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Strategic Mass Killings

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Abstract: Since World War II there have been about fifty episodes of large-scale mass killings of civilians and massive forced displacements. They were usually meticulously planned and independent of military goals. We provide a model where conflict onset, conflict intensity and the decision to commit mass killings are all endogenous, with two main goals: (1) to identify the key variables and situations that make mass killings more likely to occur; and (2) to distinguish conditions under which mass killings and military conflict intensity reinforce each other from situations where they are substitute modes of strategic violence. We predict that mass killings are most likely in societies with large natural resources, significant proportionality constraints for rent sharing, low productivity and low state capacity. Further, massacres are more likely in a civil than in an interstate war, as in the latter group sizes matter less for future rents. In non polarized societies there are asymmetric equilibria with only the larger group wanting to engage in massacres. In such settings the smaller group compensates for this by fighting harder in the first place. In this case we can talk of mass killings and fighting efforts to be substitutes. In contrast, in polarized societies either both or none of the groups can be ready to do mass killings in case of victory. Under the "shadow of mass killings" groups fight harder. Hence, in this case massacres and fighting are complements. We also present novel empirical results on the role of natural resources in mass killings and on what kinds of ethnic groups are most likely to be victimized in massacres and forced resettlements, using group level panel data.

Keywords: Mass Killings, Civil War, Natural Resources, Intensity of Conflict, Group Size

JEL Codes: C72, D74.

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"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." Thomas Jefferson (from Mann, 2005: 70).

1 Introduction

Mass killings of civilians are obviously a serious problem. 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) and by 2008 have forced the displacement of 42 million people (UNHCR, 2009). Surprisingly, while there is an increasing number of formal models of civil and interstate wars,[1] the issues of mass killings and forced displacements have so far been largely neglected in formal theory. What makes this neglect even more surprising is that mass killings seem to have different causes, motivations and implications with respect to other forms of conflict. Indeed, mass killings are a manifestation of the worst of the human being, dominated by irrational hatred and uncontrolled passion. However, 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." In this paper, we examine whether decisions to exterminate the opponent can be explained as the result of strategic, rational calculation, independently of how these decisions had been framed.

The links between mass killings and warfare are complex. While mass killings are present in many guerrilla wars (Valentino, Huth and Balch-Lindsay, 2004), there are also often episodes of mass killings perpetuated 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. Moreover, 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, while there is almost no record of mass killings of this sort in post-WWII interstate wars. As shown in Figure 1, 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.[2]

[1] See e.g. Blattman and Miguel (2009) and Jackson and Morelli (2009) for the most updated surveys on civil and interstate wars, respectively

[2] For Figure 1, data on mass killings in wars was taken 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).

One distinctive feature is that mass killings are designed to kill, i.e. to reduce the size of the opponent groups, while other forms of conflict are about winning some "prize" and the fatalities they entail are merely a by-product of appropriation. Hence, a natural question to ask is: Why could it be rational for a regime or group to engage in a costly activity that has as main goal to reduce the group size of the opponent?

We will highlight the trade-offs involved when a group considers the possibility of engaging in decimation of the opposition group's size. While in the discussion we mostly refer to mass killings, our analysis is meant to include forced displacements, since they are another measure for reducing the size of the opposition group.[3]

In the model we assume that there are two groups,[4] one of which initially controls the government. The government and rebel factions decide first whether or not to engage in fighting and on the level of fighting effort. This endogenously yields the likelihood of the rebel faction taking over power at the end of the conflict. Then the group that is in power has the option to perform mass killings to decimate the group size of the opponent.

Given that the minimum share of public spending that has to be given to the opposition group depends on their group size, mass killings allow the government group to increase their future rent share. This incentive has to be traded off against the reduction in economic output following mass killings. We find that mass killings are more attractive for the group in power when natural resource rents are large relative to economic production, and when state capacity is weak. Further, democratization and constraints on rent-sharing imposed from the outside can give incentives for the ruling group to substitute discrimination with elimination. Paradoxically, if a"bad" regime is forced to treat minorities better than it otherwise would, this could fuel massacres, as killing opponents becomes more lucrative if the share of the rents is more closely tied to group sizes. Further, it is found that large groups have greater incentives to engage in mass killings. This implies that in polarized societies there are symmetric equilibria where either both or none of the groups commit massacres, while in less polarized societies only the larger group performs mass killings.

A recent, still ongoing case can illustrate the key features of mass killings that we wish to capture. The mass killings in Sudan's Darfur region started in 2003. "The primary perpetrators of the killings and expulsions are government-backed "Arab" militias. The main civilian victims are black "Africans"" (Straus, 2005: 123). The estimates of the death toll vary between 70,000 and 400,000 fatalities,

[3] Given that the model will not distinguish between reductions of the size of a group by killing and by forced displacements, we are basically thinking about the sum of the two. A separate research question could then be the study of the tradeoffs between these potentially substitute elimination methods.

[4] These groups could be identified by any of the dividing lines in society, ethnicity, religion, race, class. 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 something of low priority in the research agenda.

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 are 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). The early 21st century was characterized by natural resource shocks (Sudan becomes an increasingly important oil producer) and political shocks (peace agreements in other parts of Sudan brought the expectation of "looming elections" and democratization) (Straus, 2005). At the same time productivity and state capacity of Sudan remained very low, and it became increasingly clear that the international community would be hesitant to rapidly and forcefully intervene (Straus, 2005; 2006; De Waal, 2007). These factors led to an explosive blend that made the mass killings in Darfur possible. Our paper contributes to bring together all these factors in a unified model of strategic interaction.

Our framework also yields interesting predictions on how massacres and warfare relate to each other. When selecting the optimal fighting levels, the groups take into account what levels of mass killings take place for each potential outcome of the battle. In asymmetric equilibria —hence at low levels of polarization— the smaller group, which would not start massacres after victory, will compensate for this by fighting harder in the first place. Thus, in those equilibria mass killings and warfare behave as substitutes. In contrast, comparing across symmetric equilibria —hence with high polarization— mass killings and warfare behave as complements, i.e. the "shadow of massacres" makes both groups fight harder.

According to our theory, there is a fundamental difference between civil wars and interstate wars. 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. In contrast, interstate wars do not challenge any status quo *social contract*, nor is there any wish to impose new sharing rules for common pools of resources, also because there is no supranational government budget to fight for in terms of entitlements or alike. In civil wars, reducing the population size of the opponent group —by extermination and/or exile— allows for a larger viable share in the new social arrangement. This factor does not play such a strategic role in interstate conflicts because across countries different groups have no enforceable claims. This is not to deny that arguments such as revenge, hurt pride and alike play a role in both types of wars. However, our point is that the payoff to mass killings is distinctly larger and strategically critical in domestic conflicts, as group sizes matter for future rents, which is not the case in interstate wars.

While mass killings have received a lot of media attention and there is a substantial empirical literature on them (as discussed below), formal theoretical research on mass killings has been very scarce. There are a few papers that study terror and intimidation of the civilian population (Azam and Hoeffler, 2002) or build rent-seeking models to account for government appropriation (Bae and Ott, 2008). Further, Bueno de Mesquita (2010) builds a model where violence against civilians is used by the revolutionary vanguard to signal the level of anti-

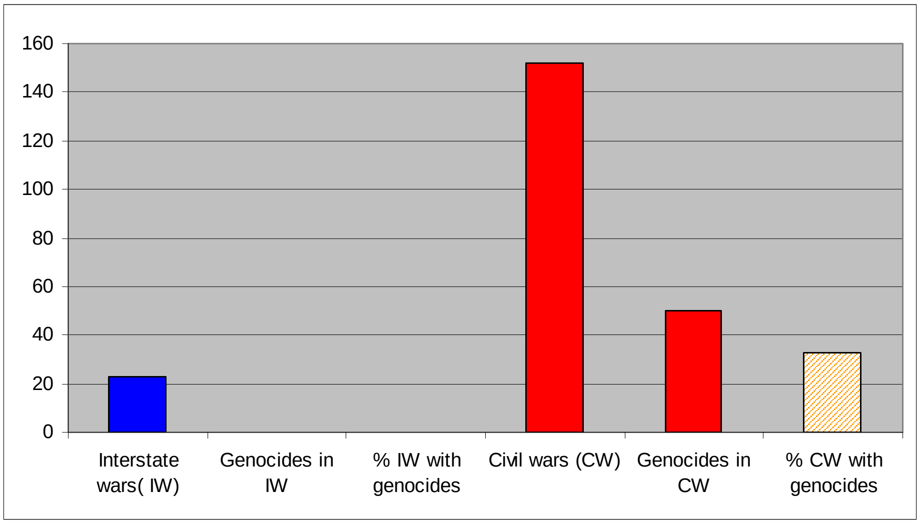

Figure 1: Mass killings in interstate and civil wars

government sentiment in society to increase support for their cause.[5] However, to the best of our knowledge, we build the first game-theoretic model of the incentives of a given ethnic group to deliberately decimate the population share of the opponent group for strategic reasons.

While the present paper is mainly theoretical, we also present several novel empirical findings, for example with respect to the impact of natural resources on mass killings. To the best of our knowledge, this is the first paper to perform an econometric analysis of massacres and displacements with a panel *at the ethnic group level*, which allows us to observe what kinds of ethnic groups are most likely to be victimized.

The paper is organized as follows. In the next section we report on the existing empirical evidence in the literature. Section 3 sets up the model, studies the strategic behavior of the two groups and establishes the existence and uniqueness of a subgame perfect equilibrium. Section 4 displays the important comparative statics, showing the effects of changing the relative group sizes, productivity, natural resources, State capacity, and limits to permissible inequality. Section 5 summarizes the main findings, discusses possible extensions, and sets the stage for Section 6, where we present new empirical evidence. Section 7 concludes.

[5] Qualitative micro-level explanations of rebel group behavior include Humphreys and Weinstein (2006) and Kalyvas (2007).

2 Stylized Facts

2.1 Definition of Mass Killings

Building on Charny (1999: 7) and Easterly, Gatti and Kurlat (2006: 132) we can define "mass killings" in the following way: "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, sometimes as mass killings, mass murder, massacres. Rudolph Rummel uses the expression "democide", while some scholars use "politicide" (political mass murder). We have opted for the general use of the term mass killing, which was also the solution adopted by Easterly, Gatti and Kurlat, 2006) and for the use of genocide only in the case in which one group is completely exterminated. For our empirical investigation we will rely on the most widely used dataset on mass killings, collected by the "Political Instability Task Force" under the direction of Barbara Harff. The most accepted quantitative minimum threshold for a massacre to count as mass killing is 50,000 (i.e., a mass killing is an intentional massacre of civilians with at least 50,000 fatalities).

2.2 The Quantitative Importance of Mass Killings and Forced Migration

Let us start the review of the stylized facts by giving an overview of the importance of mass killings. The exact numbers of fatalities are controversial,[6] but they are substantial by any standards. According to the "Political Instability Task Force" there have been 50 events of mass killings since World War II and they have cost the lives of between 12 and 25 million noncombatants. 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. Rummel (1995) estimates that the number of civilians killed by governments in 1900-1987 is almost 170 million. The punch line is that mass killings matter heavily, both in absolute terms and relatively to combat-deaths.

As explained in the introduction, the mechanisms of our model can also account for incentives to force unwanted opposition into migration and displacements. These phenomena are quantitatively very important. According to the official statistics of UNHCR (2009), out of the current 42 million forcibly displaced persons, 26 million were internally displaced population by cause of civil conflict.

[6] The estimates of how many civilians have fallen in this category vary a lot because of the difficulties in distinguishing between degrees of intentionality and targeting.

2.3 Empirical Literature on Mass Killings

Below we summarize the basic empirical results obtained by the existing literature. We will revisit these findings again in section 6 where we test the predictions of our paper.

