i, j$) selects its distribution proposal and elimination plan (λ_t^h, M_t^h).

3. Group $k \neq h$ decides whether to accept the (explicit or implicit) plan or rebel.

   (a) If k accepts, then (λ_t^h, M_t^h) are implemented. Therefore, the allocation of the current surplus to groups k and h is $\lambda_t^h \frac{N_{kt}}{N_t} S_t$ and $\left(1 - \lambda_t^h \frac{N_{kt}}{N_t}\right) S_t$, respectively. The elimination of M_t^h members of group k takes place before entering period $t+1$.

   (b) If k opts for conflict, Nature chooses group k as winner with probability $\frac{N_{kt}}{N_t}$, and h is the winner with the remaining probability. The winner receives the entire net surplus, $\beta N_t + R - d$, while the loser receives zero. Then if h_t keeps power she implements $M_t^h \in [0, N_{kt}]$, whereas if $k \neq h_t$ is the winner she takes over power and we move immediately to the beginning of next period.

4. Period $t+1$ begins with surplus $S_{t+1} = \beta(N_{i(t+1)} + N_{j(t+1)}) + R = S_t - \beta M_t^h$, $M_t^h \geq 0$, and the game restarts with group h_{t+1} in power selecting its distribution and the level of mass killings to be implemented at the end of period $t+1$ if power is consolidated.

5.2 Equilibrium analysis

We look for *Markov Perfect Equilibria (MPE)* with strategies depending exclusively on the current state.

From one period to the next, the state can either remain the same (i.e., same group in power and same population sizes), or, if it changes, it changes either in terms of the population size of the group not in power, or in terms of who is the group in power. It is not possible, given the timing of the game, to have both state variables change from one period to the next.

The continuation value at time t for player $k = j, i$ from any state in which the group in power is $h = i, j$ will be denoted by $V_k^h(N_{it}, N_{jt})$. Consistent with the two period model, we assume without loss of generality that in the initial period group j is in power, i.e., $h_0 = j$.

Lemma 2 *Suppose that for some group h that is in power at time t it is never optimal to do mass killings. Then there is permanent peace from time t on, and the opponent group receives a share that makes her indifferent between peace and conflict.*

The proof (see appendix A) consists of two steps: showing first that there always exists a feasible $\hat{\lambda}^j$ that can make group i indifferent between rebelling and not rebelling, regardless of whether group i is itself interested or not in committing mass killings when conquering power; second, showing that group j

is indeed better off choosing $\hat{\lambda}^j$ rather than choosing a lower fairness level and thereby triggering conflict.

The following lemma, proven by contradiction in Appendix A, will also be helpful for the subsequent analysis:

Lemma 3 *(I) Each group can make mass killings at most once on an equilibrium path.*

(II) If $M_t^h > 0$ for some t on the equilibrium path, then such a group concentrates such action at the end of the first period in which it is still in power at the end of the period — the first period of consolidated power on the path.

Lemmas 2 and 3 imply that on the equilibrium path if there is a group that commits mass killings it does so the first time it conquers and keeps power, after which period it will make a distributive choice that grants peace thereafter.

Proposition 2 *(I) In resource poor economies, i.e., if $\frac{R}{(1-\delta)} \leq d$, the unique equilibrium involves eternal peace and no killings: $h_t = j \ \ \forall t = 0, 1, ...,$ $N_{kt} = N_k \ \ \forall t = 1, ...$ $(k = i, j)$, and $\lambda_t^j = 1 - \frac{(1-\delta)d}{S} = \lambda^* \ \ \forall t = 0, 1, ...$.*
(II) In resource rich economies, i.e., if $\frac{R}{(1-\delta)} > d$, on the equilibrium path there must be mass killings of maximum intensity at the earliest occasion of consolidated power. Before that, there will be rebellion by whoever is the powerless group in every period if and only if $\delta \geq \delta^*$, where $0 < \delta^* < 1$ (threshold δ^* defined in Appendix A). For $\delta < \delta^*$, the powerless group may accept future extermination without rebeling.

The proof (see Appendix A) proceeds along the following steps: Given that the lemmas 2 and 3 imply that if mass killings occur they occur the first time that there is power consolidation, let M_t^j be the mass killing level chosen at time t, t being the time of first power consolidation; given any value M_t^j, we can solve recursively for the *subsequent* endogenous fairness level, which turns out to be

$$\hat{\lambda}^j(M_t^j) = 1 - \frac{(1-\delta)d}{S - \beta M_t^j}$$

assuming that group i is not interested in perpetrating mass killings conditional on conquering power. Plugging this $\hat{\lambda}^j$ in the expression for the utility maximand for group j at time t when they have to make the mass killing choice, such a maximand $U_j^j(N_i - M^j, N_j)$ is decreasing whenever $\frac{R}{(1-\delta)} \leq d$ and increasing whenever $\frac{R}{(1-\delta)} > d$. Thus, selecting $M^j = 0$ is optimal whenever $\frac{R}{(1-\delta)} \leq d$, and since this condition does not depend on group sizes, it also applies to i off the equilibrium path. Hence λ^* and no killings is an equilibrium in resource poor economies.

For resource rich economies the first step is an *a fortiori* argument: if $\frac{R}{(1-\delta)} > d$ induces mass killings under the assumption that $M^i = 0$ off the equilibrium path, then *a fortiori* the implication follows if $M^i > 0$ is expected off the equilibrium path. The last step is then the characterization of the area of parameters where civil war plus mass killings occur versus mass killings alone.

