How ethnic structure affects civil conflict: A model of endogenous grievance

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Abstract

Does ethnic structure affect the occurrence of civil conflict and, if so, how? This study develops an agent-based model of endogenous grievances which builds on the new constructivist conceptualization of ethnicity and the theories of group inequality and crosscuttingness. Specifically, I simulate conflict as a function of spontaneous economic disparities between nominal 'ethnic groups' with no predefined salient categories and related antagonism. Then I apply the model to reconsider the effect of (bidimensional) ethnic structure on conflict, which has been largely dismissed in recent scholarship. By varying the parameters of ethnic demography in artificial societies, I conduct a series of replicable experiments revealing that various structural settings yield systematically different patterns of conflict. While there is no 'most hazardous' structure per se, both polarization and crosscuttingness appear to decrease the likelihood of violence but increase its potential deadliness, which indicates a more general tradeoff of conflict incidence and intensity.

Keywords

Civil war, ethnic identity, group inequality, agent-based model

Introduction

Between 500,000 and 1,000,000 people were killed during the 100 days of Rwandan Genocide in 1994. While this massacre is conventionally viewed as a result of a recurring ethnic conflict between Hutus and Tutsis, it is much less clear how such a fierce antagonism based on a single group membership became possible in the first place. The striking fact is that most Rwandans share a common culture (including language, religion and traditions), which implies that ethnic cleavages and related enmity (or its absence) cannot be taken for granted.[1] What, then, might have contributed to the escalation of ethnic tensions? Empirical evidence suggests that persistent inequality between Hutus and Tutsis was a major factor (Stewart 2008). Apart from that, there is some corroboration that certain particularities of the Rwanda's ethnic demography induced the

conflict. For instance, it might have been the presence of two major rival groups, the situation of a privileged minority and deprived majority, or the absence of competing salient non-racial identities (Lieberman and Singh 2012*a*).

In this study, I shed light on these issues by simulating the emergence of ethnic conflict as a function of the stochastic economic disparities between nominal 'ethnic groups' with no initially predefined salient categories and related assumptions regarding 'intergroup relations.' While this is not the first work to apply agent-based modeling to the study of ethnic conflict, it is novel in two major ways. First, it models ethnicity as a partially endogenous variable. Second, it tests the effect of (bidimensional) ethnic structure and its properties on conflict, which has been largely dismissed in recent scholarship (Fearon and Laitin 2003). In particular, by varying the parameters of ethnic polarization and crosscuttingness in artificial societies, I conduct a series of replicable experiments revealing that various structural settings yield different patterns of conflict. While there is no 'most hazardous' ethnic structure per se, both polarization and crosscuttingness appear to decrease the likelihood of conflict but increase its potential intensity. In the end, I discuss the implications of these theoretical findings.

Since the end of World War II, intra-state armed conflicts have occurred in one-third of countries and resulted in up to 35 million deaths, which is four times higher than in the case of traditional interstate warfare for the same period. At the same time, the vast majority of these violent incidents are considered 'ethnic' in nature (Esteban et al. 2012). The conventional explanation of this fact often relies on essentialist assumptions of ethnic difference and thus refers to common contextual characteristics of ethnicity such as a particular culture and history. For instance, one may believe that ethnic groups have incompatible interests and evoke the framework of the security dilemma (Posen 1993) or allude to the power of emotions such as fear, hatred or resentment (Petersen 2002) as an explanation of intergroup conflict. Accordingly, it was hypothesized that a more diverse ethnic composition might indicate important political grievances in society which make states more prone to civil conflicts (Vanhanen 1999). Although most of these arguments have been formalized and have received some empirical support, it is still not conceptually clear exactly how distributions of ethnic groups should matter and why they should be more salient than other social cleavages such as those based on class or ideology.

As argued by the recent constructivist-inspired scholarship (Chandra 2012, 51), ethnic identities are "a subset of categories in which descent-based attributes are necessary for membership." These identities have only two intrinsic properties – 'stickiness' (constrained change) and 'visibility,' which should determine the causal mechanisms related to ethnicity and distinguish them from the effects of all other non-descent-based identities. The descent-based attributes, such as skin color, language and religion generate a repertoire of nominal ethnic identities (i.e. *ethnic structure*), which then might be activated by individuals themselves

and/or assigned by others in the society and thus transformed into actual ethnic categories (i.e. *ethnic practice*). There are numerous descent-based attributes, but only a few of them become socially and politically relevant. In accordance with this, Selway (2010) suggests that the existence of several non-related cleavages in society that 'crosscut' each other might reduce the likelihood of a civil war. At the same time, Stewart (2008) and her colleagues acknowledge the group nature of conflicts and point out the significance of economic and political disparities being coincident with ethnic identities. These between-group differences in income and power constitute so-called horizontal inequalities and provide a strong motivation for mobilization and potential violence.

Building on this updated conceptualization of ethnicity, the theory of group inequality and the emerging computational approach to the study of conflict, I model ethnic violence as a spontaneous consequence of intergroup economic disparity. These random inequalities induce intergroup comparison and thus engender ethnic grievances, which may potentially lead to mobilization and violent collective action. In this way, this study goes beyond the old essentialism-constructivism debate and instead draws attention to the intrinsic properties and politicization of ethnic attributes.

This study also breaks with the existing game theoretic literature on ethnic conflict (notwithstanding its significant contribution) by treating ethnic structure as a set of descent-based attributes with no assumptions regarding either cooperative or conflictual 'intergroup behavior.' As rightly noted by Epstein (2006, 22-23), "[g]ame theory may do an interesting job explaining the decision of one ethnic group to attack another at a certain place or time, but it doesn't explain how the ethnic group arises in the first place." In addition, I introduce multidimensionality of identity and the volatility of ethnic divisions into the model, which is more in line with the constructivist understanding of ethnicity. On a more conceptual level, instead of explaining ethnic conflict by demonstrating that it is a Nash equilibrium of some game, here I try to show how a population of autonomous heterogeneous agents with no predefined salient identities, interacting under some reasonable local rules, might engender such a violent state.[2]

Ethnic Structure and Civil Conflict

One of the most prominent models of civil war introduced by Collier and Hoeffler (2004) assumes that it is driven by either greed or grievance. Greed highlights the self-interested motivations and opportunity costs for rebels. Grievance emphasizes the motivations related to identity hatreds, inequality, repression and often includes ethnic diversity measures as its proxy. Overall, there is a growing consensus among scholars that such 'greed-related' aggregate-level factors as low income, large population, mountainous terrain and oil exports are positively correlated with the incidence of civil conflict (for a review, see Dixon 2009; Blattman and

Miguel 2010). Although the empirical evidence does not lend as much support to the grievance hypothesis, there have been constant attempts to revive it by using new data and more sophisticated measures (Buhaug et al. 2014).