1. **Political regime.** *Autocratic regimes are more likely to commit mass killings than democracies.*

   Non-democratic regimes are found to be more likely to commit mass killings than democracies, especially when the autocrats are powerful (Rummel, 1994, 1995; Harff, 2003; Valentino, Huth and Balch-Lindsay, 2004; Easterly, Gatti and Kurlat, 2006; Eck and Hultman, 2007; Colaresi and Carey, 2008). We find in section 6 that autocracy does not remain a significant explanatory variable for mass killings when one addresses the autocorrelation of the dependent variable and uses simple techniques for reducing the omitted variable bias.

   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 an important 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."[7]

2. **Group size and power.** *Mass killings are carried out almost exclusively by governments. Rebel violence is relatively low-scale. Rebel groups commit more civilian killings if they are militarily strong and after having won a military battle.*

   In most cases rebel violence is relatively low-scale, and mass killings are almost only carried out by governments (Harff, 2003; Valentino, Huth and Balch-Lindsay, 2004; Eck and Hultman, 2007).

   In the words of Rummel (1994: 1): "Power kills; absolute power kills absolutely". In order to be able to do mass killings a group needs the power and military strength to do so. Rebel groups commit more civilian killings if they are militarily strong relative to the government (Hultman, 2009) and after having won a military battle (Bussmann, Haer and Schneider, 2009). Total fatalities are low in situations with weaker rebel armies (Heger and Salehyan, 2007).

3. **Ethnic fractionalization and polarization.** *High levels of ethnic fractionalization are negatively correlated with the risk of mass killings, while ethnic polarization is often present in countries experiencing mass killings.*

[7] 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)

The effect of ethnic cleavages appears to be non-linear, with mass killings being less likely in fully homogenous societies or in societies with a large number of ethnic groups, and becoming more likely in the presence of few large ethnic groups. In particular, 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.

4. **Economic conditions.** *Mass killings are most likely for low and intermediate levels of GDP, large natural resources, high inequality and low trade openness.*

   It has been found that less mass killings take place in richer countries (Scully, 1997; Bae and Ott, 2008). When allowing for a quadratic form of development, an inverted U-shape relationship is found with mass killings being most risky for intermediate levels of GDP (Easterly, Gatti and Kurlat, 2006).

   Natural resources seem to increase the risk of mass killings in Africa (Querido, 2009), and also inequality (especially human capital inequality) tends to increase the risk of mass killings (Besançon, 2005). In contrast, trade openness reduces the risk of mass killings (Harff, 2003).

5. **International intervention.** *Interventions tend to reduce mass killings, but at the beginning of intervention killing efforts may increase.*

   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".

6. **Civil wars.** *Mass killings are more likely in the presence of civil war.*

   In the presence of civil war mass killings are more likely (Krain, 1997; Valentino, Huth and Balch-Lindsay, 2004), in particular when guerrilla groups are strong and benefit from support in the population (Valentino, Huth and Balch-Lindsay, 2004).

We should 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.

The model that we now turn to is heavily inspired by all the stylized facts of this section.

3 A Model of Civil War and Mass Killings

3.1 The Model

There are two groups, i and j, of population size (N_i, N_j). Hence, total population is $N = N_i + N_j$. We take the convention that group j is currently in power.

Output Y is produced by labor. We assume a rigid labor supply, so that output is proportional to population: $Y = \beta N$. We can think of β as individual productivity determined by education as well as by technology. We assume that both groups carry out their economic activity separately, so that

$$Y_h = \beta N_h, h = i, j, \text{ and } Y = Y_i + Y_j. \tag{1}$$

We assume that both groups have the same productivity.[8]

In addition, the country obtains an income from the exploitation and export of natural resources, E, controlled by the government.[9]

The Government taxes output at a rate t. We can interpret the size of t as an indicator for the State's "capacity". Hence, the government's revenue is

$$G = tY + E = t\beta N + E. \tag{2}$$

We shall denote by τ the share of the tax revenue over the total government revenues, that is,

$$\tau \equiv \frac{t\beta N}{t\beta N + E}. \tag{3}$$

The government revenue is entirely distributed over the population. The status quo share of government transfers or entitlements going to group h, $h = i, j$, is denoted by g_{0h}. These shares are the outcome of past history and may result from previous fights between the two groups. The aggregate disposable income to group h is

$$X_{0h} = (1 - t)\beta N_h + g_{0h}(t\beta N + E). \tag{4}$$

This situation may be disrupted by a shock perturbing some of the basic parameters. For instance, this shock could be originated by a change in the price or amount of the natural resource relative to the produced output. Such

[8] It is quite obvious that there is sizeable "horizontal" inequality among social groups in most countries. However, there is no conclusive evidence that this inequality is a significant source of social conflict. Cramer (2005) notes that the same data source appears to lead to conflicting claims in Wintrobe (1995), Collier and Hoeffler (1998), Stewart (2002), Nafziger and Auvinen (2002), Cramer (2003), and Besançon (2005). As it will become apparent later in the paper, assuming differential productivity across groups would modify the results only in that *ceteris paribus* the likelihood of becoming a victimized group is higher for the lower productivity group.

[9] We will discuss at the end the minor differences in the results that could derive from allowing natural resource rents to be private property rather than publicly controlled. What E wants to capture is all the sources of public revenue that do not require intensive labor input.

change may significantly alter the relative resources of the two groups and induce the rebellion of the group out of power. After deciding on whether to rebel or not (first stage), the challenger and the group in power expend resources to mobilize forces for battlefield warfare (second stage). The victorious group seizes (or keeps) power. Power, either conquered or kept, can be used to set new distribution shares over future government revenues and to perpetrate mass killings in the opponent population (third stage).[10] Figure 2 displays the timing of the game graphically.

We assume that group members act in a coordinated manner so that each group maximizes the payoff of the representative group member. Group i decides to rebel in the first stage if the group's expected payoff from conflict exceeds the payoff from remaining peaceful. Rebellion has two possible outcomes: victory with probability q and defeat with probability $(1-q)$. We use v to denote the state in which group i wins and d for the state in which i is defeated —and hence group j is victorious. Therefore, q is the probability that state v comes about.

The probability of victory q depends on the resources contributed to military conflict by both groups, which we denote by D_h, $h = i, j$. We assume that

$$q = \frac{D_i}{D_i + D_j}{}^{11} \tag{5}$$

when $D_i + D_j \neq 0$; when $D_i = D_j = 0$ we assume that the group in power continues with probability one, i.e. $q = 0$.

At the third stage of the game, the group $h = i, j$ now in power decides what number M_h of members of the other group to eliminate.[12]

We shall denote by N_{vi} and N_{di} the population of group i living at the end of the game in each of the two states. Equivalently, we shall use N_{vj} and N_{dj}, with the caveat that N_{vj} means the population of j when i wins.[13]

[10] For the sake of expositional simplicity we assume that the fighting groups do mass killings only after seizing power. It is unquestionable that fighting groups may and sometimes do combine battlefield warfare with mass killings. However, allowing for mass killings at this second stage does not seem to add any interesting insight. If killings can be performed in two periods the groups will have to decide on the timing of the executions. This question might have some intrinsic interest, but is not at the core of what we want to examine. Furthermore, empirical evidence suggests that violent conflicts do not start with mass killings (see the sixth *thesis* on ethnic cleansing by Mann, 2005). Allowing for killings in the two stages would also permit to compensate for the killings suffered from the opposing group in the second stage. Once more, while this possibility suggests that our model may underestimate the level of killings, we think that the motivations in this case are adequately captured by our model. Including this possibility would not add any new insight.

[11] The qualitative results are the same for the more general form

$$q = \frac{\Phi(D_i)}{\Phi(D_i) + \Phi(D_j)}$$

with $\Phi(\cdot)$ strictly increasing and concave.

[12] The qualitative results do not depend on whether or not killing individuals of the other group has additional costs, beside the lost future production by them, hence the analysis will be done without adding any extra cost of killing.

[13] Recall that we use the term *mass killings* to denote the decrease in population size pro-

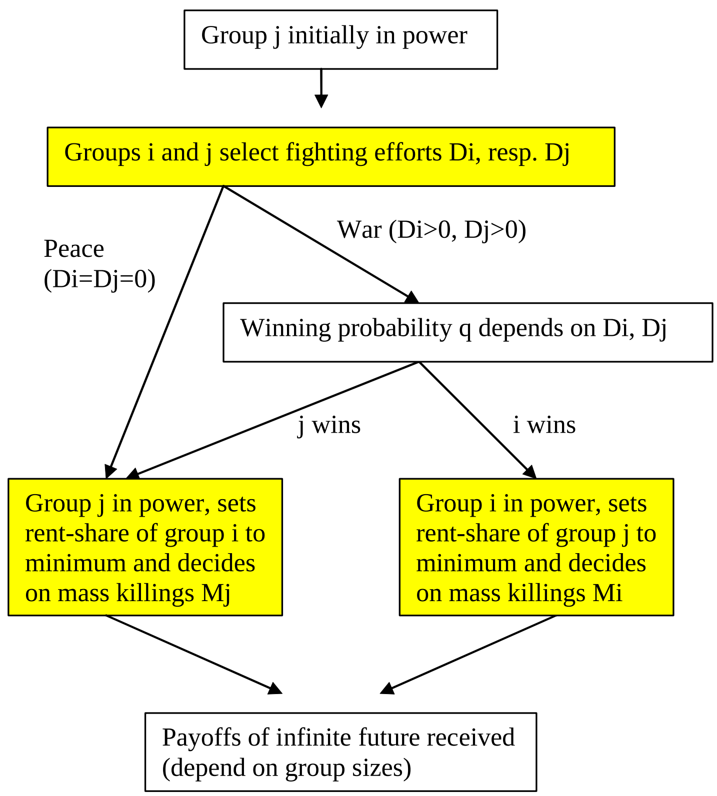

Figure 2: Timing

In state v the surviving population will be

$$N_{vi} = N_i \text{ and } N_{vj} = N_j - M_i. \tag{6}$$

In state d the surviving population is

$$N_{di} = N_i - M_j \text{ and } N_{dj} = N_j. \tag{7}$$

The probability of survival of an individual of group h in each of the two states is N_{vh}/N_h and $N_{dh}/N_h, h = i, j$. For individuals of group i the probabilities of being alive and in state v and of being alive and in state d are q and $(1-q)\frac{N_{di}}{N_i}$, respectively. For individuals of group j they are $q\frac{N_{vj}}{N_j}$ and $(1-q)$.

Therefore, if X_{sh} is the disposable income of group h in state s, the expected per capita payoff from starting conflict U_h^c/N_h is

$$\frac{U_h^c}{N_h} = \left[q\frac{N_{vh}}{N_h}\right]\frac{X_{vh}}{N_{vh}} + \left[(1-q)\frac{N_{dh}}{N_h}\right]\frac{X_{dh}}{N_{dh}} - \frac{D_h}{N_h} \tag{8}$$

where $X_{sh} = (1-t)\beta N_{sh} + g_{sh}\Big(t\beta N_s + E\Big)$.

Since N_h is exogenous and has no influence on individual decisions, we shall work with the group's total payoff $U_h^c = qX_{vh} + (1-q)X_{dh} - D_h$.

The winning group h imposes the shares $g_{sh}, s = v, d, h = i, j$ on the distribution of the government revenue in the future. To summarize the possibility that future conflicts may also arise depending on what shares the winner chooses, we assume that there are constraints on the share that the winner can impose upon the looser. Specifically, we assume that

$$g_{vj} \geq \lambda\frac{N_{vj}}{N_v} \text{ and } g_{di} \geq \lambda\frac{N_{di}}{N_d}, \lambda \in [0,1]. \tag{9}$$

In each state the winner obtains the rest. The closer λ is to unity, the closer the imposed distribution will be to fairness.

Let us momentarily pause and discuss in more detail the interpretation of parameter λ, as it plays a significant role in our analysis. One specific feature of a civil conflict, as opposed to an interstate conflict, is that the players are in an environment of repeated interaction and there is always going to be a common government budget and common pool of resources to fight over. The victorious group replaces a division rule of the common resources – a "social contract" – with another one. However, by how much the new distribution can depart from an egalitarian sharing —how low λ can be— is constrained by at least two types of factors: internal and external.

