The Construction of Social Orders and Inter-Ethnic Conflict

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Abstract

This paper seeks to explain variations in inter-ethnic conflict by variations in intra-ethnic 'social order', represented by the effectiveness of intra-group sanctions for inter-ethnic transgressions. This is in contrast to the widely accepted (e.g., Fearon and Laitin (1996)) approach which relates inter-ethnic conflict to inter-ethnic social order, represented by lack of information among members in the victim's group concerning the identity of transgressors, as a consequence of which transgressions results in all-out inter-ethnic conflict. In contrast, in our theory inter-ethnic transgressions are disciplined primarily by intra-group sanctions, with inter-ethnic conflict resulting only when these intra-group sanctions fail to be implemented. The success of inter-ethnic cooperation then hinges heavily on the efficacy of intra-group policing. As a consequence, groups with weak internal social controls tend to have more frequent and longer disputes with other groups.

Keywords: inter-ethnic conflict; social order; social control; social matching game; costly monitoring.

1 Introduction

Among theories of group conflict and cooperation, it is widely argued by rational choice theorists (Ellison (1993); Fearon and Laitin (1996); Kandori (1992)) that one of the difficulties for sustaining cooperation between groups under non-state institutional mechanisms lies in lack of information concerning the identity of those who took deviant behaviors. These theories insist that due to the anonymity of the wrongdoers, social norms can be enforced only in a way of sanctioning *all* the suspects. According to Fearon and Laitin (1996), it can be a cause of collective violence.

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Although such a problem of individual identification should not be ignored, however, there are a lot of historical events, reported by sociologists and anthropologists, that the existing theories fail to explain. Evidence indicates that collective violence had occurred even when the wrongdoers were identified. For example, in nineteenth-century Corsica, one-on-one incidents provoked group violence, not just to retaliation of vendetta, if collective contention against adversaries is stark (Gould (1999)). In medieval Iceland, "the avenger's victim need not be the actual wrongdoer; he simply had to be, in the avenger's estimation, someone associated with the wrongdoer" (Miller (1990:197)). Moreover, among Nyakyusa (people of Tanzania and Malawi), a norm tells "if a man ran off with my wife I should go and kill a village-mate of his," and "such an attack commonly led to war between the two villages" (Wilson (1983:149-50)). The existing theories can not present clear causes of these events due to the fact that the anonymity of wrongdoers did not play roles for urging people into group conflicts or collective sanctions. A question immediately arises. What motivates these people to rush into large-scale violence even though the wrongdoers are identified?

For answering this question, we take another approach to explain group conflict. To be precise, we hypothesize that collective violence works not only to deter individual transgressions, but also to control their ethnic brethren not to commit opportunistic misconducts. In the presence of collective violence, individual members are urged to construct an informal regulatory regime in which transgressors are punished by their coethnics. This mechanism of collective sanction is exactly what the above examples describe. In the example of Iceland, "group liability ... rendered the feud or fear of feud much more effective as an instrument of social control than it would otherwise have been if only the actual wrongdoer suffered the consequences of his actions" (Miller (1990:198)). Also, in the example of Nyakyusa, "thieves and adulterers were liable to be banished from a village just like witches and sorcerers, for they too brought misfortune on their fellows" (Wilson (1983:150)).

Ethnic groups may employ collective sanctions because "group-level sanctions may be expected to outperform individual-level ones" (Levinson (2003:373)) for two reasons.[1] First, collective sanction may induce mutual monitoring which can be much cheaper and more effective than monitoring from outside, and peer monitoring may help to reduce misbehaves. Group members are in a good position for monitoring other coethnics, but such monitoring can be further strengthened by threats from outside. Second, peers' sanctioning within a group can also be cheaper and more effective than outsiders' sanctioning. For example, just peers' withdrawal of esteems or suspension of transactions (ostracism) can be sufficient to discourage opportunistic transgressions. On the other hand, it is likely to be more difficult or costly for outside sanctioners to effectively threaten individual wrongdoers in a group due

[1] Sanctions are collective when they are threatened against or imposed on groups of two or more individuals (Levinson (2003:337)).

to the weak social tie between them. In short, peers are advantageous both in monitoring and in sanctioning than outside entities.