In line with lemma 1, proposition 2 confirms that whenever it pays to a group to do mass killings, it is optimal to go all the way and exterminate the opponent. Proposition 2 also tells us that when there is natural resource abundance relative to destruction costs, $\frac{R}{(1-\delta)} > d$ (the same condition as in the two period model), violence of one kind and/or another cannot be avoided in all periods. One path that constitutes an equilibrium for sufficiently high δ has conflict at the start, and the group that eventually manages to consolidate its power proceeds to the elimination of the opponent. Moreover, in resource rich economies there is no way to avoid the mass killings, since they occur also on the equilibrium path when the powerless group remains peaceful.

Given that the powerless group cannot commit not to attack or rebel in the future, the fairness level in a peaceful equilibrium continuation path is bounded from below by the indifference condition that keeps the opposition from rebelling. Lower fairness levels than that would not be sustainable. For this reason, any peaceful equilibrium must display a fairness level of exactly $\lambda^* = 1 - \frac{(1-\delta)d}{S}$, the indifference threshold for the opposition group. As the cost of conflict goes down or the present value of resource rents increases, the peaceful equilibrium fairness level λ^* keeps increasing, until we reach the resource-rich threshold, at which point the peaceful equilibrium is no longer sustainable.

5.3 Discussion

One of the main assumptions in our model is that civilian mass killings can be perpetrated exclusively by groups holding consolidated power. Our motivation is in part empirical (see discussion and citations above) and in part theoretical, based on the objective to separate the incentives to go to war from those to eliminate opponents.

If we removed the assumption that the ability to perpetrate mass killings depends on consolidated power, there would be only two possibilities: either the group in power can do them right away when conquering power or, even more extreme, even the group out of power can do them, and in both cases mass killings can occur in any period. Let us discuss these two cases separately:

1. The case in which only the group in power can kill but can do it even without the power consolidation condition: This modification would not alter the main results about the role of natural resource rents and cost of conflict of our model in terms of mass killing likelihood. However, it could not generate any implication in terms of duration of conflict nor in terms of the role of population size of groups, because when R is large the prediction would simply be that whoever is in power at the beginning kills the other group and that is it, whereas by assuming that consolidation of power is necessary we obtain a potentially long fight, and both the length of expected fight and the probability that mass killings are committed by one group or the other depend on relative size rather than depending

on initial state. Hence our assumption of power consolidation allows to generate more testable implications. Of course, allowing for stalemates could also generate similar predictions on duration.

2. The other alternative, i.e. letting all groups kill whenever they want, should determine once again the same prediction in terms of R, but would predict *total killing*, or *Armageddon*, which we never observe: Empirically we *never* observe mutual extermination of both groups.

6 Combined results and policy implications

In the last two sections we have analyzed separately the case of a fixed institutional constraint to unfairness and the opposite case in which the equilibrium level of fairness is endogenously determined by the threat of rebellion. We can now derive the combined results, which obviously depend on which constraint is binding.

For resource poor economies, proposition 1 and proposition 2(I) can be combined to obtain the following corollary:

Corollary 1 *In a resource poor economy, i.e. where* $\frac{R}{(1-\delta)} \leq d$*, there is violence (war plus mass killings or mass killings alone depending on parameter configurations)* if and only if *there are exogenous institutional constraints that force* λ *to be greater than* λ^o*. If* $\lambda \leq \lambda^o$*, the equilibrium peaceful fairness level is equal to* $\max\{\lambda, \lambda^*\}$*, i.e., whichever is the binding constraint.*

To see that this holds, note first that all exogenous constraints $\lambda < \lambda^*$ must be irrelevant, as offering at least λ^* is required for assuring peace. Further, it can be easily shown that for exogenous constraints $\lambda > \lambda^*$, the mass killings maximand continues to be convex, yielding the same threshold λ^o as in the two-period model. Given that in a resource poor economy it must always be the case that $\lambda^* \leq \lambda^o$, it will always be possible to guarantee peace if it is possible to buy off the powerless group by offering some fairness level below λ^o, which is always feasible as long as $\lambda \leq \lambda^o$.

About resource rich economies, propositions 1 and 2(II) convey a common message, namely that violence is unavoidable. Besides the differences in terms of the conditions determining whether war plus mass killings or mass killings alone can emerge, a substantial difference is that in the presence of endogenous constraints the characterization of equilibrium with $\lambda < \lambda^*$ becomes irrelevant, and hence we can state the following combined corollary:

Corollary 2 *In a resource rich economy, i.e. with* $\frac{R}{(1-\delta)} > d$*, the group in power has always incentives to exterminate the opponent at the earliest occasion,* $M^j = N_i$*, regardless of institutional constraints.*

To see this, recall that in a resource rich economy $\lambda^o < \lambda^*$. Thus, unlike in proposition 1 the possibility of a war without the shadow of mass killings does not arise when also the endogenous constraint is present, because the binding constraint is intuitively at least $\lambda^* > \lambda^o$.

A third observation that can be derived from the comparison of the two models relates to the role of population size. Proposition 2 tells us that whether or not there will be mass killings conditional on consolidating power is independent of population size. Only the importance of the present value of the non-produced rent relative to the one-shot cost of conflict matters for this conditional statement. However, conditional on conflict, the expected conflict duration is increasing in polarization (as with close to equal winning chances power consolidation takes longer on average) and constant in population size. Further, larger groups are more likely to manage power consolidation and to exterminate the opponent.

Note that in the presence of a binding institutional constraint the roles of total population and productivity are re-established in the dynamic model as well, with λ^o being increasing in population and productivity, and hence mass killings being less likely in more populous and productive societies.