The internal forces moderating the abuse of the loser by the winner are the shadow of future rebellions and the degree of commitment to democracy.[14]

duced by the use of violence against non-combatant civilians. Therefore, this term includes displacements of the population, as well as the population actually murdered.

[14] This commitment can be the outcome of a genuine domestic process or the pressure exerted by the international community, thus external.

The threat of future rebellions by the losers clearly depends on their numbers. Hence, the minimum viable share has to be related to the population size of the losers. Likewise, if we take equal treatment as the quintessence of the democratic values, the higher is the respect to these democratic values the closer the share allocated to the loser will be to their population size.

A second type of constraint on the distributional shares is external to the country and originates in the international pressure for a “fair” treatment of the defeated group as an essential ingredient of democratization. It is a universally accepted standard of behavior by international organizations to condition aid or preferential tariff treatment, for instance, to the respect of human rights and to democratic, clean elections. Once more the constraint can be captured by the closeness of the distributional share to the population size of the losers.

With an admittedly drastic simplification we have pooled together all these potential pressures for “fairness” into the parameter λ. An increase in λ can capture either a process of democratization or a better coordination of the international community to impose a "fair" deal.

How will this constraint condition the imposed distribution? A first observation is that U_h is strictly increasing in the own shares of the division of the government revenue. Hence, the winner will always exploit victory by determining a share for the loser equal to the feasible minimum. This implies that

$$g_{vj} = \lambda \frac{N_{vj}}{N_v}, g_{vi} = 1 - \lambda \frac{N_{vj}}{N_v} \text{ and } g_{di} = \lambda \frac{N_{di}}{N_d}, g_{dj} = 1 - \lambda \frac{N_{di}}{N_d}. \tag{10}$$

Therefore, the disposable income in the two states will be:

$$X_{vi} = (1-t)\beta N_i + \Big(1 - \lambda \frac{N_j - M_i}{N - M_i}\Big)\Big(t\beta\big(N - M_i\big) + E\Big), \tag{11}$$

and

$$X_{di} = (1-t)\beta(N_i - M_j) + \lambda \frac{N_i - M_j}{N - M_j}\Big(t\beta\big(N - M_j\big) + E\Big). \tag{12}$$

Note that murdering part of the opponents has two effects on one’s payoff. First, by permanently weakening the opponent in its numbers, the winner can grant for its own group a larger share of the contested revenue. Second, reducing the population also reduces the part of the government revenue accruing from tax collection. The trade-off between these two effects will be crucial in the analysis, and will lead to some of the most interesting nuanced predictions about the relative role of the various parameters describing the economic structure of the country.

In the model, mass killings or any other method to change the distributive claims of the currently powerless group have the sole purpose of maximizing the monetary expected payoff of the group in power. Thus, the best strategy is independent of what happened earlier, war or peace. It follows that if group i decides not to rebel it will enter the third stage as if it had been defeated, except that it will not have faced fighting cost D_i (plus the fix costs that we shall introduce later on). Consequently, this group will be subject to the expected revised share of government revenue and potentially to mass killings. Taking all this into account, we have that the payoff if i remains in peace, U_i^p, is

$$U_i^p = X_{di} = (1-t)\beta(N_i - M_j) + \lambda \frac{N_i - M_j}{N - M_j}\Big(t\beta\big(N - M_j\big) + E\Big). \qquad (13)$$

We can now turn to the analysis of the strategic behavior of players.

3.2 Mass Killings

We solve the game by backward induction using the solution concept of subgame perfect equilibrium. In the third stage of the game the group in power is the only one who has a decision to make. Suppose that i is the winner so that we are in state v.

The winner selects M_i to maximize the future period payoff:

$$U_{vi}(M_i) = (1-t)\beta N_i + \left[1 - \lambda \frac{N_j - M_i}{N - M_i}\right]\big(t\beta(N - M_i) + E\big) \qquad (14)$$

subject to the constraint that $M_i \leq \bar{M}$.

The upper bound $\bar{M}$ corresponds to the maximum level of mass killings beyond which the international community would intervene and stop killings. We conceive the intervention by the international community setting $\bar{M}$ as quite different from the pressures for a higher λ on three counts. First, while one is based on the humanitarian objective of sparing the lives of non-combatant civilians, the other is politically motivated. Second, stopping the mass killings is done by military intervention following the agreement of the international community. Typically, the UN Security Council plays a crucial role (Doyle and Sambanis, 2006). In contrast, the pressures for democratization may not find such a unanimous support of the international community and this may explain why they are typically performed through international agencies such as the World Bank or the IMF, essentially controlled by the US and the EU. Third, the threat of international military intervention is activated while the armed conflict takes place, while the pressures for democratization are part of the post-conflict peace agreements and can extend over the future. We thus consider the two types of international intervention as independent of each other. We assume that, for instance, there might be an effective cap on mass killings and no pressure for democratization.[15] Symmetrically, there are instances —like the case of Iraq— of pressure for democratization independent of the murders of the ongoing civil war. Importantly, as shown in Doyle and Sambanis (2006), there are trends in UN interventionism, and hence our variable $\bar{M}$ can vary over time and may be subject to shocks.

[15] This corresponds to what Doyle and Sambanis (2006) call "first generation peacekeeping operations".

Coming back to the optimal choice of mass killings, by differentiating with respect to M_i we obtain:

$$\frac{\partial U_{vi}}{\partial M_i} = \frac{\lambda N_i E}{(N - M_i)^2} - (1 - \lambda)t\beta.$$

Note that for $E = 0$ we have that $\frac{\partial U_{vi}}{\partial M_i} < 0$, so that the highest payoff is obtained with no mass killings, $M_i = 0$.

Remark 1 *A necessary condition for mass killings is that $E > 0$.*

Differentiating again we have that

$$\frac{\partial^2 U_{vi}}{\partial M_i^2} = 2\frac{\lambda N_i E}{(N - M_i)^3} > 0.$$

For $E > 0$, the third stage payoff is convex in M_i and hence attains its maximum at a corner on the interval $[0, \bar{M}]$ (while M_j is zero for sure when i wins in stage 2).

Let us denote by $M_i^o(N_i)$ the threshold such that $U_{vi}(M_i^o) = U_{vi}(0)$. That is

$$M_i^o(N_i) = N - \frac{\lambda}{1 - \lambda}\frac{1 - \tau}{\tau}N_i \tag{15}$$

with τ as defined in (3).

The definition of $M_j^o(N_j)$ is analogous.

The term multiplying N_i in (15) plays a critical role in the analysis of the third stage of the game. The threshold level M_i^o is strictly decreasing in this term and in N_i. Hence higher values of $\frac{\lambda}{1-\lambda}\frac{1-\tau}{\tau}$ and higher relative size of the group in power make mass killings more likely. Specifically, it is critical whether $\frac{\lambda}{1-\lambda}\frac{1-\tau}{\tau} > (<)1$. Simply note that

$$\frac{\lambda}{1 - \lambda}\frac{1 - \tau}{\tau} > (<)1 \text{ as } \lambda > (<)\tau.$$

τ is strictly increasing in productivity and State capacity, and it is decreasing in the natural resources.

It can be easily shown that $X_{vi}(\bar{M}) - X_{vi}(0)$ is increasing in $\bar{M}$. Hence, if $\bar{M} \leq M_i^o$ the subgame perfect equilibrium has to feature $M_i = 0$. If $\bar{M} > M_i^o$ in the subgame perfect equilibrium we will observe mass killings.

This observation has an important implication: mass murdering is either performed at a large scale, $\bar{M} > M_i^o$, or not performed at all. In other words, it is when it is technologically or situationally feasible to implement a large mass killing (high $\bar{M}$) that such an option is likely to be chosen by the group in power at its maximum feasible level. In contrast, when the maximum amount of mass killings implementable is not very high (low $\bar{M}$) the only continuation equilibrium is no civilian murdering at all.

The choice of M_i is also subject to another feasibility constraint: the complete extermination of the opponent, $M_i \leq N_j$. We say that there is *genocide* whenever this constraint is binding and $M_i = N_j$. Therefore, whenever

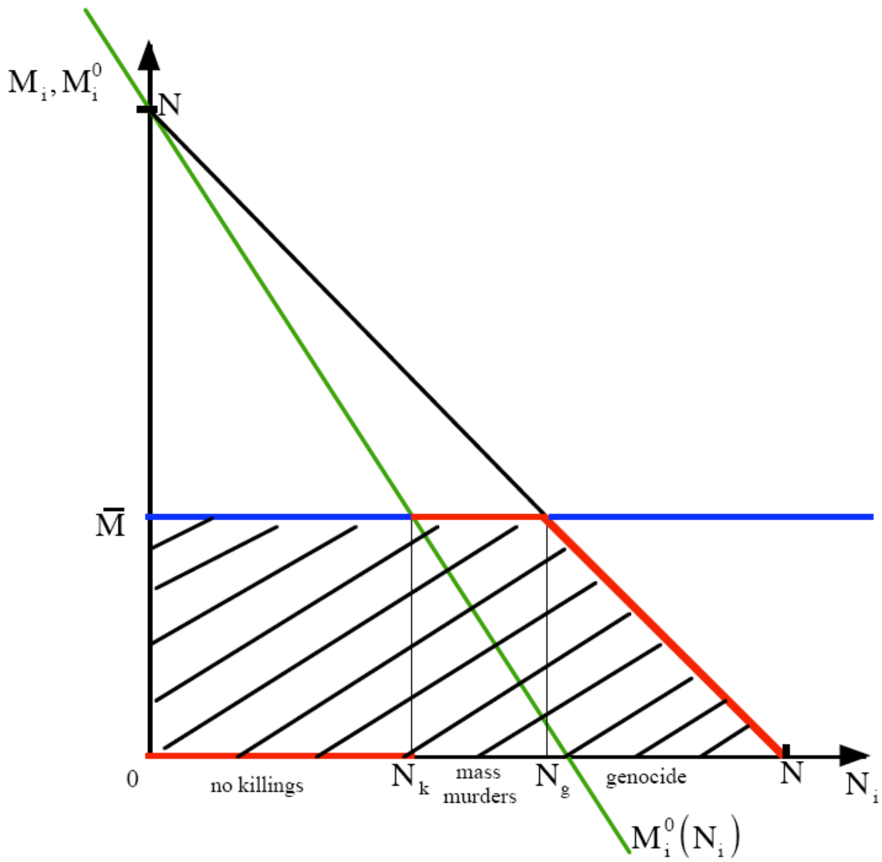

Figure 3: Mass Killings and Genocides

$M_i^o \geq N_j$, resp. $M_j^o \geq N_i$, we shall have that there will be no killings in the third stage of the game. In view of (15) this inequality is satisfied whenever

$$\lambda \leq \tau.$$

That is, when λ and/or E are small, and Y and/or t large. Notice that this condition generalizes the result in Remark 1.

Remark 2 *A necessary condition for mass killings is that $\lambda > \tau$.*

Before proceeding to the statement of our formal result, let us give a graphical presentation in Figure 3 of the conditions for mass killings.

On the axes we have group sizes and mass killings bounds and thresholds. We have drawn a -45^0 line passing through $(N, 0)$ and $(0, N)$, which represents the pairs (N_i, N_j) that add up to the given total population, N. The set of feasible M_i is the area below $min(\bar{M}, N_j)$, as it is constrained by $M_i \leq \bar{M}$ and by $M_i \leq N_j$. After $\bar{M}$ intersects the -45^0 line (at $N_g = N - \bar{M}$) we have that $M_i = N - N_i = N_j$ and we have genocide with the complete extermination of the opposing group for all $N_i \geq N_g$. Passing through $(0, N)$ we have the straight line with slope $-\frac{\lambda}{1-\lambda}\frac{1-\tau}{\tau}$ that represents equation (15) expressing M_i^o as a function of N_i. Clearly, whenever $\lambda \leq \tau$ there will be no mass killings because M_i^o exceeds the feasible set over the entire range of N_i. This is our Remark 2. Continuing with Figure 3, consider the value N_k defined by $N_k = (N - \bar{M})\frac{1-\lambda}{\lambda}\frac{\tau}{1-\tau}$ where this line intersects with $\bar{M}$. For values of $N_i \leq N_k$ there will be no killings, as $M_i^o > \bar{M}$. For $N_k \leq N_i \leq N_g$, mass killings jump up to $\bar{M}$ until the binding constraint becomes N_j, on the -45^0 line. After this point we observe full genocide.