Conventional wisdom states that ethnically divided societies are more prone to conflict. To capture this relationship, scholars have employed the measure of ethnolinguistic fractionalization (ELF), which indicates the probability that two randomly chosen individuals in the given society would have different ethnolinguistic backgrounds.[3] The underlying logic here is that the more ethnic groups there are in a given society, the higher the probability is of inter-ethnic political competition and thus of conflict (e.g. Vanhanen 1999). At the same time, other authors conversely argued that in more heterogeneous societies the coordination costs for collective action are increasing, which may reduce the propensity of conflict (Collier and Hoeffler 2004). An extensive analysis in fact showed that there is little evidence for either positive or negative effects (Fearon and Laitin 2003). These empirical conclusions induced other scholars to problematize the popular ELF measure criticized for its static and generalized nature, empirical inaccuracy and misuse (Esteban et al. 2012). But even with suggested adjustments, the question remained whether, how and why ethnic diversity might be related to violent conflicts. In the end, the comprehensive meta-analysis showed that the predominant evidence regarding the effect of fractionalization is inconclusive (Dixon 2009).

To overcome this conceptual deadlock regarding the role of ethnic demography, the civil war scholarship has adapted the notion of polarization from economics. Initially designed to examine the effect of economic inequality, this measure (when applied to ethnicity) indicates that conflicts are more likely to occur in the presence of two major equally sized groups. Given the logic of polarization, when there are two distinct groups, the differences between the groups are more evident and they are more likely to be alienated from each other. Moreover, there are more potential recruits, and thus it is much easier for political leaders to mobilize people along ethnic lines (Duclos et al. 2004). In other words, as opposed to fractionalization, polarization assumes that an increase in the number of groups leads to a reduction in social and political tensions. In accordance with this, scholars have developed the index of ethnic polarization, which appears to be a better predictor of conflict incidence than fractionalization (Reynal-Querol 2002; Garcia-Montalvo et al. 2005). Additionally, polarization turned out to be more even more robust in predicting the duration of conflicts (Montalvo and Reynal-Querol 2010).

While the measure of polarization is seemingly more theoretically sound than fractionalization, it is still entirely based on the groups' relative sizes. After all, the logic of both concepts implies that particular ethnic structures are more conducive to certain ethnic practices than others. Considering this, scholars have suggested other measures that were also supposed to reflect *ethnic salience* – the subjective importance of the ethnic dimension to people – such as ethnic minority rule (Cederman and Girardin 2007; Wimmer

et al. 2009). Although considering salience may provide a better way of assessing the role of ethnicity in civil conflicts, it still does not allow for demarcating the effects of ethnic structure and ethnic practice. For instance, it is not clear whether the former has an independent impact on conflict occurrence. In the end, the standard measures of ethnic structure not only fail to account for possible variation in ethnic practices across societies, but they also do not fully capture the complexity of ethnic demography, which goes beyond the groups' number and size.

Departing from the frameworks of Chandra (2012) and Selway (2011), I view ethnic structure as a combination of four major parameters: the dimensionality of the ethnic repertoire (e.g. skin color, language), the number of attributes within one dimension (e.g. skin color: dark, light; language: English, Spanish), the distribution of these attributes and the degree to which these dimensions are related, i.e. crosscut each other (e.g. how much more likely are people with light skin to speak English than Spanish). Quite importantly, all these structural parameters are in fact individual-level variables of one's nominal ethnic identity. By varying these parameters in artificial social systems, I conduct a series of replicable experiments to test for the possible causal effect of exogenous ethnic structure on the occurrence of conflict through the intermediate processes related to (partially) endogenous ethnic practice.

Individual Attributes and Collective Violence

Apart from the grievances driven by inter-ethnic group dynamics, both prominent studies of civil conflicts (Fearon and Laitin 2003; Collier and Hoeffler 2004) also examined the role of inequality (conceptualized in economic terms and measured via the Gini coefficient). The verdict was similar: there seemed to be no empirical evidence for the effect of economic inequality. Nonetheless, their research design was harshly criticized for not taking into account the possible combination of the two grievance dimensions or, in other words, between-group inequality.

Most prominently, Stewart (2008) argued that civil conflicts have a collective, not an individual, nature. Therefore, instead of measuring 'vertical inequalities' between individuals and general ethnic diversity that itself provides no rationale for a conflict, scholars should consider 'horizontal' inequalities (HIs) that capture multidimensional deprivation between groups and that provide motivation for mobilization and potential conflict. Subsequently, Ostby (2008) conducted a large-N study on the topic and found that social HIs (proxied by the difference in educational opportunities) indeed significantly contributed to conflicts. Her subsequent study also showed the analogous effect of economic HIs (Ostby et al. 2009), which was later reconfirmed with more elaborate geocoded data (Cederman et al. 2011), as well as by accounting for political exclusion (Buhaug et al. 2014). Finally, the effect of HIs was also implied in recent studies of crosscuttingness,

which demonstrated that civil war is twelve times less likely in societies where ethnicity is crosscut by socioeconomic class and geographic region (Selway 2011; Gubler and Selway 2012)

Group inequality is arguable one of the major factors that might link the individual attributes of ethnicity to the collective outcome of civil violence. But how exactly do HIs facilitate violent conflict? The causal mechanism here relies on the updated version of the Ted Gurr's (1970) prominent relative deprivation theory, whose analysis of disadvantaged minorities indicated that ethnic grievances may lead to violence through political mobilization. According to the recent theoretical framework outlined by Cederman et al. (2013), objective political and economic asymmetries (i.e. HIs) induce intergroup comparison and thereby transform into subjective grievances, which then, under certain conditions, may lead to group mobilization and violent collective action.

There is growing scholarly recognition that identity salience and thus support for collective action may be greatly amplified with increasing inequality between relevant social categories (Smith et al. 2012). Accordingly, intergroup relative deprivation might be more relevant than individual disparities to the occurrence of social conflict (Guimond and Dube-Simard 1983). While there are numerous identities that can potentially engender social cleavages, only a few of them may become really important to people. The intrinsic properties of ethnicity (stickiness and visibility) make it a perfect candidate for politicization (Chandra 2012), especially with the presence of some, even minimal and arbitrary, HIs (Cederman et al. 2013). As a result, the process of intergroup comparison consolidates the construction of ethnic categories out of descent-based attributes by making (initially nominal) identities more salient with the further increase in inequality (e.g., see Osborne et al. 2015).[4]

Notwithstanding the substantial contribution of the existing research on HI and ethnic conflict, neither traditional game-theoretical nor statistical approaches alone might be sufficient to model the causal chain with the sequence of several complex processes (e.g. economic inequality, intergroup comparison, mobilization and violence). The method of agent-based modeling (ABM), however, allows for such analysis which, in our case, must involve endogenous ethnic salience and its structural implications for conflict (for an introduction to ABM, see Epstein 2006; de Marchi and Page 2014).[5] Moreover, the ABM of ethnic conflict does not need to assume the reality of ethnic groups as unitary actors on the macro-level or even the homogeneity of actors within groups, which has long been the standard property in relevant game-theoretic models (for notable exceptions, see Lim et al. 2007; Sambanis and Shayo 2013).