To formalize the above argument, we develop a model of social matching game in a way that a social order within each group is endogenously determined. On the rational choice theory of social orders (e.g., Hechter (1987)), we introduce costly monitoring to the model in which a social order is enforced by the process of monitoring and sanctioning. Our model of endogenous social controls is in contrast to Fearon and Laitin (1996) model of exogenous social controls, in which full information of peers' behaviors is innately given. By investigating the mechanism of internal social control without centralized institutional arrangement, we will explain why ethnic groups in one region fail to create trust-based relationships and suffer from long disputes, while those in another area peacefully coexist and cooperatively interact with each other. Furthermore, we will attempt to find what helps to reduce the risk of ethnic conflict.

The main results of the paper are the followings. Without a dense network between groups, inter-ethnic norms must rely on the enforcement by intra-group sanctioning, and the intra-group policing is backed by the threat of external sanction. The success of inter-ethnic cooperation hinges heavily on the efficacy of intra-group policing.[2] As a consequence, groups with strong internal controls can successfully maintain long-lasting peace and cooperation, and inter-ethnic conflict is unlikely to happen between them. This corresponds to in-group policing equilibrium of Fearon and Laitin (1996), which is characterized by ethnic communities' mutual trusts.[3] In contrast, groups with weak internal controls tend to have more frequent and longer disputes with other groups.[4] Equilibrium with weak social controls is characterized by mistrusts, as opposed to in-group policing equilibrium.

The rest of the paper proceeds as follows. Section 2 presents the model of interethnic cooperation with costly monitoring. Section 3 analyzes the model and demonstrates that the larger cooperation is more difficult to sustain as implied from conditions for equilibria.

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[2] On the other hand, some articles (e.g., Fearon and Laitin (2000); Gagnon (1994/95)) claim that inter-ethnic violence may emerge as a result of intra-ethnic politics. According to them, ethnic violence is caused by political elites' manipulation of public support.

[3] In his autobiography, well-known 'Lawrence of Arabia' reported a lonely Arab man who was ostracized and cut off from any friendly intercourse with his tribe, being penalized for murdering a Christian (Lawrence (1935:77)). This example seems to exactly match with the punishment of in-group policing equilibrium. I thank Dilip Mookherjee for notifying this story.

[4] Focusing mainly on civil wars between central governments and minority rebels, Fearon and Laitin (1999) and Fearon (2004) studies variations in ethnic conflict from other points of view. Fearon and Laitin (1999) showed structural factors such as rough terrain or size of rebels' group for explaining the scale of civil violence. These factors influence rebels' military prospects for any given level of counterinsurgent effort. Fearon (2004) explained that civil wars might be longer if the government has a 'commitment problem'. According to his theory, if rebels doubt the government's ability to make a commitment due to fluctuations in its strength, negotiated settlement becomes difficult, and civil war tends to be longer.

On the other hand, the environment our model applies is restricted to cases without centralized formal institution.

	C	D
C	$1, 1$	$-\beta^\theta, \alpha^\theta$
D	$\alpha^\theta, -\beta^\theta$	$0, 0$

Table 1: The prisoner's dilemma stage game. $\theta = in$ and $\theta = out$ denote the interaction with a peer and that with an outsider, respectively. For $\theta \in \{in, out\}$, $\alpha^\theta > 1$, $\beta^\theta > 0$, $(\alpha^\theta - \beta^\theta)/2 < 1$ and $\alpha^\theta \leq 1 + \beta^\theta$.