We can therefore state the following proposition:

Proposition 1 *Let group h be in power in the third stage of the game. Let $N_k = (N - \bar{M})\frac{1-\lambda}{\lambda}\frac{\tau}{1-\tau}$ and $N_g = N - \bar{M}$. In the subgame perfect equilibrium strategy*

1. $M_h = 0$ *if either* $\lambda \leq \tau$, *or* $\lambda > \tau$ *and* $N_h \in (0, N_k]$;
2. $M_h = \bar{M}$ *if* $\lambda > \tau$ *and* $N_h \in [N_k, N_g]$; *and*
3. $M_h = N - N_h$ *if* $\lambda > \tau$ *and* $N_h \in [N_g, N)$.

With the help of Figure 3, let us now examine how the policy varies as a function of the different parameters. We have two possible changes to consider: variations in the slope of the $M_i^o(N_i)$ line and variations in $\bar{M}$. As the slope of the $M_i^o(N_i)$ line becomes steeper, the range of N_i for which there is mass murdering expands at the expense of no killings, but leaves the range of genocides unchanged. Therefore, first, if for given N_i we have $M_i = N_j$, this is independent of the parameters determining the slope of the $M_i^o(N_i)$ line, as long as it remains less than -1. Secondly, for small values of N_i, if this slope becomes steeper, it may provoke a jump from no killings to mass murdering at the level $\bar{M}$. This change in the slope depends on λ, β, t, E and N. Larger λ and/or E increase the range of N_i for which there are mass killings. In contrast, increases in productivity, State capacity and/or in total population[16] reduce the range for mass killings (but leave the range for genocide unaffected).

As for the effects of lowering $\bar{M}$ for given N_i when $\lambda > \tau$, it will eventually make mass killings turn into no-killings and turn genocide into mass killings.

We put together these observations in the following Proposition:

Proposition 2 *Let $\lambda > \tau$. For any given N_h, in the subgame perfect equilibrium strategy a sufficient decrease in E and/or λ and a sufficient increase in t, β*

[16] Notice that an increase in total population has the effect of reducing the weight of E on GDP. The same effect has increasing β.

and/or N can turn mass killings into no-killings, but has no effect if the strategy was to commit genocide, unless the shift in parameter values is so large that the zone of mass killings completely disappears. Also, as $\bar{M}$ decreases, genocide may turn into mass killings and mass killings may turn into no-killings.

Mass killings can occur when λ is too close to unity. When population shares have to be closely respected it pays to reduce the number of the opponents. Similarly, if the non-produced rent E is too large relative to the tax revenue $t\beta N$, exterminating the enemy will have little cost in loss of tax collection.

Using (14), let us finally compute the third stage payoffs for group i in state v under the three possible levels of mass killings:

- for $M_i = 0$ we have

$$U_{vi}(0) = (1-t)\beta N_i + \left[1 - \lambda\frac{N_j}{N}\right]\big(t\beta N + E\big). \tag{16}$$

- for $M_i = \bar{M}$ we have

$$U_{vi}(\bar{M}) = (1-t)\beta N_i + \left[1 - \lambda\frac{N_j - \bar{M}}{N - \bar{M}}\right]\big(t\beta(N - \bar{M}) + E\big). \tag{17}$$

- for $M_i = N_j$ we have

$$U_{vi}(N_j) = \beta N_i + E. \tag{18}$$

If group i enters the third stage as defeated there is no decision to be taken, but the payoff will be affected by the actions of group j, then in power. The corresponding payoffs are

- for $M_j = 0$ we have

$$U_{di}(0) = (1-t)\beta N_i + \lambda\frac{N_i}{N}\big(t\beta N + E\big). \tag{19}$$

- for $M_j = \bar{M}$ we have

$$U_{di}(\bar{M}) = (1-t)\beta(N_i - \bar{M}) + \lambda\frac{N_i - \bar{M}}{N - \bar{M}}\big(t\beta(N - \bar{M}) + E\big). \tag{20}$$

- for $M_j = N_i$ we have

$$U_{di}(N_i) = 0. \tag{21}$$

Notice that these payoffs are exactly the same player i will obtain if staying in peace. The payoffs to player j at the third stage of the game can be computed analogously.

3.3 Fighting Intensity

In the second stage of the game, players use the payoffs associated to the best responses in the third stage and compute the expected payoff using the win probability q. Then each group chooses the amount of fighting resources, D_i and D_j, that maximizes the expected payoff as a response to the fighting effort contributed by the opposing group.

If the rebel group decides to start a conflict in the first period, it has to incur a fixed cost K as well. The parameter K can be interpreted as a minimum size of necessary investment to have a positive probability of success. This minimum expenditure includes the establishment of an organization to coordinate the action and minimum number of armed people the opposition group needs to put on the ground to start having an impact.[17] In order to capture the advantage of being in power, we have assumed that the ruling group does not face this fix cost.

As seen from the second stage, conflict has two possible outcomes (v, d). The expected payoffs are

$$U_i = \frac{D_i}{D_i + D_j} U_{vi} + (1 - \frac{D_i}{D_i + D_j}) U_{di} - (D_i + IK), \tag{22}$$

where I denotes an indicator function taking value 1(0) if group i decides to (not to) rebel.

$$U_j = \frac{D_j}{D_i + D_j} U_{dj} + (1 - \frac{D_j}{D_i + D_j}) U_{vj} - D_j. \tag{23}$$

The precise values for (U_{vi}, U_{di}) and (U_{dj}, U_{vj}) are the ones computed in the previous section.

If group i decides not to rebel ($I = 0$), group i receives payoff U_{di} with probability 1 while saving the fixed cost of conflict; on the other hand, starting conflict and then choosing a zero fighting effort yields the same U_{di} with probability 1 but after spending K; hence it can never be part of an equilibrium behavior to declare war and then put zero fighting effort. Thus, the first stage decision to remain in peace or to rebel is equivalent to solving whether U_i is maximized by $D_i = 0$ or by a strictly positive military effort.

The payoff U_i is strictly concave in D_i. Differentiating U_i with respect to D_i in (22) we obtain

$$\frac{\partial U_i}{\partial D_i} = \frac{D_j}{(D_i + D_j)^2} \Big(U_{vi} - U_{di} \Big) - 1. \tag{24}$$

Thus the FOC implies that

$$\frac{D_j}{(D_i + D_j)^2} \Big(U_{vi} - U_{di} \Big) = 1, \tag{25}$$

[17] Small sized revolutionary groups are typically dismantled by the police, without an active participation of the army. It is only after a movement has reached a threshold level that it becomes a military threat. This is what K represents.

Denoting by Δ_i the utility differential $U_{vi} - U_{di}$, (25) can be written as

$$D_i = \sqrt{D_j}\sqrt{\Delta_i} - D_j. \tag{26}$$

From this expression we can easily deduce that

$$\frac{D_i}{D_i + D_j} = \frac{\sqrt{\Delta_i} - \sqrt{D_j}}{\sqrt{\Delta_i}}. \tag{27}$$

Multiplying now by D_i both sides of (25) we have

$$\frac{D_j}{D_i + D_j}\frac{D_i}{D_i + D_j}\Delta_i = D_i.$$

Using this result into (22) and rearranging we obtain the payoff when choosing D_i accordingly with (26)

$$U_i = U_{di} + \left(\frac{D_i}{D_i + D_j}\right)^2 \Delta_i - K. \tag{28}$$

We can now take into account the fix cost K in the choice of the best response. Combining (28) with (27), we have the following Lemma.

Lemma 1 *Let $\tilde{D}_j$ be defined as*

$$\sqrt{\tilde{D}_j} \equiv \sqrt{\Delta_i} - \sqrt{K}. \tag{29}$$

Then, for $0 < D_j \leq \tilde{D}_j$ the best response by player i is (26) $D_i = \sqrt{D_j}\sqrt{\Delta_i} - D_j$, and for $D_j > \tilde{D}_j$ is $D_i = 0$. When $D_j = \tilde{D}_j$ player i randomizes between the two responses with arbitrary probability p.

When $D_j = 0$, the best response by player i is $D_i = 0$ if $K \geq \Delta_i$, otherwise it is not well defined.[18]

This Lemma says that if the payoff differential between victory and defeat is small (relative to the fix cost of rebelling) the group out of power will choose peace. When will the payoff differential be large? We can obtain these differentials from the payoffs computed in the previous section from (16) to (21). One instance is when the group in power will engage in genocide or large scale mass killings. Also a small λ increases the gap between the two payoffs.

The best reply function is represented in Figure 4. It is concave, starts at the origin with infinite steepness, reaches its maximum when it crosses the 45 degree line, at $D_i = D_j = \frac{\Delta_i}{4}$, and intersects the axis at $D_j = \Delta_i$. At $D_j = \left(\sqrt{\Delta_i} - \sqrt{K}\right)^2 < \sqrt{\Delta_i} - \sqrt{K}$ the fix cost creates a discontinuity and D_i drops to zero.[19]

[18] In this case, in a discretized environment where $\epsilon > 0$ is the smallest positive fighting effort feasible, it would be optimal to choose $D_i = \epsilon$, with ϵ arbitrarily small.

[19] The shape of the best reply is the same as in Esteban and Ray (2010). This is a general feature of the class of conflict games with win probabilities of the form $q = \frac{\phi(D_i)}{\phi(D_i)+\phi(D_j)}$.

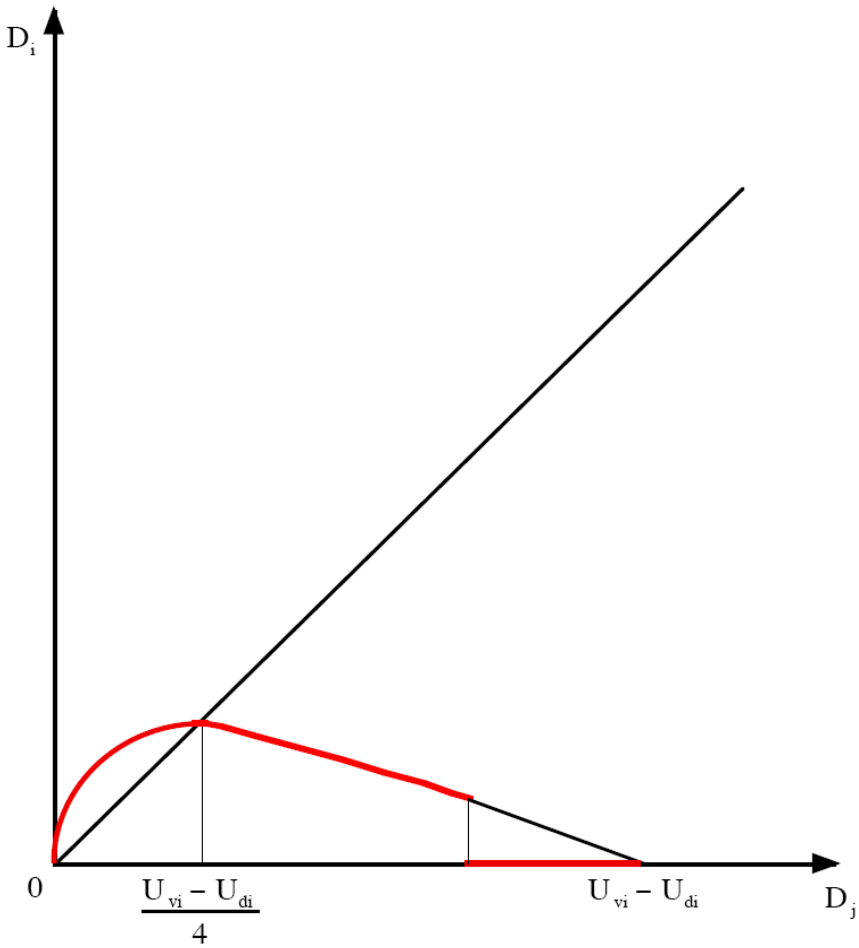

Figure 4:

The best reply function of player j is similar to that of player i, except for two differences. First, player j, being in power, faces no fix cost of conflict. Second, if player i chooses $D_i = 0$, its best reply is obviously $D_j = 0$.