To summarize, our results from the static and dynamic versions of the model robustly show that: (1) mass killings are more probable in societies that base their surplus on natural resources; (2) if they happen there is a robust incentive to go for large scale mass killings; (3) given the endowment of resources generating a rent, the higher the development of the productive sector the more unlikely there will be mass killings; (4) larger total populations should induce less mass killing incentives, but tend to make rebellion more likely;[37] (5) length of conflict increases in polarization, and smaller groups are on average more likely to lose and face extermination; (6) finally, the lower the cost of conflict, the more likely there will be mass killings and civil war.[38]

With our theoretical findings in mind, before moving to the empirical analysis of the determinants of mass killings, it is important to lay out some basic implications of our model for the external evaluation of alternative policies aimed to minimize violence.

In our model there are at least five possible channels through which external intervention may have an effect on equilibrium behavior. The first one is the type of interventions geared to increase the cost of conflict, d; a second type is the threat of military intervention in case mass killings exceed some cap $\overline{M}$; the third type one could consider is the imposition of a minimum level of fairness in treating the opposition; fourth, the establishment of an international embargo on the products of the country in question can be considered; finally, the international community could try to influence the general economic productivity of the country in question, namely affecting the productivity parameter β.

[37] As shown above, in the static model this is unambiguous. As can be seen from Appendix A, under mild conditions this continues to hold even in the dynamic model.

[38] Looking at the dynamic setting's comparative statics, with a smaller d there is unambiguously a higher likelihood of war plus mass killings (in Appendix A it can be easily seen that it unambiguously holds that $\partial\lambda^{\dagger j}/\partial d < 0$, $\partial\lambda^{\dagger i}/\partial d < 0$, $\partial\lambda'^{j}/\partial d > 0$ and $\partial\lambda'^{i}/\partial d > 0$). Notice that the effect of the cost of conflict has a twist. What creates the incentives for the extermination of the opponent is the fact that, being cheap for the opponent to go to conflict, the threat of future rebellions would prevent the ruler from appropriating much of the surplus.

1. *Policies aimed at raising d.* Suppose the country is in conflict under the shadow of mass killings, and the international community coordinates in order to increase d. A higher cost of fighting d will curb both the incentives for rebellion and for mass killings. In particular, a large enough increase in d will stop mass killing incentives, but at the cost of some unfairness in the distribution of the rents. As the cost of conflict becomes even larger, then the distribution will become increasingly unfair. If the community is also interested in fairness, the cost should probably be brought to the point in which the government is just indifferent to the extermination of the opponent.

2. *Policies aimed at tightening the upper bound $\overline{M}$ on mass killings.* If there exist policies (and not too costly of course) to tighten $\overline{M}$ as a total constraint, the effect would be to unambiguously reduce the scope for mass killings.[39] However, if the only policies available of this kind can limit only the per-period killings, such policies would have the implication that mass killing incentive would not necessarily disappear after a mass killing event, and the dynamic analysis of the countervailing effects becomes quickly intractable.

3. *Policies affecting λ.* The pros and cons of such policies have been discussed already at various points. To recapitulate, suppose the country is in conflict (and hence, given the dynamic analysis, we are in the resource rich scenario). Then *there is nothing that can be done* via affecting λ. Suppose instead that we start from a resource poor country in peace, but with a very unfair distribution of the surplus. This is when λ^* is very low. Imposing higher λ will increase fairness in a country in peace. However, an excessive demand for fairness, imposing $\lambda > \lambda^o$ will precipitate conflict and mass killings.

4. *International embargoes.* Embargoes of exports of natural resources may have important short-run effects on rents, but for a high value of δ the present value of all the future stream of rents is unlikely to be severely affected if long run embargoes are not credible.

5. *Policies aimed at fostering productivity in labor intensive sectors.* Policies having the effect of an increase in β foster fairness in a peaceful country

[39] Stopping the mass killings is usually done by military intervention following the agreement of the international community. Typically, the UN Security Council plays a crucial role (Doyle and Sambanis, 2006). As shown in Doyle and Sambanis (2006), there are trends in UN interventionism, and hence $\overline{M}$ can vary over time and may be subject to shocks. International intervention, when directly directed against the perpetrators, can stop or at least slow down mass killings (Krain, 2005). Bussmann, Haer and Schneider (2009) find that "partisan interventions in civil wars might deter the main perpetrators from continuing the slaughtering, but might invite the targets of these acts to seek reciprocal revenge under the protection of the international community". The full evaluation of these direct intervention policies depends on commitment, enforcement, and on what consequences are expected from the intervention, clearly requiring a broader framework of analysis.

and reduce the overall likelihood of mass killings.[40] Promises of support in institution building and development funding in case of peace agreement could be good examples of policy proposals to be made. Other promises, like foreign aid managed by the elite, would instead have potentially a negative effect, since any "cake" not produced by labor has the same incentive consequences as natural resource windfalls.

7 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 7.1 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 afterwards in subsection 7.2 aims to study 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).

7.1 Country level evidence

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 1 and 2 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." This definition results in 268 country-years (3.5 percent of all observations) being coded as experiencing 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. In the Appendix B all variables are explained in detail and summary descriptive statistics are provided.

[40] As shown in Appendix A, the effect of β on the likelihood of rebellion is ambiguous.

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 1 with between 2257 and 4771 observations depending on the specification.

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.[41] 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. 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.

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. A further advantage we have is that most existing studies are dated, and we have more recent data.

Another 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.

Table 1 displays our results, with on the top line for each variable the co-

[41] 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.

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

efficient 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 we do not control for autocorrelation 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 increases 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 autocorrelation 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.

In the benchmark regression of column 2 we use 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 that trade openness, population size, and mountainous terrain are found to decrease the risk of mass killings.

In column 3 we use oil reserves / GDP as the main explanatory variable. 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 4 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 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%.

In column 5 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 6 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.