Bhavnani and Miodownik (2008) were among the first scholars to use ABM for simulating the role of ethnic salience in conflict which was derived from economic disparities between two nominally rival ethnic groups. Overall, they confirmed the positive correlation between ethnic polarization and conflict onset, but they also found that the initial assumptions regarding ethnic salience largely moderate this relationship.

When the ethnic dimension is salient by default, which is implicitly assumed in most quantitative studies, conflicts are twice more likely than when it is permitted to vary (i.e. being a function of relative group income).[6] The authors conclude that "if indeed the importance individuals attach to their ethnic identities is a key determinant of conflict, then shifts in ethnic salience should assume center stage in explanations that link ethnicity to conflict" (Bhavnani and Miodownik 2008, 45).

Quite ironically, while Miodownik and Bhavnani aimed to eliminate the assumptions regarding static ethnic salience, they still stipulated a form of rivalry between groups, which can also be attributed to essentialism. For instance, one may argue that when ethnicity is not salient, there can be no ethnic groups in and out of power, because this dimension is simply irrelevant to people. In other words, when they assume that groups have different power, they already infer some implicit form of political horizontal inequalities at the initial stage of their simulation. As opposed to Miodownik and Bhavnani, this work attempts to refrain from postulating any assumptions that intrinsically lead to conflict.

The Agent-based Model

One of the main theoretical and practical challenges of ABM is to sufficiently generate relevant macro phenomena from bounded interactions of individual agents while constructing these agents and their behavioral rules in as simple a way as possible. In their seminal sugarscape model, Epstein and Axtell (1996) show how a sharply skewed wealth distribution and general heterogeneity of cultural traits can be 'grown' in an artificial society under the simple local rules of resource search/accumulation, sexual reproduction and cultural transmission. To minimize the complexity of my model, I take these results as exogenously given and then use them to generate endogenous ethnic antagonism.

The model developed here essentially represents an artificial social system (with temporal and spatial dimensions) in which N heterogeneous actors are engaged in individual economic activities. At an arbitrary time step t, each agent j is placed on a wrapped-around square grid at coordinate $j \in (x, y)$ and characterized by three major parameters: 'objective' well-being referred to as *wealth* (W_{jt}), 'subjective' well-being referred to as *happiness* (H_{jt}) and nominal ethnic identity(s) comprised of one or more *ethnic attributes* (E_{ij}).

At the very beginning ($t = 0$), all agents are given a random coordinate $(x, y)_{jt}$. Most important, each agent gets some initial wealth W_{j0} distributed randomly with an exponential distribution ($W_{j0} \sim Exp[\lambda]$) where λ is the rate parameter (see Epstein and Axtell 1996). To grasp various psychological differences and make the model less deterministic (see Epstein 2002), individuals are also endowed with a constant rate of 'happiness' (H_j) which has a normal distribution. Note that H_j and W_j are assumed to be independent.[7]

Agents 'work and consume', i.e. they constantly move across space and change their wealth. For the sake

of brevity, this economic activity is modeled simply as a random adjustment to the existing wealth of agents. However, this adjustment increases if an agent is rich, which is determined by the threshold parameter ψ. Specifically, ψ_t is the 4^{th} quantile of W_t (for the rationale, see Hu et al. 2006). Hence, at each successive point in time $t+1$, the wealth of an individual is determined by the following formula:

$$W_{j(t+1)} = W_{jt} \times \mathcal{N}(\mu, \sigma^2), \text{if } W_{jt} < \psi_t \tag{1}$$

$$= W_{jt} \times \mathcal{N}(\mu', \sigma^2), \text{if } W_{jt} > \psi_t, \text{where } \mu' > \mu \tag{2}$$

Departing from Chandra (2012), agents have one of the n number of descent-based attributes (E_{ij}) which nominally distinguish them from each other and constitute repertoires for the potential ethnic categories. In principle, the model is capable of simulating complex ethnic structure with an unlimited number of attributes within unlimited dimensions. For the purpose of simplicity, however, here I assume that each agent is characterized by one of the two 'color attributes' ($E_{1j} = \{0, 1\}$) and one of the two 'shape attributes' ($E_{2j} = \{0, 1\}$). Given that ethnicity is distinguished from other social attributes (e.g. partisanship, class) by its two intrinsic properties – relative 'stickiness' and 'visibility', here it is viewed as a constant characteristic. Accordingly, the model assumes that if an agent is born green, she cannot turn yellow and everyone knows that she is green, regardless of whether her 'greenness' is activated or not. Although some ethnic attributes can arguably be altered in one or more generations, the short-term changes in salience of ethnic identities are much likelier (for an evolution model of ethnicity, see Hammond and Axelrod 2006).

The ethnic attributes become salient or 'activated' only when they coincide with unequal wealth distribution, which occurs stochastically at a certain point in time due to the randomness of initial wealth distribution and its subsequent change. It is worth noting that, with a large number of agents, HI cannot be caused solely by the initial wealth distribution and rather emerges with time due to the spontaneous (but heterogeneous) process of economic activity. In other words, although I model ethnicity as originally non-functional (i.e. it has no effect on agents' behavior), it may become salient by chance via individual-based economic processes. In particular, with the rise of HI, all 'carriers' of the underprivileged attribute acquire another parameter - a feeling of *ethnic deprivation* (D^E_{it}), which is proportional to the strength of the HI at time t and identical across all members in the potential ethnic category E_i: $D^E_{it} = 1 - E[W_{it}]/E[W'_{it}]$ where $E[W_{it}]$ is the expected value of wealth for the underprivileged ethnic category of E_i at time t and $E[W'_{it}]$ - for the privileged one. The model assumes that agents may have several ethnic attributes, so their overall ethnic deprivation D^E_{jt} is the average of their possible group deprivations across all ethnic dimensions: $D^E_{jt} = E[D^E_{ijt}]$, which efficiently accounts for the complexity of ethnicity. When an agent's own wealth is below societal average, she also experiences *individual deprivation* (D^I_{jt}), which is inversely proportional to

her level of 'happiness': $D^I_{jt} = 1 - H_{jt}$ if $W_{jt} < E[W_{jt}]$.

It is important to acknowledge that, while the spontaneous emergence of interpersonal inequality is well-established (Epstein and Axtell 1996; Smith and Choi 2007), the occurrence of a significant intergroup inequality by chance is unlikely in reality. Empirically, the observed 'durable inequality' between ethnic groups around the world has often been a result of intentional and persistent 'exploitation' and 'opportunity hoarding' (Tilly 1999) such as related to conquest, colonization, discrimination and segregation (also see Cederman et al. 2013; Brubaker 2015). Consequently, the omission of ethnicity from the wealth determination formula in the model might be regarded as a strong simplifying assumption. Nonetheless, one could think of certain social processes such as peer effects that may amplify even initially negligible and largely random intergroup differences (see Bowles et al. 2014). This, in turn, may link individual economic activities and ethnic attributes to the substantial and self-perpetuating between-group inequality even without any deliberate ethnic exclusion.