Therefore, we have the following Lemma.

Lemma 2 *The best response by player j to $D_i \geq 0$ is given by*

$$D_j = \sqrt{D_i}\sqrt{\Delta_j} - D_i, \tag{30}$$

where

$$\Delta_j \equiv U_{dj} - U_{vj}.$$

We can now proceed to the characterization of equilibrium behavior.

3.4 Equilibrium

An *equilibrium* is a collection of strategies by each player, (M_i^*, D_i^*, p^*) and (M_j^*, D_j^*) such that M_i^* is optimal for player i in state v and (D_i^*, p^*) are best reply to D_j^* and M_j^* is optimal for player j in state d and D_j^* is best response to (D_i^*, p^*).

Start by noting that both M_i^* and M_j^* depend on exogenous parameters. Therefore, the equilibrium payoffs in the third stage of the game when the groups play M_i^* and M_j^* also depend on exogenous parameters. So do Δ_i^* and Δ_j^*. Therefore, in order to verify whether an equilibrium exists, we simply have to check whether the two best reply curves intersect when computed for M_i^* and M_j^*.

Let us for a moment put aside the role of K. Each of the two curves start at the origin with an unbounded slope, cross the 45 degree line and eventually intersect the respective axis. Therefore, they intersect and do so only once. Suppose now that because of K the best reply of player i drops to zero before intersecting with the other best reply curve. It is immediate that there is a probability $p \in (0, 1)$ such that $D_j^* = \tilde{D}_j$ when player i plays a mixed strategy playing $D_i = \sqrt{\tilde{D}_j}\sqrt{\Delta_i} - \tilde{D}_j$ with probability p and $D_i = 0$ with probability $(1 - p)$. We have thus proven the following result.

Proposition 3 *An equilibrium always exists and it is unique.*

We diagrammatically represent an equilibrium in Figure 5. The equilibrium strategies correspond to the point of intersection of the two best reply curves.

Using (26) and (30) we can readily obtain that the equilibrium fighting efforts are given by

$$D_i^* = \Delta_j \Big(\frac{\Delta_i}{\Delta_j + \Delta_i} \Big)^2, \tag{31}$$

and

$$D_j^* = \Delta_i \Big(\frac{\Delta_j}{\Delta_j + \Delta_i} \Big)^2, \tag{32}$$

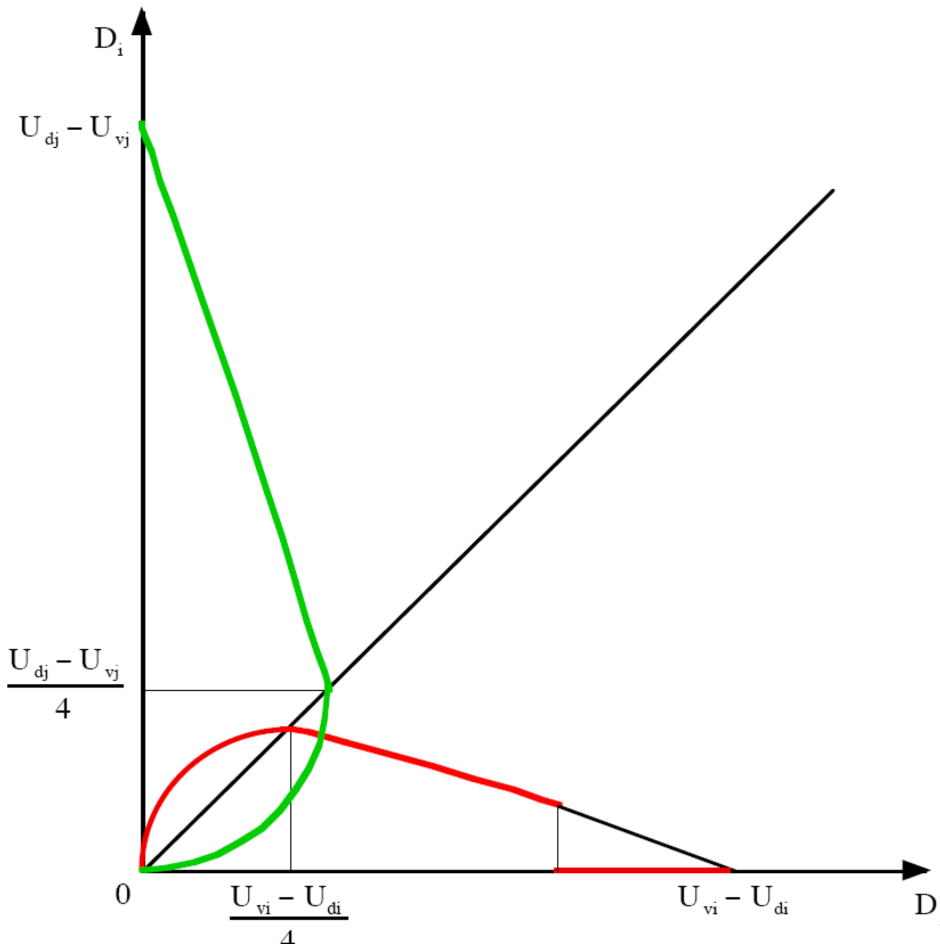

Figure 5: Equilibrium

whenever $D_j^* < \tilde{D}_j$ and otherwise we have $D_j^* = \tilde{D}_j$ and player i plays a lottery over $D_i^* = \sqrt{\tilde{D}_j \Delta_i} - \tilde{D}_j$ and $D_i^* = 0$ with probabilities p and $(1-p)$, respectively, with p chosen to make $\tilde{D}_j$ a best reply.

Note that when $K \geq \Delta_i$ the equilibrium features no battlefield warfare. If $K \leq \Delta_i$, the equilibrium win probability for group i, q^*, can be easily computed to be

$$q^* = \frac{\Delta_i}{\Delta_i + \Delta_j}. \tag{33}$$

This expression allows us to rewrite the equilibrium (D_i^*, D_j^*) in a useful form:

$$D_i^* = \Delta_i q^*(1-q^*), and \tag{34}$$

$$D_j^* = \Delta_j q^*(1-q^*). \tag{35}$$

Total warfare effort is

$$D^* = D_j^* + D_i^* = \frac{\Delta_i \Delta_j}{\Delta_j + \Delta_i}. \tag{36}$$

In the subsequent discussion it will be useful to distinguish between two possible equilibrium scenarios: *symmetric* and *asymmetric* third stage strategies of the groups. An equilibrium will display symmetric behavior if the two players choose the same equilibrium strategy for the third stage of the game. An equilibrium is asymmetric otherwise.

We shall denote by $\Delta_h(M_i, M_j)$ the utility differential between victory and defeat for a player h under the third stage strategies (M_i, M_j). Note that M_h can take on one of the following three values $\{0, \bar{M}, N - N_h\}$, corresponding to no murders, mass killings and genocide of the opponent.

Using (16) through (21) and the equivalent expressions for group j we can compute the corresponding utility differentials.

Lemma 3 *In symmetric equilibria the utility differentials are*

$$\Delta_i(0,0) = \Delta_j(0,0) = (1-\lambda)(t\beta N + E) \tag{37}$$

and

$$\Delta_i(\bar{M}, \bar{M}) = \Delta_j(\bar{M}, \bar{M}) = \Delta_i(0,0) + \lambda \frac{\bar{M}E}{N - \bar{M}} + \big(1 - 2(1-\lambda)t\big)\beta \bar{M}; \tag{38}$$

for asymmetric equilibria with mass killings are

$$\Delta_\ell(\bar{M}, 0) = (1-\lambda)(t\beta N + E) + \lambda \frac{N_\ell \bar{M} E}{N(N - \bar{M})} - (1-\lambda)t\beta \bar{M}, \tag{39}$$

and

$$\Delta_s(\bar{M},0) = \Delta_\ell(\bar{M},0) + \beta\bar{M}; \tag{40}$$

and with genocides are

$$\Delta_\ell(N_s,0) = t\beta N_\ell + E - \lambda\frac{N_\ell}{N}(t\beta N + E), \tag{41}$$

and

$$\Delta_s(N_s,0) = \Delta_\ell(N_s,0) + \beta N_s; \tag{42}$$

where s and ℓ stand for the smaller and larger group, respectively (here $i = \ell$).

Using now (31), (32), and (33) we can compute the equilibrium winning probabilities and warfare effort. Note that in an asymmetric equilibrium it has to be that group ℓ is the one that is doing mass killings.

Proposition 4 *We shall have peace with neither warfare nor mass killings if and only if $K \geq (1-\lambda)(t\beta N + E)$ and either $\lambda \leq \tau$, or $\lambda > \tau$ and $N_\ell \in (0, N_k]$.*

In case of conflict, the equilibrium probabilities of winning and fighting efforts are the following functions of the expected behavior after victory:

A. in symmetric equilibria:

$$q^*(0,0) = q^*(\bar{M},\bar{M}) = \frac{1}{2}, D^*(0,0) = \frac{\Delta_j(0,0)}{2}, D^*(\bar{M},\bar{M}) = \frac{\Delta_j(\bar{M},\bar{M})}{2}; \tag{43}$$

B. in asymmetric equilibria with mass killings:

1. when $N_j = N_\ell$

$$q^*(0,\bar{M}) = \frac{\Delta_j(0,\bar{M}) + \beta\bar{M}}{2\Delta_j(0,\bar{M}) + \beta\bar{M}}, D^*(0,\bar{M}) = \frac{\Delta_j(0,\bar{M}) + \beta\bar{M}}{2\Delta_j(0,\bar{M}) + \beta\bar{M}}\Delta_j(0,\bar{M}); \tag{44}$$

2. when $N_i = N_\ell$

$$q^*(\bar{M},0) = \frac{\Delta_i(\bar{M},0)}{2\Delta_i(\bar{M},0) + \beta\bar{M}}, D^*(\bar{M},0) = \frac{\Delta_i(\bar{M},0) + \beta\bar{M}}{2\Delta_i(\bar{M},0) + \beta\bar{M}}\Delta_i(\bar{M},0); \tag{45}$$

C. in asymmetric equilibria with genocide:

1. when $N_j = N_\ell > N - \bar{M}$

$$q^*(0,N_i) = \frac{\Delta_j(0,N_i) + \beta N_i}{2\Delta_j(0,N_i) + \beta N_i}, D^*(0,N_i) = \frac{\Delta_j(0,N_i) + \beta N_i}{2\Delta_j(0,N_i) + \beta N_i}\Delta_j(0,N_i); \tag{46}$$

2. when $N_i = N_\ell > N - \bar{M}$

$$q^*(N_j,0) = \frac{\Delta_i(N_j,0)}{2\Delta_i(N_j,0) + \beta N_j}, D^*(N_j,0) = \frac{\Delta_i(N_j,0) + \beta N_j}{2\Delta_i(N_j,0) + \beta N_j}\Delta_i(N_j,0). \tag{47}$$

We now proceed to the study of the effect of changes in group size and in the exogenous parameters on both types of strategic violence that we have analyzed.