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 variable in column 7 the lagged value of oil production in absolute terms and in column 8 the absolute amount of oil reserves, for which these concerns are least likely to apply. The coefficients of oil production, resp. reserves have the expected sign and are statistically significant at the 1% level. Note that also other resource measures such as for example the lagged absolute amount of oil production in barrels or an oil producer dummy 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 1, 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 4 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 2 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 often 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.[42] 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 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 ordered logit regressions are run. Natural resource abundance is still found to be significant at the 1% level.

7.2 Ethnic group level evidence

While in the last subsection we carried out an analysis on the country year level, here we focus on a panel at the ethnic group year level. Hence, while the last subsection provided the big picture of the main driving factors of mass killings, the current subsection 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 with respect to existing work: 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.

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

Dependent variable	Incid. M.K.	Incid. M.K.	Incid. M.K.	Onset M.K.	Incid. M.K.	Large M.K.	Ord. M.K.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
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***
	(0.93)	(0.53)	(0.32)		(0.79)	(1.00)	(1.27)
GDP per capita (t-1)	-0.50	-0.05	-0.07*	-0.09	-0.13	-1.07	-0.16
	(0.48)	(0.07)	(0.04)	(0.11)	(0.11)	(0.80)	(0.11)
Ethnic polarization	1.78	2.85*	1.35	2.14	3.28*	3.74	2.27
	(1.58)	(1.48)	(0.86)	(1.85)	(1.98)	(5.37)	(1.80)
Democracy (t-1)	0.01	-0.03	0.01	0.04	0.08	0.04	-0.02
	(0.07)	(0.04)	(0.02)	(0.04)	(0.08)	(0.06)	(0.09)
Civil war incidence		1.67**	0.75**	2.13*	2.15***	4.40***	2.11***
		(0.66)	(0.32)	(1.15)	(0.77)	(1.64)	(0.47)
Democratization (t-2)		0.11	0.07	0.11	0.14	0.34*	0.11
		(0.09)	(0.05)	(0.08)	(0.11)	(0.20)	(0.11)
Trade / GDP (t-1)	0.14	-3.69***	-1.63***	-3.04	-3.82**	-2.35	-3.25**
	(1.77)	(0.92)	(0.48)	(2.28)	(1.82)	(1.62)	(1.41)
Chief executive military		0.82	0.50	1.87*	1.72**	1.73	0.93*
		(0.55)	(0.33)	(0.96)	(0.85)	(1.38)	(0.49)
Population (t-1)	-0.10	-0.02**	-0.02**	-0.04	-0.05**	-0.02	-0.02
	(0.13)	(0.01)	(0.01)	(0.07)	(0.02)	(0.02)	(0.02)
Mountainous Terrain	2.04	-1.20	-1.02**	0.14	-2.32	-6.83***	-4.17*
	(1.89)	(0.75)	(0.51)	(1.23)	(1.85)	(2.57)	(2.26)
Population density (t-1)		3.08	0.53	2.76	-4.38	4.50	-5.68
		(2.23)	(1.05)	(2.89)	(5.67)	(3.07)	(8.10)
Estimator	Logit	Relogit	Probit	Logit	Reg.FE Logit	Logit	Ord. Logit
Sample	Civ.War	All	All	All	All	All	All
Observations	237	3161	3068	632	2463	2701	3161
Pseudo R-squared	0.723	0.8156	0.841	0.205	0.853	0.843	0.601

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 3-7 control for unreported annual time dummies.

Table 2: Robustness checks on Mass Killings on the country level

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.[43]

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 "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 3 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

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

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.[44] 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 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 (cf. for example Henderson, Storeygard, and Weil, 2011, and Rohner, Thoenig, and Zilibotti, 2011). 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 3) 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

[44] 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).

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 5 of Table 1). To account for unobserved heterogeneity, all columns have robust standard errors that are allowed to be clustered at the country level.

Like in the country level regressions above, we code in the benchmark specification of column 1 of Table 3 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. Groups that are geographically dispersed, that live in mountainous areas, that live on valuable soil and that are involved in a civil conflict are also significantly more likely to be massacred.[45] The result that groups occupying valuable high-quality land are more at risk is particularly interesting. In the next 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 in column 2 this original coding 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%.[46] It is found that oil and gas abundance on the group-

[45] 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.

[46] 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

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 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 by 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.

8 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 has a large percentage of GDP coming from resource rents and the destructive expected costs of civil war are not overwhelmingly high, the dynamic incentives to kill or displace minority groups materialize. 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.

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 5 of Table 1 (not reported).

Table 3: The determinants of victimization of ethnic groups

These results are robust to the introduction of a full-fledged infinite horizon extension of the initial two-period simple model with exogenous constraints, and this extension allows us to obtain also some additional results on the positive relationship between polarization and duration of conflict. When the binding constraint to unfair distribution is the endogenous one obtained in the infinite horizon model, i.e. the threat of future rebellion (which is certainly the relevant constraint in dictatorships), then productivity of the economy and population size have no effect on the likelihood of mass killings, whereas when democratization kicks in, making the institutional constraint bind, in that subset of cases the prediction is that higher productivity and larger population sizes should reduce the likelihood of mass killings.

In the absence of binding external constraints on the inequality of surplus shares between groups, peace can always be achieved in the absence of natural resource rents. When natural resources are discovered or their value increases, we have shown that if peace remains feasible then inequality between groups must go down, but as the value of natural resources keeps increasing, eventually the peaceful equilibrium can stop being feasible, unless the destruction costs of war increase at a similar rate.

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.[47] In Rwanda, for example, the really important contestable resource is productive land, and a combination of excessive population and decreasing returns from agricultural production could explain the mass killings incentives.[48] 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 important 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

[47]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.