Further, if agents are deprived both ethnically and individually, they start to foster grievances against the privileged group. The new individual parameter of *ethnic grievance* is calculated simply by multiplying the two deprivations ($G_{jt} = D^E_{jt} \times D^I_{jt}$) or:

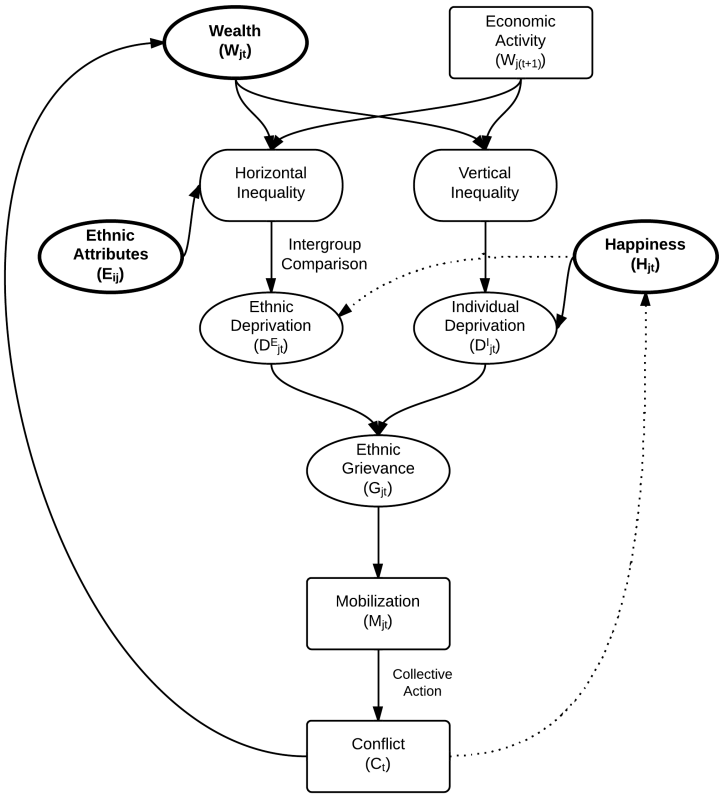
$$G_{jt} = E\left[1 - E[W_{ijt}]/E[W'_{ijt}]\right] \times (1 - H_{jt}) \text{ if } W_{jt} < E[W_{jt}] \text{ and } E[W'_{ijt}] > E[W_{ijt}] \tag{3}$$

When this grievance exceeds a certain level, i.e. becomes intolerable, an agent becomes *mobilized* ($M_{jt} = \{0, 1\}$), which indicates readiness to participate in violent collective action in the name of a newly emerging ethnic group: $M_{jt} = 1$ if $G_{jt} \geq \gamma$; $M_{jt} = 0$ if $G_{jt} < \gamma$ where γ is a threshold parameter.[8]

How do the 'activated' ethic grievances of *individual* agents transform into a *group* confrontation? The model assumes a simple "critical mass" mechanism (see Oliver 1993), in which the conflict ($C_t = \{0, 1\}$) emerges in the system if one of the deprived ethnic categories is more than δ-percent mobilized: $C_t = 1$ if $\sum M_{ijt} \geq \delta$. When conflict occurred, mobilized agents of the underprivileged group attack the neighboring agents of the privileged ones. They kill and are killed with a probability p (within a neighborhood of ethnic rivals), as well as cause some 'collateral damage' to the society as a whole (a small percentage k of the population is ceased). $P(K) = p + k$ if $C_t = 1$ where $P(K)$ is the probability of being killed in the conflict C_t.

Finally, there is an extensive literature that indicates a highly negative impact of civil conflict on development and people's well-being (for a review, see Blattman and Miguel 2010). Accordingly, when the conflict is over, all agents become 'quiet' again and their wealth becomes partially redistributed with a slight decrease in the overall wealth of the system: $W_{j(t+1)} = W_{jt} \times \mathcal{N}(\mu_2, \sigma_2^2)$ if $C_{t+1} = 0$ and $C_t = 1$. In

Figure 1: Model of Endogenous Grievance



Note: This is a visual representation of the model described in the paper. Ovals depict parameters (bolds are primary individual characteristics); rectangles depict basic behavioral rules; arrows depict causal linkages (dotted line is a mediated effect)

addition, the level of 'happiness' of the attacked privileged group decreases: $H'_{ij(t+1)} = H'_{ijt} \times \mathcal{N}(\mu_2, \sigma_2^2)$ if $W'_{ijt} > E[W_{jt}], C_{t+1} = 0$ and $C_t = 1$. In this way, I model the post-conflict ethnic structure, which is arguably more salient (for justification, see Fearon and Laitin 2000). In other words, the latter indirectly contributes to the intergroup antagonism and thus proxies the emergence of more 'essentialist' ethnic categories, which makes the following conflict likelier.

The general mechanics and components of the model are presented in Figure 1. The pseudocode and the model software visualization (Figure A1) can be found in Appendix. It is worth noting that there can be more realistic *strategic* ways to model economic activity and violent collective action even within the proposed agent-based framework (e.g. via a coordination game, see Epstein and Axtell 1996). However, the particular incentive-based mechanisms behind these processes have been extensively explored elsewhere and are arguably not crucial for the argument that relates group inequality (regardless of how exactly occurred) to conflict (Cederman et al. 2013, also see Discussion).

Results

Overall, I run two sets of replicable experiments with 100 iterations for each of the 10 different parameter settings, which are all aimed at exploring how the ethnic structure of a population may influence the likelihood of violent civil conflict. Each simulation involves over 1000 agents to make sure that the results are not driven by the skewness of the initial wealth distribution.

The first set of experiments (5 settings and 500 runs) is designed to test the possible impact of various nominal group proportions in the framework of unidimensional ethnic demography. Here I use *ethnic polarization* as treatment and set it to vary from an extreme value (when the population is split into two groups of equal size) to some intermediate values with the clear majority and minority. For the sake of a more lucid analysis, I adopt the parameter settings of polarization indices and corresponding group ratios used by Bhavnani and Miodownik (2008): 1.0 (50/50), 0.99 (45/55), 0.89 (35/65), 0.85 (25/75), 0.51 (15/85). The Reynal-Querol index of ethnic polarization is computed as follows: $RQ = 4\sum_{i=1}^{N} \pi_i^2(1-\pi_i)$ where π_i is a proportion of group i and N is the number of groups (Garcia-Montalvo et al. 2005, 798).