4 Comparative Statics

We shall now examine the effects of the variations of the various key parameters on the warfare effort and the use of mass killings. To this effect we shall use the results collected in Lemma 3 and Proposition 4. All the parameters are embodied in the equilibrium differential $\Delta_h, h = i, j$, together with the additional direct effect of β and $\bar{M}$ in asymmetric equilibria. Since D^* is strictly increasing in Δ_h, our comparative statics exercises essentially focus on the effects of parameter changes on this payoff differential. In order to simplify the presentation we focus on the case in which $N_j = N_\ell$: the larger group is in power.

4.1 Group size polarization

We start by examining the effects of changes in group sizes on the two types of violence we deal with.

In the previous section we have seen that equilibrium behavior critically depends on whether we are in a symmetric or asymmetric equilibrium. When $\lambda \leq \tau$ both players will choose not to do mass killings and we shall thus observe symmetric behavior for all levels of group polarization. However, when $\lambda > \tau$ equilibrium behavior depends on how polarized society is.

Let us examine the case in which $\lambda > \tau$. Start by considering the perfect bipolar situation with $N_i = N_j = N/2$. Clearly, in this situation we shall observe symmetric equilibrium behavior. We can readily compute that the common strategy will be no mass killings whenever $\frac{1}{2}\frac{N}{N-\bar{M}} \leq \frac{1-\lambda}{\lambda}\frac{\tau}{1-\tau} < 1$ and mass killings otherwise. As polarization comes down one group becomes larger, say N_j, and the other smaller. In view of Proposition 4, when initially there were no mass killings the fall in polarization will have no effect neither on q^*, nor on D^*, until group j has become sufficiently dominant and starts doing mass killings in the third stage of the game, entering in an asymmetric equilibrium. If at the perfect bipolar distribution both groups use mass killings in their strategy, a fall in polarization will eventually make the smaller group shift to no mass killings.

Using (37) and (38) we can compare symmetric equilibria with mass killings and without and obtain that

$$D^*(\bar{M}, \bar{M}) - D^*(0,0) = \frac{1}{2}\left(\lambda \frac{\bar{M}E}{N-\bar{M}} + \big(1 - 2(1-\lambda)t\big)\beta\bar{M}\right) =$$

$$= \frac{1}{2}\frac{\bar{M}}{N-M}\Big[\lambda E + \big(1-2(1-\lambda)t\big)\beta(N-\bar{M})\Big].$$

From Remark 2 we know that a necessary condition for there to be mass killings is that

$$\lambda E > (1-\lambda)t\beta N.$$

Therefore,

$$\begin{aligned} D^*(\bar{M},\bar{M}) - D^*(0,0) &\geq \\ \frac{1}{2}\frac{\bar{M}}{N-\bar{M}}\left[(1-\lambda)t\beta N - (2(1-\lambda)t-1)\beta(N-\bar{M})\right] &> 0 \end{aligned}$$

because $(1-\lambda)t > 2(1-\lambda)t - 1$.

We have thus shown that $D^*(\bar{M},\bar{M}) > D^*(0,0)$. It follows that, if we compare across symmetric equilibria, mass killings and warfare behave as complements: warfare increases when mass killings is an equilibrium strategy in symmetric equilibria.

Once the size distribution is such that we are in an asymmetric equilibrium, the one sided threat of mass killings leads the smaller group i to put much more warfare effort. We can easily verify that $q^*(0,\bar{M}) > \frac{1}{2}$ and their win probability is thus higher than in a symmetric equilibrium. In asymmetric cases, within equilibrium behavior suggests that warfare and mass killings are substitutes. Furthermore, if we compute the warfare effort, we obtain that $D^*(0,\bar{M})$ is strictly increasing as polarization becomes lower.

We summarize these results in the following Remark:

Remark 3 *Concerning the role of the distribution of groups sizes we have obtained the following results:*

1. *In asymmetric equilibria the small group always puts more warfare effort per capita than the larger group. As the size difference increases and polarization falls, both groups fight harder, the difference between their fighting efforts becomes smaller, and q^* decreases towards $1/2$.*

2. *For very high levels of polarization the total warfare effort is independent of group size. However, for smaller levels of polarization warfare effort increases as polarization decreases.*

3. *Comparing across symmetric equilibria —hence with high polarization— mass killings and warfare behave as complements. However, in asymmetric equilibria —hence at low levels of polarization— the group that does not use the mass killing strategy is the one that puts in more warfare effort. Thus in those equilibria mass killings and warfare behave as substitutes. In sum, for high polarization mass killings and warfare are complements, but for low levels of polarization they are substitutes.*

Let's conclude this subsection with some general observations that come out of the above analysis. One thing that has clearly emerged is that it cannot happen that the small group is the only one doing mass killings. This seems to be in line with available evidence underscoring that mass killings and genocides are primarily carried out by the large ethnic groups, when they are in power.

A second general observation is that the small group, due to the expected violent consequences of defeat, has more at stake and hence shows a higher fighting activity in the battlefield. Irrespective of group size, they never spend less —over and above the fix cost— than the large group. The prediction that the rebel minority will fight *relatively* harder than the government also seems aligned with available evidence.

4.2 State capacity and productivity

We have repeatedly seen that the share of the tax revenue over the total government revenue, τ, plays a determinant role on equilibrium behavior. Increases in State capacity, t, and in productivity, β, both raise τ. We now jointly examine how groups of given size change their behavior as State capacity or productivity increase.

Using Lemma 3 and Propositions 1 and 4 and bearing in mind that $\bar{M} < N/2$, one can easily obtain the following result:

Remark 4 *For all types of equilibrium behavior, symmetric or asymmetric, increases in State capacity, t, or in productivity, β, increase the aggregate warfare effort, but eventually induce to stop mass killings, the smaller group first and the larger one later. Hence, increases in t or in β make mass killings and warfare behave as substitutes.*

When we contrast the implications of this result with evidence, we have an ambivalent reaction. While the smaller likelihood of mass killings seems to conform to facts, the implication that warfare effort will be larger seems difficult to reconcile with evidence. Note however, that the precise prediction of the model is that *conditional on there being conflict* the intensity of warfare will be positively related to state capacity and productivity.

How likely will it be that we observe peace instead of conflict? In view of Propositions 1 and 4, there being peace (i.e. neither fighting, nor mass killings) depends on two conditions that have to be simultaneously met. One is that either $\lambda < \tau$ or $\lambda > \tau$ and $N_j \in (0, (N - \bar{M})\frac{1-\lambda}{\lambda}\frac{\tau}{1-\tau})$. In this case, increases in t or in β make this condition more likely to be met. The second condition for peace is that $K \geq (1-\lambda)(t\beta N + E)$. Here, increases in t or β make this condition harder to satisfy. Thus the effects of increase State capacity or productivity run in opposite directions and we cannot come up with an unquestionable conclusion.

Note however, that the direction of the second effect is caused by the increase of government resources while K is kept constant. According to our interpretation of K, this should capture the minimum fixed costs that has to be incurred by insurgents to challenge the standing military and police forces in hands of the government. One could plausibly argue that K should increase with government resources, thus mitigating or reversing this negative effect and making peace more likely.[20]

[20] Note as well that for simplicity we have normalized the marginal cost of fighting effort to unity. In reality, however, leaders have to hire soldiers, resp. fighters, whose salaries are

4.3 Natural resources

Let us now examine the effects of increases in the natural resource generated rent component of public revenue E on the intensity of warfare, mass killings and the likelihood of conflict.

Using again Lemma 3 and Propositions 1 and 4 we obtain the following result concerning the natural resources abundance.

Remark 5 *For all types of equilibrium behavior, symmetric or asymmetric, increases in natural resource revenue, E, increase the aggregate warfare effort and make mass killings more likely. Hence, increases in E make mass killings and warfare behave as complements.*

As a country becomes more resource rich, the government revenue is less dependent of the productive activity of its population. As the cost of doing mass killings is lower murdering becomes more lucrative. As for warfare, it seems natural that the efforts are higher the more is at stake.

There is peace (i.e. both fighting and massacres are absent) if and only if:

- either $\lambda < \tau$ or $\lambda > \tau$ and $N_j \in (0, (N - \bar{M})\frac{1-\lambda}{\lambda}\frac{\tau}{1-\tau})$. Any increase in E reduces τ and this makes the conditions for peace —including the range of population levels— less likely to be met.
- The second condition for peace is that $K \geq (1 - \lambda)(t\beta N + E)$. Again, increases in E make this condition harder to satisfy.

We can thus conclude that an increase in E makes conflict and mass killings more likely. This is consistent with the empirical literature showing that the presence of natural resources increases the risk of civil war (see for example Ross, 2006, for a survey). The existing evidence on natural resources and mass killings is very scarce, but we will present in Section 6 some new findings consistent with the above predictions.

In the previous subsection we argued that as the government revenue increases so do the army and police forces —and K with them. If this were the case, the effect of an increase of E on the second condition would be less clear cut.

4.4 Limits to exploitation

We now deal with the consequences of a tighter pressure for a fair treatment of the losers, captured by an increase in λ. There seems to be a well established view that one of the essential roles of the international community is to stop unfair treatment of the opposition and to promote democracy. These are seen as means towards a more peaceful world. Our results challenge that wisdom.

Using once more Lemma 3 and Propositions 1 and 4 we obtain the following result concerning the tightening of the limits to unfairness.

an increasing function of β. Hence, in more productive countries the opportunity cost of becoming a professional soldier is higher, which makes conflict costlier, and peace easier to sustain.

Remark 6 *For all types of equilibrium behavior, symmetric or asymmetric, increases in λ decrease the aggregate warfare effort, but make mass killings more likely. Hence, increases in λ make mass killings and warfare behave as substitutes.*

According to our model, while a moderate pressure for fairness may be beneficial in that it reduces the intensity of warfare, a tight pressure may precipitate mass killings. The rationale is that the tighter the limitations to unfairness, the smaller is the gain in case of victory for the given population. This makes mass killings the most profitable strategy. External intervention, while having a long run positive effect, may in the short run trigger episodes of mass killings.

But, will an increase of pressure for fairness and democracy enhance or hinder peace? Following the same steps as in the previous subsections we can see that it will have an ambiguous effect on the likelihood of peace. While the first condition is harder to meet, the second condition is easier with an increase in λ. Once more the overall result is ambiguous.

Notice, however, that if the second condition is met but not the first one the model predicts that the government will do mass killings even without an uprising. Therefore, if a non-democratic country had been in peace and is induced to commit to democratization, our model predicts that the government may murder part of the opponents before starting the democratization process.

4.5 The "shadow" of mass killings

Even though the conditions for mass killings have been already dealt with when analyzing equilibrium behavior, we wish to briefly discuss the specific role of the "shadow" of mass killings on strategic behavior.

We have shown that in non polarized societies, where only the larger group wants to commit massacres, mass killings and battlefield warfare are substitutes, in the sense that the smaller group compensates for the fear of decimation if defeated by fighting harder than the other group. We have also seen that there is complementarity in symmetric equilibria: when both groups plan mass murdering in case of victory, both fight harder in the battlefield.

We can now ask what happens if $\bar{M}$ is lowered, i.e. if the threshold on mass killings before a foreign intervention is triggered is tightened. Lowering $\bar{M}$ obviously reduces the number of victims (conditional on there being mass killings), and secondly it makes them less likely by shrinking the set of group sizes for which there will be mass killings. Furthermore, in the symmetric case, with $\lambda > \tau$, we can easily obtain that battlefield efforts will also decrease.

Let us now discuss the asymmetric case where $N_i < N_j$, and only group j would want to commit massacres. Differentiating with respect to $\bar{M}$ in (42) we obtain that

$$\frac{\partial \Delta_i(0, \bar{M})}{\partial \bar{M}} = \frac{\partial \Delta_j(0, \bar{M})}{\partial \bar{M}} + \beta.$$

It follows that the warfare effort contributed by the smaller group relative to the effort by the larger one will have increased. Consequently, $q*$ increases too. Therefore, again, in relative terms warfare efforts are substitutes for mass killings in asymmetric equilibria.

Note that because $q^* > 1/2$ a further increase in q^* reduces the term $q^*(1-q^*)$ in (34) and in (35), the expressions for D_i^* and D_j^*. Hence, the total sign of the effect of $\bar{M}$ on the absolute levels of warfare efforts D_i^* and D_j^* cannot unambiguously be established.