[48]Andre and Platteau (1998) show that in the mass killings in Rwanda Tutsis with large land holdings faced a particularly high risk of being targeted by the Hutu death squads.

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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Appendix A (Proofs)

Proof of Lemma 2.

Let us ignore the time subscripts whenever it does not create confusion, recalling that in the initial period we have assumed without loss of generality that group j is the group in power.

The proof has two steps. We first show that there always exists a share λ^j that makes i indifferent between peace and conflict if the group in power does not consider mass killings. The second step shows that the peace granting strategy is optimal for the group in power.

Step 1. $M_0^j = 0$ implies $N_{k1} = N_k, \quad k = i, j$, regardless of whether there is conflict or not at time 0. Group i is indifferent between peace and rebellion for $\hat{\lambda}^j$ that solves

$$\hat{\lambda}^j \frac{N_i}{N} \frac{S}{1-\delta} = \frac{N_i}{N} \left[S - d + \delta V_i^i(N_i, N_j) \right] + \frac{N_j}{N} \left[\delta V_i^j(N_i, N_j) \right]. \tag{6}$$

Since it can easily be shown that

$$V_i^i(N_{it}, N_{jt}) \geq V_i^j(N_{it}, N_{jt}) \ \ \forall t,$$

it follows that

$$\hat{\lambda}^j \frac{N_i}{N} \frac{S}{1-\delta} \leq \frac{N_i}{N}(S-d) + \delta V_i^i(N_i, N_j). \tag{7}$$

Further, given that $V_i^i(N_i, N_j) < S/(1-\delta)$, we have

$$\hat{\lambda}^j \frac{N_i}{N} \frac{S}{1-\delta} < \frac{N_i}{N}(S-d) + \delta \frac{S}{1-\delta}$$

and thus

$$\hat{\lambda}^j \frac{N_i}{N} < \left[\frac{N_i}{N}(1-\delta) + \delta \right] - \frac{N_i}{N} \frac{d(1-\delta)}{S} < 1. \tag{8}$$

The peace keeping share $\hat{\lambda}^j \frac{N_i}{N}$ is strictly less than unity and is thus feasible. Note that this holds independently of whether the opposition group i would want to do mass killings or not.

Step 2. We now establish that the group in power is better off offering such an indifference share, $\hat{\lambda}^j$, rather than offering less and provoking conflict.

The discounted value to the group j in power from guaranteed peace in the absence of mass killings is $\frac{\left(1-\hat{\lambda}^j \frac{N_i}{N}\right)S}{1-\delta}$.

By definition of $\hat{\lambda}^j$, group i can always grant to itself in conflict a payoff equivalent to

$$\frac{\hat{\lambda}^j \frac{N_i}{N} S}{1-\delta}.$$

Since these outcomes are attainable, we have that the value functions do satisfy the inequalities

$$V_j^j(N_i, N_j) \geq \frac{(1-\hat{\lambda}^j \frac{N_i}{N})S}{1-\delta} \text{ and } V_i^j(N_i, N_j) \geq \frac{\hat{\lambda}^j \frac{N_i}{N} S}{1-\delta}.$$

Adding the two inequalities we obtain

$$V_j^j(N_i, N_j) + V_i^j(N_i, N_j) \geq \frac{S}{1-\delta}.$$

However, it can be easily shown that $V_h^h + V_k^h \leq S/(1-\delta)$. Therefore, it has to be that

$$V_j^j(N_i, N_j) = \frac{(1-\hat{\lambda}^j \frac{N_i}{N})S}{1-\delta} \text{ and } V_i^j(N_i, N_j) = \frac{\hat{\lambda}^j \frac{N_i}{N} S}{1-\delta}.$$

This implies that group j offering $\hat{\lambda}^j$ and i accepting is equilibrium behavior given the assumption alone that group j is not interested in a positive amount of mass killings. **QED.**

Proof of Lemma 3.

(I) Assume group j is in power. We start by showing that it cannot be optimal to sequence mass killings over various periods. Suppose it is optimal to sequence mass killings over two consecutive periods (m_1^j, m_2^j). Since m_1^j is optimal, it has to be that

$$\max\{V_j^j(N_i, N_j), V_j^j(N_i - (m_1^j + m_2^j), N_j)\} < V_j^j(N_i - m_1^j, N_j).$$

But in order to be optimal to perform the second phase, it has to be that

$$V_j^j(N_i - (m_1^j + m_2^j), N_j) > V_j^j(N_i - m_1^j, N_j).$$

A contradiction. Hence, if a group is in power on the equilibrium path for two (or more) consecutive periods, it performs mass killings (if ever) all in the first period. We have not proven yet that the two above inequalities cannot jointly hold if there is a change of power in-between the two potential mass killing episodes, which matters if this implies that the second time j has the possibility to do mass killings it has lower population size, $N_j - M^i$. However, if it is not worth delaying mass killings when keeping power for sure, it is *a fortiori* even less worthwhile to delay if there is a risk of losing power.

(II) Assume now that the equilibrium path entails $h_{t-1} = h_t = j$ and a one-shot mass killing of $M_t^j > 0$ at time t. This cannot belong to the equilibrium path because if M_t^j is optimal at time t, it should also have been optimal at $t-1$ because the environment was identical. **QED.**

Proof of Proposition 2.