The second set of experiments (5 settings and 500 runs) examines the possible effect of crosscutting cleavages in the framework of a bidimensional ethnic demography. Here I use the index of *crosscuttingness* (CC) as treatment and set it to vary from a complete superimposition to a complete independence of different ethnic dimensions. The index is computed as follows: $CC = 1 - \sqrt{[\sum \frac{(O-E)^2}{E}]/nm}$ where O and E are the observed and expected proportions respectively, n is the sample size and m is the number of groups minus one in the least fractionalized cleavage (Selway 2011, 52). According to this formula, perfect crosscuttingness occurs when ethnic categories are statistically independent, i.e. information on membership in one group does not provide any information about another group. Consequently, in our case of the ethnic structure with two attributes, the perfect crosscuttingness (1.0) occurs when colors are identically distributed across shapes or vice versa. The partial crosscuttingness (0.25, 0.5, 0.75) designates social structure where agents of a certain color are (4, 2, 1.33 times respectively) more likely to have a certain shape.[9]

The main dependent variables in both cases are the number of casualties (or simply *dead*), the number of conflict incidences (or simply *conflict*). The conflict is considered to take place if someone dies (of ethnic-related violence) within one timestep. All the models run for not more than 500 timesteps or until 80% of population has ceased. In the end, I also measure whether the social system has been peaceful (*peace %*) or, at least, has survived (*survival %*) the designated time.

Table 1: The effect of ethnic polarization on conflict

RQ	Ratio	Dead*	Conflict*	Peace*	Survival*	n*	*Dead***	*Conflict***	n**
0.51	85/15	184 (229)	4.3 (5.6)	47%	95%	100	*347 (204)*	*8.1 (5.4)*	53
0.85	75/25	239 (277)	4.0 (5.4)	48%	92%	100	*460 (212)*	*7.7 (5.2)*	52
0.89	65/35	269 (305)	3.5 (4.3)	48%	92%	100	*517 (224)*	*6.8 (3.8)*	52
0.99	55/45	177 (294)	2.1 (3.7)	67%	90%	100	*537 (259)*	*6.3 (3.7)*	33
1.00	50/50	252 (311)	2.9 (3.8)	52%	88%	100	*524 (241)*	*6.0 (3.3)*	48

Note: The data are generated by computer simulations; * – for the whole sample (n = 500); ** – for the non-peaceful subsample (n = 238). The effect of polarization (from RQ = 0.51 to RQ = 1.00) for *dead* and *conflict* is statistically significant (t=-3.99, df=99, p < 0.000; t=2.32, df=99, p = 0.020 respectively). Standard deviations are in parentheses. RQ – Reynal-Querol index of ethnic polarization

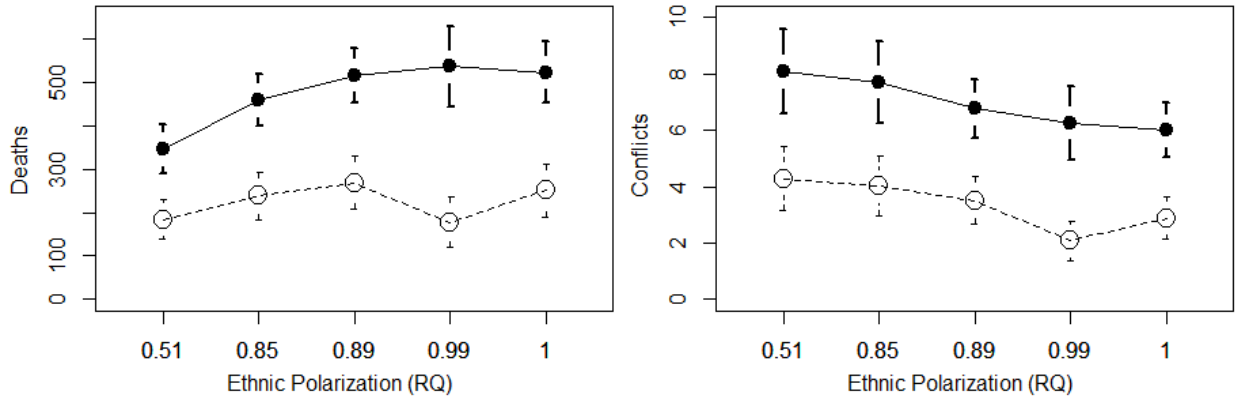
Experiment 1: Unidimensional Structure

According to the recent empirical analysis of Sambanis and Shayo (2013, 294), "polarization per se – computed without taking into account the (partly endogenous) salience of ethnic cleavages – is a rather poor predictor of civil war incidence." What happens when the non-constant nature of ethnicity's relevance is considered? As it can be seen from Table 1, the first experiment shows that the effect of the ethnic structure is still contentious. Quite expectedly, in polarized societies the death toll is higher and the survival rate is lower. Nevertheless, such systems are also characterized by fewer conflicts and a higher frequency of peaceful states.[10]

The big standard deviations of the means for *dead* and *conflict* reflect predominantly peaceful nature of the observed artificial societies. For instance, more than a half of the cases (52.4%) experienced no violence at all. At the same time, there seems to be a tendency for the less frequent survival *and* the fewer number of conflicts in more polarized systems. Furthermore, while it may be hard to see a relationship between polarization and the number of deaths in the raw data, filtering out the peaceful states gives a much clearer picture of its positive effect. Overall, this evidence suggests that, under the polarized structure, conflicts are less frequent but more severe (Figure 2).

What are the possible explanations for these results? The model lacks political and institutional content, but the groups are still unequal in their economic resources (which essentially brings up conflicts in the system). While the situation of a perfect polarization only assumes that one of the groups might be better off than the other, lower polarization also makes it possible to have a (demographic) minority or majority domination. If we split simulations according to whether the first conflict was initiated by an economically deprived majority or minority, it turns out that this factor significantly affects the patterns of conflict. As can be seen in Figure 3, societies with a dominating minority unconditionally experience deadlier conflicts that may, nonetheless, be less frequent under low polarization. In addition, such societies have a significantly