The results obtained make sense. If the life toll of being defeated decreases because of a lower $\bar{M}$, the threatened group decreases its warfare effort. As for the larger group, the reduced possibility of increasing its payoff via a larger rent share (produced by murdering) partially compensates for a larger probability of victory.

Overall, if the international community had to decide whether to change policies in a way to reduce $\bar{M}$ or increase λ, the first channel should definitely be preferred, according to our analysis. However, a reduction in $\bar{M}$ also reduces the probability of winning on the battlefield for the minority group, and hence our analysis can also rationalize opposition to foreign intervention by leaders of minority groups.

5 Discussion and extensions of results

5.1 Mass killing incentives do not apply to interstate conflicts

If i and j are countries rather than groups in one country, then there are several differences with respect to the model analyzed in this paper. Internationally it is harder to enforce treaties, hence the maximum exploitation bounds are harder to conceive and implement. This amounts to saying that in the interstate crisis settings, the λ constraint that can be feasible is lower. If the λ constraint that can be imposed is lower, this automatically implies lower likelihood of mass killings in interstate wars even keeping the rest of the model unchanged.

Most importantly, two separate countries do not have a common government, do not have a common pool of resources and a common State capacity, so the incentives to exterminate the other country's population are lower because these people are not claiming a proportional share of a significant common pool of resources. Moreover, even if two neighboring countries discover natural resources at the borders and try to agree on a division of the future revenues, it is less likely than in domestic arrangements that the proportionality benchmark to group sizes would have any bearing.

5.2 Democratization and foreign "political" intervention

Let us now return to the multiple potential sources of changes in λ.

The parameter λ captures how well powerless groups expect to be treated de facto in a country. In this sense, $\lambda\frac{N_i}{N} - g_{0i}$ could be thought of as a measure of *democratization* or *improved minority protection.* We prefer to talk about democratization rather than democracy, or improved minority protection rather than absolute level of minority protection. The reason is simple: if the country has a stable regime and there are no external or internal new pressures to change the acceptable discrimination of minority groups, consistency would require that the initial share for group i, g_{0i}, be exactly equal to $\lambda \frac{N_i}{N}$. Thus the starting point, interpreted in that case as a steady state of a dynamic process, would have to be peaceful.[21]

On the other hand, the situations in which $\lambda \frac{N_i}{N} - g_{0i}$ is positive are instead situations in which our model fully applies, capturing therefore a transition phase, a phase in which the ruling group is expecting tighter limits to its ability to exploit or, by the same token, the rebel group expects the time to be right to change the unfair status quo.

Another interpretation of the variable λ is how tight outside constraints are for power-sharing. The variable λ can reflect foreign "political" interventions. It may depend on the pressure on the terms of the after war settlement. This pressure can involve conditions for qualifying for foreign aid or access to loans from international financial institutions. A higher λ could also reflect an expectation of an incipient democratization process imposed from outside pressures, leading eventually to less group discrimination. If the world's superpower(s) follow a so-called "Neo-Con" agenda and put a lot of pressure on rogue States and their leaders to adopt some ready-made democratic measures in favor of powerless groups this would be reflected in our model by a large λ.

Suppose λ was small because historically the international community had not been able to effectively intervene in civil wars. In this scenario, an increase in intervention —an increase in λ— has beneficial effects because it reduces battlefield warfare. However, as soon as it goes above the threshold, foreign intervention may trigger mass killings or genocide. We would obtain the same implication if, consistently with our first interpretation, the change is due to an expected democratization of the country (either domestically or international propelled).

Hence, one conclusion of our analysis is that at least in some situations this will not work. Forcing a "bad" leader to exploit less some minority than he would want in equilibrium may lead to a substitution and can give incentives for killing rather than exploiting some minority. The failure of externally imposed pseudo-"democracy" in the absence of a strong civil society has for example been observed in Iraq, Afghanistan, and in various African States.[22]

In what contexts is external intervention in domestic politics (i.e. imposing a large λ) especially problematic? A large λ increases the risk of mass killings. However, if the level of natural resources E is very low, even for a large λ mass killings are not feasible. Hence, while the Neo-Con agenda of imposing democracy failed in resource rich countries like Iraq they may have better chances to

[21] For this to be true, one should imagine that one of the determinants of the lower bound on exploitation of minorities is indeed the elimination of the incentives to further rebellions down the road.

[22] See Collier and Rohner (2008) for a systematic analysis of the conditions under which democracy can backfire.

succeed in resource-poor countries.

5.3 Extensions of the model

The model could be easily extended by allowing each group to have different wealth endowments, different productivity levels, and even separate control or property rights on natural resource discoveries, rather than assuming government control of all natural resources. Adding separate endowments w_i, w_j and separate natural resource rent controls, E_i, E_j, would be easy to do, and the results would not change qualitatively. An advantage of this extension is that it would make the model fit with the economic motivations behind the Holocaust (significant wealth to appropriate).

If we allowed for different distributions of property rights on natural resource rents between private and public, our analysis would suggest that natural resource discoveries would typically be more dangerous if the resources are directly owned and controlled by the government.[23]

A second extension to consider could be an explicit interpretation of λ as determined by the threat of future rebellions: the most the winners can appropriate is the "peace surplus", that is the equilibrium waste of a subsequent civil war. This depends on the population sizes of the two groups. Therefore, a richer analysis of strategic mass killings should include as an additional motivation that the decimation of the opponent also has an effect on their future capacity to rebel. The extension of our model to a fully dynamic framework is in our research agenda.

Beside the potential extensions to heterogeneous parameters mentioned above, a third important 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. If one thinks of Rwanda, the really important contestable resource there is productive land, and a combination of excessive population and decreasing returns from agricultural production could explain the mass killings incentives there.[24] This 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.

We would like to emphasize that the logic of our model could also be useful to capture the essential motivations behind the genocide 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 would have to attribute a lower β_i to the Indians and consider E as $E(N_i)$, capturing the fact that the amount of productive

[23] We also find in our empirical analysis that natural resources have a stronger impact on mass killings if they are State-owned (regression results are available from the authors).

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

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. In any case, it is obvious that these historical explorations are a research subject on their own. Now we limit ourselves to the analysis of the richer available data on mass killings occurring after World War II.

6 Empirical Analysis

We shall confront some of our predictions with the data.

One of the main purposes of the country level regressions in subsection 6.1 is to assess how robust the existing empirical evidence on mass killings and refugees is when important econometric issues are taken into account. Further, we want to include in the analysis several new variables, e.g. on natural resources, that play a crucial role in our model, but have been largely neglected in the existing literature.

The ethnic group level analysis performed afterwards in subsection 6.2 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 and displacements 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 these phenomena with a panel of ethnic group data makes sense, as in reality decisions to commit massacres are strategic decisions *at the group level* (as emphasized in our model).

6.1 Country level evidence

We shall start with 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 section 2, we use a dummy variable for mass killings and we run logit regressions. For the dependent variable in Table 1 we will rely on the most widely used dataset on mass killings, collected by the "Political Instability Task Force" under the direction of Barbara Harff. All independent variables are explained in detail in the Data Appendix. Our sample contains all countries that are in the Correlates of War system, i.e. which corresponds to all countries that have some minimum size and international recognition, and covers the years 1960-2007. This leaves us with between 2500 and 5000 observations depending on the specification.

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

1) There is usually an important omitted variables bias. 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.

	(1)	(2)	(3)	(4)	(5)
	Mass kill. Incidence	**Mass kill. Incidence**	**Mass kill. Incidence**	**Mass kill. Incidence**	**Mass kill. Onsets**
Incidence mass killings (t-1)		7.08***	8.14***	7.09***	
		(0.55)	(1.15)	(0.92)	
Oil production / GDP (t-1)		15.05***		24.17***	13.33***
		(4.15)		(7.14)	(4.26)
Oil reserves / GDP (t-1)			60.72***		
			(15.53)		
GDP per capita (t-1)	-0.00***	-0.00	-0.00***	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Ethnic polarization	1.86***	2.93**	5.11**	5.44*	2.91
	(0.51)	(1.42)	(2.25)	(2.79)	(1.81)
Democracy (t-1)	-0.11***	-0.01	-0.08*	-0.04	-0.03
	(0.02)	(0.04)	(0.05)	(0.04)	(0.05)
Democratiz. between (t-2) and (t-1)		0.09	0.01	-0.02	0.03
		(0.09)	(0.06)	(0.06)	(0.03)
Chief executive is military officer		1.08**	0.79*	1.08*	1.53**
		(0.51)	(0.43)	(0.58)	(0.73)
Population (t-1)	0.00***	-0.00**	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Trade / GDP (t-1)		-0.02***	-0.02**	-0.02**	-0.04*
		(0.01)	(0.01)	(0.01)	(0.02)
Mountainous terrain		-0.01	-0.03*	-0.02	0.00
		(0.01)	(0.02)	(0.01)	(0.01)
Civil war incidence	2.69***	1.96***	3.15***	2.11***	0.93
	(0.19)	(0.64)	(1.06)	(0.76)	(0.90)
Population density (t-1)		0.00	0.00**	0.00**	0.00**
		(0.00)	(0.00)	(0.00)	(0.00)
Average age of political parties				-0.03	
				(0.02)	
Std. errors clustered by country	No	Yes	Yes	Yes	Yes
Observations	4809	3197	2659	2574	3115
Pseudo R2	0.273	0.816	0.877	0.835	0.180
Log likelihood	-473.2	-74.92	-41.21	-42.61	-40.75

Note: Sample: 1960-2007. Logit regressions with intercept. *** p<0.01, ** p<0.05, * p<0.1. Standard errors in parenthesis.

Table 1: Regressions on Mass Killings

	(1)	(2)	(3)
	Refugees	**Refugees**	**Refugees**
Refugees (t-1)	0.86***	0.91***	0.86***
	(0.01)	(0.02)	(0.03)
Oil production / GDP (t-1)		13,648.37	27,163.27
		(25,704.15)	(42,214.25)
GDP per captia (t-1)	-0.03	0.07	0.11
	(0.15)	(0.07)	(0.14)
Ethnic polarization		853.41	-1,044.96
		(2,130.74)	(2,515.72)
Democracy (t-1)	-452.55***	-162.55	-329.10
	(169.27)	(182.33)	(278.68)
Democratiz. between (t-2) and (t-1)		260.56*	480.90**
		(150.67)	(208.38)
Chief executive is military officer		1,224.62	-2,016.44
		(2,825.82)	(4,787.65)
Population (t-1)		0.00	0.00
		(0.00)	(0.00)
Trade / GDP (t-1)		-16.73	-11.88
		(14.56)	(17.56)
Mountainous terrain		14.39	-49.27
		(50.46)	(78.75)
Civil war incidence	37,501.14***	25,712.99*	33,183.31**
	(4,244.99)	(13,512.34)	(16,344.06)
Population density (t-1)		0.59	-0.22
		(1.10)	(1.53)
Average age of political parties			-18.00
			(33.67)
Std. errors clustered by country	No	Yes	Yes
Observations	3073	1960	1639
R-squared	0.821	0.915	0.871

Note: Dependent variable: Total number of refugees by country of origin. Sample: 1960-2008. OLS with intercept. *** p<0.01, ** p<0.05, * p<0.1. Standard errors in parenthesis.

Table 2: Regressions on Refugees (by country of origin)

However, we cannot do this as some key explanatory variables like ethnic polarization are not time-varying. Hence, as a reasonable compromise we will cluster standard errors by country, which will already eliminate part of the problem. This is also the approach adopted by Montalvo and Reynal-Querol (2008).

2) The second problem is that the dependent variable mass killings is auto-correlated over time. Put differently, if in a given year mass killings occur it becomes much 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, 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 in the table (the former in columns 2 to 4, the latter in column 5).