(I) Combining Lemmas 2 and 3, it must be the case that as soon as one group commits mass killings, after that there is peace forever even if the opponent group has not been fully eliminated. Suppose that a mass killing event took indeed place at some time t, committed without loss of generality by group j, with $M_t^j < N_i$. Then, given stationarity from that time on, we know that group i receives from that time on a share $\lambda^j \frac{N_i - M_t^j}{N - M_t^j}$ per period, with λ^j to be determined. Letting $N_i' \equiv N_i - M_t^j$ and $N' \equiv N - M_t^j$, and letting $S' \equiv S_0 - \beta M_t^j$, we have

$$V_i^j(N_i', N_j) = \lambda^j \frac{N_i'}{N'} \frac{S'}{1-\delta}. \tag{9}$$

In order to pin down λ^j (which must make group i indifferent between accepting and rejecting), we have to establish what would happen in the continuation game after a conflict-deviation by group i. If i rebels at time $t+1$, right after the killings by group j, the expected group utility is

$$\frac{N_i'}{N'}[S' - d + \delta V_i^i(N_i', N_j)] + \frac{N_j}{N'}\delta V_i^j(N_i', N_j) = V_i^j(N_i', N_j). \tag{10}$$

From (9) and (10), we obtain

$$\hat{\lambda}^j = \frac{S' - d + \delta V_i^i(N_i', N_j)}{\left(1 - \frac{N_j}{N'}\delta\right)\frac{S'}{1-\delta}}. \tag{11}$$

Assume for now that in state $(N_i', N_j, h=i)$ it is optimal for i to set $M^i = 0$. If i does not do mass killings we have that

$$V_j^i(N_i', N_j) = \lambda^i \frac{N_j}{N'} \frac{S'}{1-\delta}. \tag{12}$$

As before, the way to pin down λ^i is to look at the outside option with respect to which group j should be indifferent between accepting and rejecting:

$$\frac{N_j}{N'}[S' - d + \delta V_j^j(N_i', N_j)] + \frac{N_i'}{N'} \delta V_j^i(N_i', N_j) = V_j^i(N_i', N_j). \tag{13}$$

From (12) and (13), we obtain

$$\hat{\lambda}^i = \frac{S' - d + \delta V_j^j(N_i', N_j)}{\left(1 - \frac{N_i'}{N'}\delta\right) \frac{S'}{1-\delta}}. \tag{14}$$

Using the fact that $V_j^j(N_i', N_j) = (1 - \hat{\lambda}^j \frac{N_i'}{N'}) \frac{S'}{1-\delta}$, and $V_i^i(N_i', N_j) = (1 - \hat{\lambda}^i \frac{N_j}{N'}) \frac{S'}{1-\delta}$, we obtain a system with two equations and two unknowns:

$$\hat{\lambda}^i = \frac{S' - d + \delta(1 - \hat{\lambda}^j \frac{N_i'}{N'}) \frac{S'}{1-\delta}}{\left(1 - \frac{N_i'}{N'}\delta\right) \frac{S'}{1-\delta}}, \tag{15}$$

$$\hat{\lambda}^j = \frac{S' - d + \delta(1 - \hat{\lambda}^i \frac{N_j}{N'}) \frac{S'}{1-\delta}}{\left(1 - \frac{N_j}{N'}\delta\right) \frac{S'}{1-\delta}}. \tag{16}$$

Solving, it yields

$$\hat{\lambda}^i = \hat{\lambda}^j = 1 - \frac{(1-\delta)d}{S'}. \tag{17}$$

Now, we can compute the optimal mass killings level of group j in period t, given that it knows that it can buy-off the opponent i by offering $\hat{\lambda}^j \frac{N_i'}{N'} \frac{S'}{1-\delta}$ from then onwards. Hence, the payoff U to maximize for j becomes:[49]

$$U_j^j(N_i - M^j, N_j) = \left(1 - \left[1 - \frac{d(1-\delta)}{S - \beta M^j}\right] \frac{N_i - M^j}{N - M^j}\right) \frac{\delta(S - \beta M^j)}{1-\delta}. \tag{18}$$

We can easily find that

$$\frac{\partial U_j^j(N_i - M^j, N_j)}{\partial M^j} = \frac{\delta N_j}{(1-\delta)(N - M^j)^2} \left[R - d(1-\delta)\right]. \tag{19}$$

[49] Note that the mass killings decision only affects the payoffs of future periods, as the output from the current period has already been distributed and consumed.

Note that $U_j^j(N_i - M^j, N_j)$ is decreasing whenever $R \leq (1-\delta)d$ and increasing whenever $R > (1-\delta)d$. Thus, selecting $M^j = 0$ is optimal whenever $R \leq (1-\delta)d$ and the correct anticipation of group i's behavior in case it obtained power off the equilibrium path does not include killings. Note that the condition $R \leq (1-\delta)d$ does not depend on population sizes, hence $M^i = 0$ would also be a best response to the anticipation that $M^j = 0$ off the equilibrium path. Further, lemma 2 implies that in the absence of mass killings, the powerless group i will renounce to rebellion, and will receive and accept a rent sharing offer $\hat{\lambda}^j$. Hence peaceful sharing according to $\hat{\lambda}^j$ is indeed an equilibrium whenever $R \leq (1-\delta)d$.

We now need to show that when $R \leq (1-\delta)d$ permanent peace without threats of mass killings is the unique equilibrium path. To this effect, we start by showing that there cannot be an equilibrium with peace in which the fairness level results from the threat of killings by i, $M^i > 0$. Sub-game perfection requires that if there is a one-step deviation and i accesses to power after winning in a rebellion $M^i > 0$ continues to be the optimal strategy. Note that if this were the case, group i would be in exactly the same position as j is in the previous part of this proof, i knowing that j will not do mass killings. Hence, solving as before we obtain that when $R \leq (1-\delta)d$ the optimal decision is $M^i = 0$. Hence, peace under the threat of killings by i cannot belong to a MPE. This observation together with the result that over all the feasible levels of killings j would choose $M^j = 0$ also implies that j killing members of i and having peace thereafter is not an equilibrium neither. Finally, we have to discard the path starting with the rebellion of i. Indeed, this could happen only if $\hat{\lambda}^j$ was not feasible. But we have shown it is. This completes the proof of part I of the proposition.