Section 4 further develops the model by allowing for mistakes or "noise" and considers the policies of confrontation and concession. Section 5 concludes by summarizing the obtained results and suggesting further research agenda.

2 The Model of Inter-Ethnic Cooperation

2.1 Social Matching Game

This section provides a model of inter-ethnic cooperation. The model employs a social matching game. Suppose that there are two ethnic groups A and B, each of which consists of n individuals. These groups are represented by sets $A = \{1, 2, \ldots, n\}$ and $B = \{n + 1, n + 2, \ldots, 2n\}$, where each individual is indexed by i.[5] Each individual is assumed to be homogeneous in characteristic except his ethnic identity. In successive periods $t = 0, 1, 2, \ldots$, each individual i is randomly matched with an opponent and plays the prisoner's dilemma, in which each individual independently selects to cooperate or to defect $a_{i,t} \in \{C, D\}$. One can imagine that people roam around a commercial area and encounter one another to seek for business opportunities.

Payoffs are shown in Table 1. Because the defection may involve any sort of harmful acts on the opponent such as cheat, steal, robbery, malfeasance or even violence, we add one restriction to the standard prisoner's dilemma game that the damage caused by the opponent's misconduct is so heavy that $\alpha^\theta \leq 1 + \beta^\theta$ for $\theta \in \{in, out\}$.

In each period, k individuals in each group are paired with members in the other group ("outsiders") while the remaining $n - k$ are paired among themselves ("peers"). $p = k/n$ is the probability that an individual interacts across groups in each period, and it denotes the density of the network between groups. It is assumed that $k < n/2$ — thus, $p < 1/2$ — so that interactions within a group ("in-group matches") are more frequent than interactions across groups ("out-group matches").[6]

[5] Some articles (Hardin (1995); Bowen (1996); Fearon and Laitin (2000); Lester (2005)) argue that ethnic distinctions are not innate or immanent, rather socially constructed for acquisition of political or economic ends. We ignore this "endogeneity" of ethnic borders and give the set of ethnic groups exogenously for focusing on our main concerns.

[6] Follwing Fearon and Laitin (1996), we assume that both k and n are even, and n is larger than 7.

2.2 The Structure of Information and Costly Monitoring

The structure of information in this two-sided social matching game can be characterized by the gap of difficulty in intra- versus inter-group transmission of information. While the information about an individual's behaviors can be easily spread among his peers by rumors or gossips, it is less likely to be transmitted beyond the ethnic border and to be shared by outsiders due to the relative infrequency of interactions or the difference in social manners or languages. Thus, the plausible setting would be the relative cheapness and quickness of the transmission within a group to across groups, but in order to make the analysis tractable, we will adopt simpler assumptions as follows.

For in-group interactions, actions and identities are assumed to be perfectly observed and shared by all the group members. Also, they know one another's history of play. However, these actions are totally unobservable to members in the other group.

For out-group interactions, all pairs of actions are perfectly observed by *both* groups (i.e., common knowledge). However, the identity of an individual who defects is totally unknown to outsiders and only imperfectly detected by peers. (As discussed later, this anonymity of defectors does not change results as long as the information of identity can not pass across the ethnic border.) One can imagine that once a defection occurs, it will be reported by newspapers or local media and then quickly become public information.

In order to deter selfish defections in out-group matches, each ethnic group $I \in \{A, B\}$ determines the cost of monitoring its members m_I at the beginning of the game and assigns it to every group members at each period. The cost m_I is likened to be a membership tax and can not be rejected by members.[7] (Those who evade paying taxes will be punished outside of the model.) Also, for simplicity, once m_I is determined, it can not be changed in the midst of the game. By monitoring, those who defect in out-group interactions will be detected by peers with the probability $r(m_I)$ in the period of the defections, where $r(\cdot)$ is a monotonically increasing function with properties $r(0) = 0$, $r'(m) > 0$ and $r(m) \in (0, 1)$ for $m > 0$. For simplicity, let us assume that if a group fails to find the wrongdoers in the period of defections, they can never be identified for all the future periods.