3) The existing studies also use only a rather limited number of control variables, which increases the omitted variable problem. We add a range of new control variables. A further advantage we have is that most existing studies are dated, and we have 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 and displacements, which plays 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), and uses PRIO data on whether there are natural resource deposits in a country. This data has the advantage of being geo-referenced (which makes it valuable for analysis on the local or regional level), but it is not ideal for cross-country panels, as the ones used by us or Querido, as it does not contain information on the value of resources. Furthermore, Querido only includes the level of natural resources, which is per se not a disadvantage, but makes it hard to assess our model's predictions, which are about the ratio of natural resources to GDP. To address these issues, we use in our global sample a standard measure of the value of oil production from British Petroleum (2009), divided by the country's GDP.

Table 1 displays our results. In the first column we include the variables that have attracted most attention in the existing literature: GDP per capita, ethnic polarization, democracy, population and civil war incidence. Like in most of the existing literature we do not control for auto-correlation of the dependent variable, we do not use 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, a large population and the presence of civil war increases the risk.

	(1)	(2)	(3)	(4)	(5)	(6)
	massacres	**massacres**	**massacres**	**resettlem.**	**resettlem.**	**resettlem.**
% of group's territory covered with oil and gas	0.03***	0.02***		0.02**	0.02**	
	(0.01)	(0.01)		(0.01)	(0.01)	
% of group's territory covered with oil			0.03***			0.02**
			(0.01)			(0.01)
Group's pop. as % of country's pop.	12.24***	10.89***	12.11***	-3.20	-2.83	-3.32
	(2.92)	(2.74)	(2.97)	(2.29)	(2.17)	(2.39)
Group different language	-0.02	-0.05	-0.05	2.07**	2.08**	2.03**
	(0.65)	(0.66)	(0.65)	(1.01)	(0.95)	(1.03)
Group different race	-2.45**	-2.69*	-2.39**	-0.07	-0.05	0.02
	(1.21)	(1.40)	(1.21)	(0.54)	(0.54)	(0.52)
Group different religion	4.66***	4.34***	4.59***	1.51	1.48	1.54
	(1.55)	(1.55)	(1.56)	(0.94)	(0.93)	(1.00)
Group's economic differential index	0.71***	0.66***	0.71***	0.03	0.05	0.03
	(0.14)	(0.12)	(0.14)	(0.18)	(0.17)	(0.18)
Group has (strong) regional homeland	-0.95	-0.81	-0.91	0.89	0.84	0.85
	(1.02)	(1.15)	(1.02)	(1.14)	(1.18)	(1.13)
Group's autonomy grievances index	0.07	0.01	0.05	-0.21	-0.26	-0.24
	(0.27)	(0.30)	(0.28)	(0.46)	(0.46)	(0.45)
Country's democracy (t-1)	-0.42***	-0.41***	-0.41***	-0.09	-0.10	-0.09
	(0.12)	(0.13)	(0.12)	(0.08)	(0.08)	(0.08)
Country's ln GDP per capita (t-1)	0.00	0.05	-0.01	0.01	-0.01	0.02
	(0.77)	(0.80)	(0.78)	(0.32)	(0.33)	(0.33)
Country's growth (t-1)	-2.01	-2.30	-2.04	8.47	10.24	8.27
	(3.88)	(3.91)	(3.88)	(5.65)	(7.48)	(5.73)
Country's ln population (t-1)	2.19***	2.15***	2.17***	-0.41	-0.35	-0.43
	(0.55)	(0.57)	(0.56)	(0.32)	(0.29)	(0.33)
Mountains as % territory country	-0.10**	-0.11**	-0.10**	0.02	0.02	0.02
	(0.04)	(0.05)	(0.04)	(0.03)	(0.03)	(0.03)
Observations	657	657	657	657	657	657
Pseudo R2	0.448	0.494	0.448	0.190	0.234	0.193
Log likelihood	-37.56	-30.29	-37.57	-102.7	-81.43	-102.2

Note: Dep. variable: first row. Sample: 1996-2000. Logit with dep. var. as dummy in col. (2), (5), ordered logit otherwise. All col. with intercept, yrs dummies and errors clustered at country level (in parent.). *** p<0.01, ** p<0.05, * p<0.1.

Table 3: The determinants of victimization of ethnic groups

From column 2 on we now add clustered standard errors, we include the lagged mass killings and several additional control variables. The findings are as follows: A large ratio of oil production (resp. oil reserves) over GDP increases the risk of mass killings in all columns at a significance level of 1 percent. Also ethnic polarization significantly increases the mass killings risk in most columns. In contrast, GDP per capita and democracy levels are now usually insignificant. Democratization (i.e. the recent change in democracy levels) has a positive sign, but is insignificant. So is population and mountainous terrain. Having a military officer as chief executive, being in the presence of civil war and having a large population density are all factors that significantly increase the risk of mass killings, while large trade over GDP significantly decreases the mass killings risk.

As mentioned earlier, our theory applies to any form of costly elimination of members of the opponent group for the purpose of maximizing the future rent share. Instead of killing opponents, a group in power can take actions to make opponents leave the country. Therefore, our theory also applies to refugees. Table 2 displays analogous regressions as before, but with the number of refugees (by country of origin) as dependent variable. We use the same method and the same battery of independent variables as in Table 1. Again, all variables are explained in the Data Appendix.

Generally speaking, the sample size with refugees is smaller, and not many variables are significant once all controls are in place. However, what is most remarkable is the effect of democracy and democratization on refugees. Notably, democracy becomes insignificant once various control variables are included and standard errors are clustered. In contrast, recent democratization increases refugees significantly in all columns. This is in line with our argument that when discrimination becomes harder, there are stronger incentives for elimination / expulsion. Also civil war incidence and past refugee levels significantly increase the refugee levels in a given country and year.

6.2 Ethnic group level evidence

While the two tables in the last subsection used panels at the country year level, the table in this subsection uses a panel on the ethnic group year level. Hence, while the first two tables gave us the big picture of the main driving factors of mass killings and refugees, this third table allows us to study what kind of ethnic groups become victims of military massacres of civilians and of forced resettlements. As mentioned, to the best of our knowledge we are the first ones who study these two dependent variables at the ethnic group level.

To construct the dataset, we use as starting point the dataset of the "Minorities at Risk" (MAR) project which follows a multitude of ethnic minority groups over several years. 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). However, 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 and forced displacements. Second, and more importantly, we build a group-level variable of natural resource wealth. So far, only natural resource data on the country level has been used in related papers. Our group-level variable of petrol wealth allows us to identify more precisely whether groups in petrol-rich areas become more attractive targets for strategic elimination.

All data is explained in detail in the data appendix. Below we will focus on describing the construction of our novel independent variable, the percentage of a group's territory covered with oil and gas. First, we matched the ethnic groups in the MAR dataset with the ethnic group in the "Geo-referencing of ethnic groups" (GREG) dataset (Weidmann, Rod and Cederman, 2010), which allowed us to know the geographical coordinates of where a given ethnic group settles. Then we merged this with the geo-referenced petroleum dataset (PETRODATA) from Lujala, Rod and Thieme (2007), which tells us where oil fields lie. Combining this information we were able to compute 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. By attacking such groups the government can substantially increase its share and total amount of natural resource rents, but only marginally decreases the production output.

To study this we run logit, resp. ordered logit regressions for our panel. To control for unobserved heterogeneity we cluster errors at the country level and we add several standard country-level control variables. The real focus of table 3, however, lies on the effects of the group-level variables: With respect to massacres, we find that indeed groups that are rich in natural resources and relatively unproductive (i.e. having a large economic differential) are privileged targets. Relatively large minority groups who are serious contenders for political power are more likely to be victimized (note that all groups included in our dataset are minorities, with population shares typically well below 50%). While being of a different race does not increase the risk of being victimized, having a different religion does. Variables related to regional identity and autonomy grievances are not significant.

For resettlement, similar group-level variables matter: Again, groups that are more natural resource rich are more likely to be forcefully resettled, and groups speaking different languages than the majority are also more likely to suffer this fate. As before, identity and grievances do not seem to play a large role.

7 Conclusions

We have built a model of civil conflict in which the two main groups (ethnic, religious, or political) struggling for the control of the government can engage in costly fighting but can also choose to perpetrate mass killings. Mass killings can be enacted in the model only by the group in power, either in the absence of rebellion or after winning a civil war. The common resources the groups fight about are the tax revenue of the State and the rents from natural resources.

While the groups' expected utility is concave in their fighting effort, their expected utility turns out to be convex in mass killings, and hence the killings of civilians either do not happen or are performed at a large scale. Mass killings are chosen in the region of parameters characterized by many natural resources in the common pool and high expected pressure (international pressure for example) to maintain surplus sharing close to the shares proportional to relative population size. If the winner of a civil war expects such limitations to exploitation of the other group in terms of shares of the future common pools of resources, then the temptation arises to simply eliminate the people themselves who would have claims on such common resources. In other words, under high pressure on the post-conflict distributional shares, the only potential benefit from being in power is the possibility of cutting the population numbers of the opposing group. The main reasons why we only very rarely observe mass killings of civilians in conjunction with interstate wars, are that the enforcement of treaties on lower bounds of exploitation is less likely in interstate conflicts and that there do typically not exist common pools of resources on which countries can be assigned fixed sharing dependent on population sizes by a supra-national government.

Our analysis allows us to reach as well some novel and nuanced predictions about the connection between mass killings and fighting efforts. In not very polarized societies we end up in asymmetric equilibria where only the larger group would want to commit massacres if in power. In such settings the smaller group compensates for this by fighting harder in the first place. Hence, we can think in this case of mass killings and fighting efforts to be substitutes. In contrast, in polarized societies either both or none of the groups would want to engage in massacres when in power. We show that when the equilibrium features mass killings in the final stage, groups will fight harder. Thus, in symmetric equilibria mass killings and fighting efforts behave as complements.

We further find that productivity, state capacity and low proportionality constraints for rent sharing all tend to reduce the incentives for massacres, but increase the incentives for fighting. In contrast, natural resources are found to increase both the scope for fighting *and* for mass killings.

The paper also contains some novel empirical results: We show that the ratio of natural resource rents over GDP is a powerful predictor of mass killings in a global country level sample. More importantly, we are to the best of our knowledge the first ones to study the incentives for massacres and forced resettlements with a panel *at the ethnic group level.* This allows us to show that mostly groups with large natural resource holdings and a low productivity are victimized.

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Data Appendix

This appendix describes the data used in section 6.

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 ongoing. 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).

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

GDP per Capita: At constant 2000 US$. From World Bank (2009).

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 has (strong) regional homeland: Dummy recoded from the gc2 variable from Minorities at Risk (2009).

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

Group economic differential index: Variable Ecdifxx from Minorities at Risk (2009). High values correspond to ethnic minority groups that are economically less productive with respect to the country average.

Group population as % of country population: From Walter (2006).

Massacres (in Table 3): Military massacres of suspected rebel supporters (on the group level). From Minorities at Risk (2009), variable Rep22. In column (2) of Table 3 coded as dummy, taking a value of 1 when Rep22 equals 1 or more.

Mass Killings (in Tables 1 and 2): Dummy variable taking a value of 1 when mass killings are reported. From Political Instability Task Force (2010).

Mountainous Terrain: Percentage of territory covered by mountains. From Collier et al. (2009).

Oil Production: In million tones. From British Petroleum (2009).

Oil Reserves: Proved reserves in thousand million barrels. From British Petroleum (2009).

Party Age: Average age of the main government and opposition parties. From Beck et al. (2001), updated version 2007.

Percentage of group territory covered with oil and gas: As explained in the main text.

Percentage of group territory covered with oil: As explained in the main text.

Population: From World Bank (2009).

Population Density: From World Bank (2009).

Refugees (in Tables 1 and 2): Total number of refugees by country of origin. From UNHCR (2010).

Resettlements (in Table 3): Forced resettlements (on the group level). From Minorities at Risk (2009), variable Rep12. In column (5) of Table 3 coded as dummy, taking a value of 1 when Rep12 equals 1 or more.

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