(II) Let $R > (1-\delta)d$ and j be in power.

One implication of part I of the proof is that if $R > (1-\delta)d$ and if, in spite of that, group i is expected to choose $M^i = 0$ in the off-equilibrium situation in which they fight, conquer power and consolidate power, group j will exterminate group i if not challenged at $t = 0$.

Now we shall prove by contradiction that also for $M^i > 0$, group j will exterminate group i if not challenged at $t = 0$. Note first that $M^i > 0$ implies that $V_i^i(N_i, N_j - M^i) > V_i^i(N_i, N_j)$. This in turn implies that the fairness level $\tilde{\lambda}^j$ that makes group i indifferent between rebelling and not rebelling must be larger for $M^i > 0$ than for $M^i = 0$, i.e. $\tilde{\lambda}^j > \hat{\lambda}^j$. Second, we know from part I that for $M^i = 0$ group j will exterminate group i if not challenged at $t = 0$, i.e. it prefers $M^j = N_i$ over any other possible level of $M^j \neq N_i$. Third, we know that the payoff for j of full extermination of i does not depend on the level of M^i (trivially, because i does not exist anymore), i.e. $V_j^j((0, N_j) \mid M^i = 0) = V_j^j((0, N_j) \mid M^i > 0)$. Fourth, we know that for any level of M^j the payoff is weakly smaller if it has to pay some $\tilde{\lambda}^j$ instead of $\hat{\lambda}^j$ from period $t+1$ onwards, i.e. $V_j^j((N_i - M^j, N_j) \mid \tilde{\lambda}^j) \leq V_j^j((N_i - M^j, N_j) \mid \hat{\lambda}^j)$.

We are now ready for the proof by contradiction. Suppose now that $M^j \neq N_i$ was optimal for $M^i > 0$. This would imply that $V_j^j((N_i - M^j, N_j) \mid \tilde{\lambda}^j) > V_j^j((0, N_j) \mid \tilde{\lambda}^j)$, where $M^j \neq N_i$. Given that $V_j^j((0, N_j) \mid \tilde{\lambda}^j) = V_j^j((0, N_j) \mid \hat{\lambda}^j)$, this would further imply that $V_j^j((N_i - M^j, N_j) \mid \tilde{\lambda}^j) > V_j^j((0, N_j) \mid \hat{\lambda}^j)$. But this can never be the case as $V_j^j((0, N_j) \mid \hat{\lambda}^j) > V_j^j((N_i - M^j, N_j) \mid \hat{\lambda}^j) > V_j^j((N_i - M^j, N_j) \mid \tilde{\lambda}^j)$. A contradiction.

Hence for $R > (1-\delta)d$ the first time power is consolidated full extermination of the opponent takes place. It follows that we can have two scenarios only. Either at t=0 group i does not rebel and it is exterminated at the end of the period, or group i rebels and eventually one of the two groups gets annihilated as soon as one consolidates power.

We obtain now the conditions under which there will be open conflict in every period until one group consolidates power, at which point there is extermination. Let us first suppose that whoever is the powerless group indeed rebels in every period, and derive conditions under which such behavior is optimal. Let j be in power at time 0. If the equilibrium path involves immediate rebellion in order to avoid power consolidation by j, the expected utility for group i in this initial situation can be written as

$$V_i^j(N_i, N_j) = \frac{N_i}{N}[S - d + \delta V_i^i(N_i, N_j)]. \tag{20}$$

Deviating and hence accepting to be exterminated without rebelling yields a current period payoff of $\lambda^j \frac{N_i}{N} S$ (and 0 in all future periods given that i is fully exterminated at the end of the first period).

The value of gaining power, $V_i^i(N_i, N_j)$, is as follows (given that in this equilibrium also j would fight against being exterminated in period $t = 1$):

$$V_i^i(N_i, N_j) = \frac{N_i}{N}[S - d + \frac{\delta}{1-\delta}(\beta N_i + R)] + \frac{N_j}{N}\delta V_i^j(N_i, N_j). \tag{21}$$

Plugging (21) into (20), we obtain

$$V_i^j(N_i, N_j) = \frac{N_i}{N}[S - d + \delta \left\{ \frac{N_i}{N}[S - d + \frac{\delta}{1-\delta}(\beta N_i + R)] + \frac{N_j}{N}\delta V_i^j(N_i, N_j) \right\}]. \tag{22}$$

Solving for $V_i^j(N_i, N_j)$, we get

$$V_i^j(N_i, N_j) = \frac{N_i[S - d + \delta \frac{N_i}{N}[S - d + \frac{\delta}{1-\delta}(\beta N_i + R)]]}{N - \delta^2 \frac{N_i N_j}{N}}. \tag{23}$$

Therefore, we shall have that i will prefer conflict over accepting extermination if $\lambda^j \leq \min\{\lambda^{\dagger j}, \frac{N}{N_i}\}$ where $\lambda^{\dagger j}$ satisfies

$$\lambda^{\dagger j} \frac{N_i}{N} S = \frac{N_i[S - d + \delta \frac{N_i}{N}[S - d + \frac{\delta}{1-\delta}(\beta N_i + R)]]}{N - \delta^2 \frac{N_i N_j}{N}}.$$

That is,

$$\lambda^{\dagger j} = \frac{\frac{N+\delta N_i}{N}\frac{S-d}{S} + \frac{N_i}{N}\frac{\delta^2}{1-\delta}\frac{\beta N_i + R}{S}}{1-\delta^2\frac{N_i N_j}{N^2}}. \tag{24}$$

The complementary condition $\lambda^{\dagger j} \leq \frac{N}{N_i}$, comes from feasibility. If $\lambda^{\dagger j} > \frac{N}{N_i}$ the transfer associated with this level of fairness would exceed the total surplus.