The payoff of individual i in group I at period t is equal to the payoff from the prisoner's dilemma minus the cost for monitoring m_I, and payoffs in the future periods are discounted by a common discount factor $\delta \in (0, 1)$.

[7] Here arises the so-called second order collective action problem which is often discussed with the provision of common-pool resources. Some scholars (Taylor (1982:65); Singleton and Taylor (1992)) are relatively optimistic about resolving the problem without a formal institution, while others (Hechther (1984); Ostrom (1992)) are more pessimistic. Since it is not the main focus of this paper, the present model assumes it away to reduce the complexity of analysis and does not specify how the monitoring is implemented. Members in a group may call for specialists of monitoring, but they may be able to effectively monitor each other. Thus, this assumption does not necessarily imply the need of a formal institution.

3 Equilibria and Conditions

3.1 Equilibrium without Monitoring

In a social matching game, there are multiple equilibria, but this section first picks up three representative equilibria without monitoring. They can be distinguished in terms of the degree of cooperation: (1) no cooperation, (2) only intra-group cooperation, (3) intra- and inter-group cooperation. Then, we consider (4) an equilibrium of intra- and inter-group cooperation with monitoring. These four equilibria will be compared by criteria of payoffs and conditions of parameter values. Another important criterion of equilibria, which is robustness to the possibility of mistakes or "noise," will be discussed in the next section. We adopt Subgame Perfect Nash Equilibrium (SPNE) as a solution concept, that requires incentive constraints to be satisfied in all the states of the world.

Equilibria without monitoring are the followings.

1. *Equilibrium of no cooperation* σ_1. For any pairings, play D.

2. *Equilibrium of intra-group cooperation* σ_2. For in-group pairings, play C with any individual in the normal phase ("cooperator"), and play D against any individual in the punishment phase ("defector"), regardless of one's own status. An individual enters (or restarts) the punishment phase of T^{pun} periods by defecting against a cooperator in in-group pairing. An individual who is not in the punishment phase is in the normal phase. For out-group pairings, always play D. The game starts with the normal phase.

3. *Spiral equilibrium* σ_3. For in-group pairings, play in the same way as in σ_2. For out-group pairings, play C during the peace phase, while play D during the conflict phase. Groups go to the conflict phase for T^{con} periods if any individual defects in an out-group pairing during the peace phase. When groups are not in the conflict phase, it is in the peace phase. The game starts with the normal/peace phase.[8]

In σ_1, no cooperation occurs in any interactions. In σ_2, people cooperate only within groups, and those who misbehaved will be punished by their peers. People further cooperate across groups in σ_3, where the ethnic conflict is sparked by a single defection in an interaction across groups. The conditions for equilibria are as follows.

Lemma 1 *(Fearon and Laitin (1996)) (i) The strategy profile σ_2 forms a SPNE if and only if $p < \frac{1}{1+\beta^{in}}$ and $\delta^{T^{pun}}(1-p)\left(1+\beta^{in}\right) \geq \beta^{in}$. (ii) The strategy profile σ_3 forms a SPNE*

[8] Action pairs in interactions within groups forms a strongly renegotiation-proof in terms of Farrel and Maskin (1989).

if and only if $p < \frac{1}{1+\beta^{in}}$, $\delta^{T^{pun}}(1-p)\left(1+\beta^{in}\right) \geq \beta^{in}$ *and* $\delta\frac{1-\delta^{T^{con}}}{1-\delta}p \geq \alpha^{out} - 1$. *Either for (i) or for (ii), it is always possible to take* $T^{pun} = 1$.

The proof appears in the Appendix.