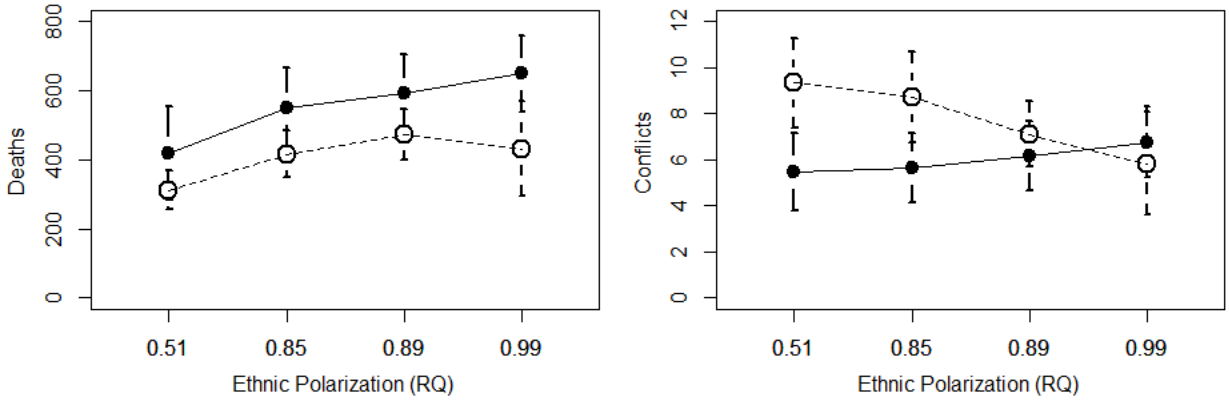
Figure 2: The effect of ethnic polarization on conflict



Note: Dotted lines represent the whole sample (n = 500). Solid lines represent the non-peaceful subsample (n = 238). Each dot depicts the mean level of deaths or conflict incidents under a particular value of ethnic polarization. Vertical bars indicate 95% CI. The data are generated by computer simulations (also see Table 1)

higher variability of deaths but a lower variability of conflict incidents (see Table A1). More generally, the effect of minority domination seems to resemble the effect of polarization by producing more peaceful societies that, however, also have a lower probability of survival. Although this may require further investigation, it seems that the combination of a highly (but not perfectly) polarized society with a dominating minority yields the most intense but rare conflicts.[11]

Figure 3: The effect of ethnic polarization on conflict intensity by minority domination



Note: Solid (dotted) lines represent minority (majority) domination for the non-peaceful sample (n = 238). Each dot depicts the mean level of deaths or conflict incidents under a particular value of ethnic polarizaiton. Vertical bars indicate 95% CI. The data are generated by computer simulations (also see Table A1)

Experiment 2: Bidimensional structure

What happens when the ethnic structure is bidimensional and furthermore it is characterized by a non-zero degree of crosscuttingness? The results of the second experiment (Table 2) are even less straightforward. On the one hand, the survival rate has a negative relationship with the CC index, which is hardly in line with the conventional wisdom on crosscutting cleavages. On the other hand, however, the existence of multiple crosscutting ethnic dimensions in the society seems to engender more peaceful states with no occurrence of ethnic conflicts. For instance, in societies with perfect (1.0) ethnic crosscuttingness, absolute peace is much likelier than in the state of zero crosscuttingness. Relatedly, the higher CC leads to the smaller variance in the number of conflicts. The data indicate that ethnic crosscuttingness decreases the probability of a first conflict in the system but makes it much more severe if it occurs. In other words, crosscuttingness reduces the salience of a particular ethnic dimension and thus makes it harder for grievances to emerge in the first place. However, if the system happens to experience conflict, the causative ethnic cleavages, which are more complex than in the case of zero crosscuttingness, become even more salient and potentially provoke greater violence. These results notwithstanding, we also see that the numbers of deaths and conflicts do not change systematically with the increase of crosscuttingness.

Overall, while ethnic crosscuttingness seems to reduce the likelihood of conflict, it also makes potential ethnic violence more severe. Interestingly, these patterns are quite similar to the effects of polarization and of minority domination. It is worth emphasizing that these results do not in principle contradict the conclusions of Gubler and Selway (2012) regarding the mitigating effect of crosscuttingness. For instance, while the present experiment examines crosscutting ethnic attributes (related to the ethnic structure), Gubler and Selway explore the crosscutting ethnic categories (related to ethnic practice) and also various non-ethnic categories.

Discussion and Conclusion

The purpose of the paper was twofold. First, I aimed to demonstrate how ethnic grievances and related violence might emerge from the individual behavior with no predefined salient intergroup cleavages. To accomplish this, I devised a model that viewed ethnic conflict as a function of spontaneous group inequalities with the intermediate processes of intergroup comparison and mobilization. The ABM method was particularly suited for these purposes because, under minimal assumptions, it enabled controlled 'thought' experiments that would have been impossible to implement empirically. Second, I used this model to simulate and explore the possible effect of ethnic structure on the likelihood of conflict by varying the parameters

Table 2: The effect of ethnic crosscuttingness on conflict*

RQ(c)	Ratio(c)	RQ(s)	Ratio(s)	CC	Dead	Conflict	Peace	Survival	n
1.00	50/50	1.00	50/50	0.00	629 (236)	18.0 (9.2)	2%	51%	100
1.00	50/50	1.00	50/50	0.25	634 (261)	16.5 (8.5)	3%	41%	100
1.00	50/50	1.00	50/50	0.50	686 (231)	16.5 (7.9)	5%	28%	100
1.00	50/50	1.00	50/50	0.75	641 (274)	15.7 (8.0)	6%	36%	100
1.00	50/50	1.00	50/50	1.00	694 (230)	16.5 (7.1)	6%	27%	100

Note: The data are generated by computer simulations (n = 500); * – this set of experiments is not directly comparable to the previous one due to the assumption that various ethnic dimensions reinforce each other. ANOVA indicates that the *dead* and *conflict* variance within CC groups is larger than the variance across them (F=0.789, p = 0.500; F=0.649, p = 0.584 respectively). Standard deviations are in parentheses. RQ(c)/RQ(s) – Reynal-Querol index of ethnic polarization for the color/shape attribute; CC – Selway's index of crosscuttingness

of ethnic dimensionality, group proportions and their crosscuttingness.

Despite the conventional claim of ubiquitous ethnic grievances, there is substantial empirical evidence showing how the subjective importance of ethnicity greatly varies within and between countries, as well as across time.[12] Correspondingly, in this work I assert that, besides the commonly acknowledged incentive and institutional mechanisms (see Fearon and Laitin 1996), ethnic peace might prevail due to the fact that the existing ethnic repertoire is often not relevant enough for people to induce intergroup grievances. Departing from rather minimal constructivist assumptions, I demonstrate how nominal descent-based attributes might become salient and potentially trigger conflict simply due to the spontaneity of individual economic activity.

Fearon and Laitin (2003, 75) also famously conclude that "it appears not to be true that a greater degree of ethnic or religious diversity - or indeed any particular cultural demography – by itself makes a country more prone to civil war." Indeed, we can be confident that no specific ethnic composition might be sufficient for conflict initiation. However, the computational study described above reveals that some structures seem to yield more intense but rare conflicts than others. Although the empirical evidence is mixed (Collier and Hoeffler 2004), there is considerable literature on civil war arguing that ethnically polarized societies are more prone to conflict (Reynal-Querol 2002; Garcia-Montalvo et al. 2005). In contrast, my computational analysis suggests that polarization might actually decrease the likelihood of violent outbreaks. Moreover, as opposed to the results of Montalvo and Reynal-Querol (2010), the simulations done here do not indicate that polarization increases the duration of conflicts. Nonetheless, I show that polarized societies, though less conflict-prone, might be susceptible to more intense violence, which points out to the unjustly disregarded dimension of conflict severity. It is worth noting that, despite conventional assumptions, the model emphasizes the theoretical distinction between the expected number of battle deaths – a standard indicator of conflict intensity – and the underlying rate of societal survival. As shown by simulations, these

two factors do not necessarily covary.