As for player j, she has two possible strategies to consolidate power and exterminate i. The first one is to offer a large enough λ^j that prevents rebellion. The payoff to j of being λ^j fair and the subsequent annihilation of the opponent is

$$\left(1-\lambda^j\frac{N_i}{N}\right)S + \frac{\delta}{1-\delta}(\beta N_j + R). \tag{25}$$

The second possible strategy is to consolidate power by winning a second period of conflict. The value of triggering immediate conflict $V_j^j(N_i, N_j)$ is

$$V_j^j(N_i,N_j) = \frac{N_j}{N}\left[S-d+\frac{\delta}{1-\delta}(\beta N_j + R)\right] + \frac{N_i}{N}\delta\frac{N_j}{N}\left[S-d+\delta V_j^j(N_i,N_j)\right]. \tag{26}$$

Note that if it is optimal to trigger conflict at $t=0$ it must continue to be optimal to trigger conflict on every occasion regaining power.

Let λ'^j denote the level of fairness that makes j indifferent between the two strategies. Equating expression (25) with the right hand side of equation (26), and rearranging, we obtain

$$\lambda'^j = \frac{1-\delta(1+\delta)\frac{N_j}{N} + \frac{\delta}{1-\delta}\frac{\beta N_j + R}{S}\left(1-\delta^2\frac{N_j}{N}\right) + \frac{d}{S}\frac{N_j}{N_i}\left(1+\delta\frac{N_i}{N}\right)}{1-\delta^2\frac{N_i N_j}{N^2}}. \tag{27}$$

Player j will prefer conflict for all $\lambda^j > \lambda'^j$. Hence, it is not possible to prevent group i from rebeling if

$$\lambda^{\dagger j} > \min\{\lambda'^j, \frac{N}{N_i}\}.$$

The conditions are analogous when i is in power. In particular, it is not possible to prevent group j from rebeling if $\lambda^{\dagger i} > \min\{\lambda'^i, \frac{N}{N_j}\}$, where

$$\lambda^{\dagger i} = \frac{\frac{N+\delta N_j}{N}\frac{S-d}{S} + \frac{N_j}{N}\frac{\delta^2}{1-\delta}\frac{\beta N_j + R}{S}}{1-\delta^2\frac{N_i N_j}{N^2}}, \tag{28}$$

$$\lambda'^i = \frac{1-\delta(1+\delta)\frac{N_i}{N} + \frac{\delta}{1-\delta}\frac{\beta N_i + R}{S}\left(1-\delta^2\frac{N_i}{N}\right) + \frac{d}{S}\frac{N_i}{N_j}\left(1+\delta\frac{N_j}{N}\right)}{1-\delta^2\frac{N_i N_j}{N^2}}. \tag{29}$$

Hence rebellion in every period by whomever is the powerless group is an equilibrium if and only if both $\lambda^{\dagger j} > \min\{\lambda'^j, \frac{N}{N_i}\}$ and $\lambda^{\dagger i} > \min\{\lambda'^i, \frac{N}{N_j}\}$ jointly hold.

Note that $\partial\lambda^{\dagger j}/\partial\delta > 0$, $\partial\lambda^{\dagger i}/\partial\delta > 0$, $\partial(N/N_i)/\partial\delta = 0$, and $\partial(N/N_j)/\partial\delta = 0$. Further, $\lim_{\delta\to 1}\lambda^{\dagger j} = \infty$, $\lim_{\delta\to 1}\lambda'^j = \infty$, $\lim_{\delta\to 1}\lambda^{\dagger i} = \infty$, and $\lim_{\delta\to 1}\lambda'^i = \infty$. Moreover, for $\delta = 0$ it is the case that $\lambda^{\dagger j} = \lambda^{\dagger i} = 1 - \frac{d}{S}$, $\lambda'^j = 1 + \frac{d}{S}\frac{N_j}{N_i}$, and $\lambda'^i = 1 + \frac{d}{S}\frac{N_i}{N_j}$. It follows that for $\delta = 0$ it always holds that $\lambda^{\dagger j} < \min\{\lambda'^j, \frac{N}{N_i}\}$ and $\lambda^{\dagger i} < \min\{\lambda'^i, \frac{N}{N_j}\}$, while for $\delta \to 1$ it always holds that $\lambda^{\dagger j} > \min\{\lambda'^j, \frac{N}{N_i}\}$ and $\lambda^{\dagger i} > \min\{\lambda'^i, \frac{N}{N_j}\}$. Hence, there must exist a threshold δ^*, where $0 < \delta^* < 1$, such that rebellion in every period by whomever is the powerless group is an equilibrium if and only if $\delta \geq \delta^*$. **QED.**

Appendix B (Data Description)

This appendix describes the data used in section 7. Table 4 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) (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) (International Market Price - Average Unit Production Cost). From World Bank (2010).

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 2, 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) (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 3 coded as dummy, taking a value of 1 when Rep22 equals 1 or more. Coded as 0 in the columns 1-4 of Table 3 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
Oil reserves / GDP	4138	2.667	10.514	0	212.374
Energy rents	5246	0.045	0.114	0	1.507
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 (in 100 billion barrels)	4613	0.061	0.251	0	2.643
Oil production (in 100 billion US$)	6390	0.053	0.209	0	3.610
GDP per capita (in 1000 US$)	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 4: Descriptive summary statistics