Another strand of literature contends that non-polarized structures might actually exhibit more conflict than polarized ones if a society has a deprived ethnic majority (Cederman and Girardin 2007; Wimmer et al. 2009). Notwithstanding these results, my analysis indicates that the effect of (economic) ethnic minority domination might in fact resemble the general effect of polarization leading to less probable but deadlier conflicts. Finally, some scholars build on classical literature (Lipset 1959) and argue that the existence of various cross-cutting cleavages in society reduces the risk of conflict occurrence (Selway 2010). Although my results provide some support for this idea, they also indicate that crosscuttingness, similar to polarization, leads to more severe conflicts.

Overall, these findings combined help explain why it has been so difficult to determine the effect of ethnic demography on civil conflict. Most important, the likelihood of conflict initiation and the intensity of conflict seem to move in opposite directions. Furthermore, non-polarized societies might not be less hazardous than the polarized ones due to their propensity to yield a particular ethnic practice of minority rule. Interestingly enough, these results are line with the argument of Esteban and Ray (2008), even though their game-theoretic model of conflict is very different from the one developed here. While there is no most 'hazardous' ethnic demography per se, the patterns of ethnic violence seem to systematically vary in accordance with the tradeoff of conflict incidence and intensity.

Of course, conceptualizing ethnic grievances as a function of spontaneous group inequalities with no strategic component of wealth or power accumulation is surely a simplification. Specifically, although agents are implied to care about their relative wealth both in individual and group terms (in order not to be deprived), there is no explicit utility function to maximize in the model. Likewise, the model is silent regarding the potential effect of ethnic attributes and their distribution on economic activity (Akerlof and Kranton 2000) and thus group inequality (Bowles et al. 2014). Therefore, in future research scholars may find it fruitful to explore whether the mechanisms modeled in the current study are affected by some of the traditional strategic factors such as related to incomplete information and commitment problems.

Furthermore, it would be quite imprudent to argue that inequalities are always translated into grievances and grievances always lead to violence, but the model has no elites or other political bodies involved. Meanwhile, there is a reason to believe that the state and other formal institutions play a significant role in breeding ethnic salience by politicizing particular attributes and excluding certain categories (Wimmer et al. 2009; Lieberman and Singh 2012*b*; Cederman et al. 2013). Accordingly, here I do not take into account the political dimension of between-group inequality, as well as the possibility of relevant salient non-ethnic (i.e. changeable) cleavages (e.g. partisanship). Finally, the model has no government, while most of the studies assume that civil conflict involves state as one of the parties. Consequently, although the basic mechanisms

of ascribed identification and intergroup comparison modeled here are arguably likely to apply to a wider range of cases, one may contend that the model is more reminiscent of communal violence or pogroms rather than large scale civil conflicts.

Although I concur with these concerns, I also believe that the premise of this model was different. Its aim was to show how ethnic violence might emerge with no assumptions regarding the primordial antagonism between peoples and to test some prominent conjectures regarding the role of ethnic demography. Considering this, spontaneous economic disparities provided a rather limited but lucid way to endogenize ethnic grievances in a relatively parsimonious computational model.[13]

The flexibility of ABM comes at a cost of an expansive parameter space (de Marchi and Page 2014), which unavoidably makes the choice of certain values for basic model rules somewhat arbitrary and thus potentially limits external validity. To further address this concern, future studies may build on the model presented here to develop a more empirically driven simulation with the parameter settings calibrated to actual conflict data. In other words, while the model has already yielded some useful theoretical insights, the next logical step would be to confront it with empirical evidence (see Girardin and Cederman 2007). Besides the introduction of some political and economic strategic component, such study would also need to pay more attention to spatial properties of settling, interaction and conflict (e.g., see Weidmann and Salehyan 2013; Bhavnani et al. 2014).

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Notes

[1]One might even argue that the whole Hutu-Tutsi divide was created and then institutionalized by the colonial rule of Belgium only in the early 20th century (Mamdani 2002)

[2]According to this alternative epistemological approach, "[t]o explain a macroscopic regularity x is to furnish a suitable microspecification that suffices to generate it" (Epstein 2006, 51)

[3]More formally, it is calculated via the Herfindahl index by the following formula: $F = 1 - \sum_{i=1}^{N} \pi_i^2$ where π_i is a proportion of a group i

[4]Social Identity Theory (SIT) posits that intergroup comparison emerges as a consequence of the people's cognitive disposition to categorization and their psychological need for a positive self-concept. As long as people identify themselves with a certain collective, they tend to view their in-group favorably in comparison to out-groups in order to derive satisfaction from their group membership (Tajfel and Turner 1979)

[5]See Lustick (2000) for a detailed discussion of the particular suitability of ABM for constructivist theorizing about identity, as well as for one of the first model implementations of these ideas

[6]In their more recent paper Miodownik and Bhavnani (2011) elaborate on the work of Cederman and Girardin (2007) and their subsequent critics by assessing the effect of ethnic minority rule mediated by the assumptions regarding ethnic salience. They find that when salience is fixed, conflict onset increases with the size of the minority population. When salience is a variable itself, conflict onset decreases with the increase of the minority size

[7]Cross-national research shows that various indicators of objective and subjective well-being are only slightly correlated and the latter have a much less skewed empirical distribution than the former (e.g., see Diener and Oishi 2000)

[8]This threshold of grievance is a very important system constant that essentially determines the frequency of conflict. While it was possible to fix it at the high level to imitate the more natural very rare occurrence of ethnic violence (see, Fearon and Laitin 1996), I intentionally set it up at the intermediate level to observe more conflicts and thus facilitate the comparison between different ethnic structures

[9]It is worth noting that the zero crosscuttingness means the absolute overlap of the shape and color dimensions, which is, however, not equal to the unidimensional structure as in the first set of experiments. For instance, one may argue that overlapping ethnic dimensions reinforce each other and thus indicate bigger differences between groups, which may induce conflict (Lipset 1959; Selway 2010)

[10]One may notice that with the slight decrease of polarization (RQ = 0.99), the number of conflicts and battle deaths reach their minimum and peace reaches its maximum across all the tested structures. While it may seem odd, this empirical occurrence might be an artifact caused by the formal nature of the computational model per se. For instance, Bhavnani and Miodownik (2008) also observed similar patterns of value peaks for the *almost* polarized societies in a completely different model

[11]Given the comparable survival ratios, this result does not seem to be driven by the greater number of ethnic rivals in more polarized societies

[12]For instance, while more than 90% of people identify "first and foremost" with their ethnic group in some states of Nigeria, it is the case for only 3% of population in Tanzania (according to Afrobarometer data, see Bhavnani and Miodownik 2008)

[13]See Sambanis and Shayo (2013) for another notable recent attempt to address the problem of ethnic endogeneity with the use of more traditional game-theoretic modeling

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Appendix

Pseudocode

Basic structural parameters

Set grid size: 36 × 36 (wrap-around) $j \in (x, y), 0 \leq x, y \leq 35$
Set population density: 80% $\implies$ number of agents $N(j) \leq 1037$
Move one patch in any direction if it is free [Moore 1 neighborhood]
Set halt conditions: 500 ticks or 80% dead

Basic individual parameters

Set ethnic attribute of color E_{1j} = {green and yellow}
Set ethnic attribute of shape E_{2j} = {square and circle}
Set initial happiness H_{j0}: random-normal draw ($\mu = 0.5$, $\sigma = 0.1$)
Set initial wealth W_{j0}: random-exponential draw ($\mu = 10$)

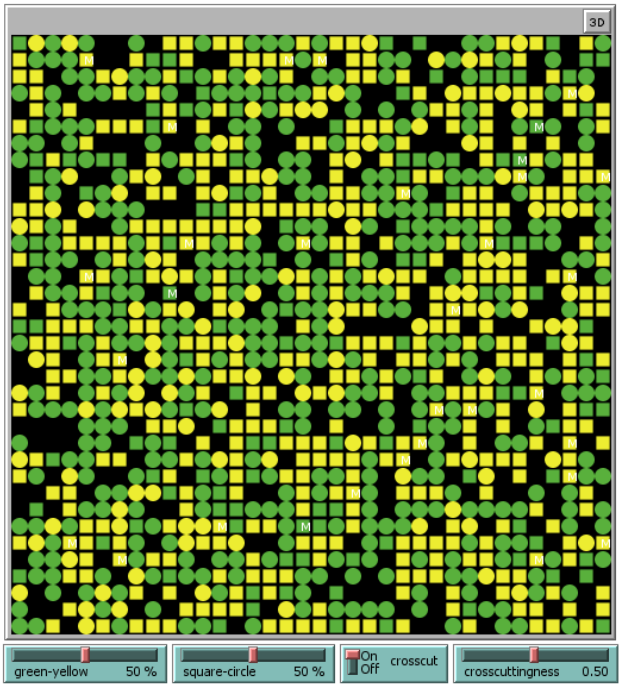
Individual rules and heuristics

Do economic activity $W_{j(t+1)}$ [Poor-Rich threshold ψ: mean wealth × 1.6]:
  W_{jt} × random-normal draw ($\mu = 1.001$, $\sigma = 0.01$) if poor OR
  W_{jt} × random-normal draw ($\mu = 1.01$, $\sigma = 0.01$) if rich
Compute color deprivation D_{1t} and shape deprivation D_{2t}:
  1 - (mean income of deprived group / mean income of privileged group) [at t]
Compute (average) ethnic deprivation $D^E_{jt} : (D_{1jt} + D_{2jt})$ / sum(i)
Compute individual deprivation $D^I_{jt} : (1 - H_{jt})$ if $W_{jt} < E[W_{jt}]$
Compute ethnic grievance $G_{jt} : D^E_{jt} \times D^I_{jt}$

Individual (inter)actions

Do mobilization (M_{jt}): TRUE if $G_{jt} \geq \gamma$ [Grievance threshold γ: 0.25]
  Set conflict C_t: TRUE if $\sum M_{ijt} \geq \delta$ = 10%
    Do attack: kill a neighbor of a privileged group with p=30%
    Do defeat: die with p=30% [attacking agents]
  Count conflict-incidence: TRUE if any agent died
    Do collateral damage: die with p=1% [all agents]
    Do redistribution: W_{jt} × random-normal draw ($\mu = 0.8$, $\sigma = 0.1$) [all agents]
    Do antagonism: H_{jt} × random-normal draw ($\mu = 0.8$, $\sigma = 0.1$) [attacked group]

Figure A1: Model visualization in NetLogo



Note: Agents are represented by shapes, characterized by the color and the form of these shapes and placed on the grid. The label 'M' refers to the readiness for mobilization. On the figure greens are twice more likely to be circles than squares and yellows are twice more likely to be squares than circles (CC = 0.5)

Table A1: The effect of ethnic polarization on conflict by minority domination

RQ	Ratio	MD	Dead	Conflict	Peace	Survival	*Dead***	*Conflict***
0.51	*85/15*	–	*184 (229)*	*4.3 (5.6)*	*47%*	*95%*	*347 (204)*	*8.1 (5.4)*
0.51	85/15	0 (59%)	191 (199)	5.7 (7.4)	39%	98%	*312 (162)*	*9.3 (5.8)*
0.51	85/15	1 (41%)	174 (268)	2.3 (3.4)	59%	90%	*420 (265)*	*5.5 (3.3)*
0.85	*75/25*	–	*239 (277)*	*4.0 (5.4)*	*48%*	*92%*	*460 (212)*	*7.7 (5.2)*
0.85	75/25	0 (63%)	232 (253)	4.8 (6.1)	44%	95%	*417 (192)*	*8.7 (5.9)*
0.85	75/25	1 (37%)	252 (317)	2.6 (3.5)	54%	86%	*549 (229)*	*5.7 (2.9)*
0.89	*65/35*	–	*269 (305)*	*3.5 (4.3)*	*48%*	*92%*	*517 (224)*	*6.8 (3.8)*
0.89	65/35	0 (57%)	274 (284)	4.1 (4.7)	42%	96%	*474 (210)*	*7.1 (4.1)*
0.89	65/35	1 (43%)	262 (335)	2.7 (3.7)	56%	86%	*592 (234)*	*6.2 (3.1)*
0.99	*55/45*	–	*177 (294)*	*2.1 (3.7)*	*67%*	*90%*	*537 (259)*	*6.3 (3.7)*
0.99	55/45	0 (49%)	150 (258)	2.0 (3.8)	65%	94%	*431 (266)*	*5.8 (4.4)*
0.99	55/45	1 (51%)	204 (324)	2.1 (3.5)	69%	86%	*650 (204)*	*6.8 (2.9)*
1.00	*50/50*	–	*252 (311)*	*2.9 (3.8)*	*52%*	*88%*	*524 (241)*	*6.0 (3.3)*

Note: The data are generated by computer simulations; * – the whole sample (n = 500); ** – the non-peaceful subsample (n = 238). The effect of minority domination on *dead* and *conflict* is statistically significant (t=-4.26, df=188, p < 0.000; t=3.42, df=188, p = 0.003 respectively). Standard deviations are in parentheses. RQ – Reynal-Querol index of ethnic polarization; MD – Minority Domination