Lemma 1 confirms that cooperation in a larger society will be more difficult to sustain as predicted by theories of the collective action problem (Olson (1965); Taylor (1982:53); Bendor and Mookherjee (1987)), even though cooperation with more persons is more beneficial in the model. (The averaged payoffs from σ_1, σ_2 and σ_3 are 0, $1-p$ and 1, respectively.) No constraint is assigned on σ_1, because every individual takes the dominant action. The condition on σ_2 implies that the network within a group (represented by $1-p$) must be dense enough that peers' sanctioning is effective to deter transgressions. The equilibrium σ_3 requires, in addition to the condition on σ_2, that p be large enough for given T^{con}. This can be interpreted that the social connection between groups must be so tight that the threat of the group-level conflict discourages inter-group transgressions. The difficulty of large cooperation, according to the theory, owes to the infrequency of interactions and the insufficiency of information.

The last constraint on T^{pun} shows that the shorter length of punishment is more desirable. It is because those who are being punished may refuse to conform if the length is so long. In other words, the incentive constraint off the path becomes more restrictive as the length extends.

3.2 Equilibrium with Monitoring

This subsection considers an equilibrium using monitoring. One of the main differences of the present game from other social matching games such as Kandori (1992) or Ellison (1994) is that there are two sorts of incentives to be considered for equilibria: one is an individual incentive for selecting actions and the other a collective incentive for choosing the cost for monitoring. One may wonder why a group has incentives to monitor its members, although it is costly. Inter-group cooperation is collective benefit to each group, but it is easily destroyed in the absence of effective punishments. Due to the anonymity of outsiders, only a single defection causes large-scale violence as collective sanction which is harmful to all in the group. Thus, the threat of such violence creates two incentives in the target group of the sanction, one is not to defect against outsiders, and the other to control peers not to defect in out-group pairings. In order to control others in an effective way, a group introduces monitoring to influence conformity and deviance. As is realized soon, the efficacy of monitoring has a large impact on the possibility of inter-ethnic cooperation.

The profile of the following strategy is adopted for the equilibrium with monitoring.

4. *Dual policing equilibrium* σ_4. For in-group pairings, play in the same way as in σ_3

except that an individual enters the punishment phase by defecting a cooperator in in-group pairings, or by being identified to defect (with a probability determined by monitoring) in out-group pairings during the peace phase. For out-group pairings, play in the same way as in σ_3. (What triggers the conflict phase is also the same as in σ_3.) For monitoring, take $m_I = m^*$ which maximizes the expected payoff of a representative individual.

The difference of σ_4 from spiral equilibrium σ_3 is that inter-group cooperation relies not only on the threat of conflict, but also on punishments by peers. As a result, it could sustain the cooperation across groups which is impossible in the spiral equilibrium.

Proposition 1 *The strategy profile σ_4 forms a SPNE if and only if $p < \frac{1}{1+\beta^{in}}$, $\delta^{T^{pun}}(1-p)\left(1+\beta^{in}\right) \geq \beta^{in}$, and there exists $m \in [0,p]$ such that*

$$r(m)\,\delta^{T^{pun}}(1-p)\left(1+\beta^{in}\right) + \delta\frac{1-\delta^{T^{con}}}{1-\delta}p \geq \alpha^{out} - 1. \tag{P1}$$

The smallest $m \in [0,p]$ satisfying P1 is chosen as the equilibrium level m^*. Further, T^{pun} can be chosen to be one if the strategy profile is a SPNE.

The proof appears in the Appendix.

The first term in the LHS is the loss by peers' punishments, and the second term the loss by group conflict, while the RHS denotes the gain from the deviation. The equality must hold in equilibrium because the group selects the lowest possible level of monitoring to maintain the cooperation. (Recall that $r(m)$ is monotonically increasing.)

The proposition gives five implications. First, the restriction P1 implies that the probability to detect miscreants must be sufficiently high, with a limited cost, to discourage wrongdoings. To put it another way, the monitoring is not necessarily employed when its cost is high. The benefit from inter-group cooperation is p, while the cost to support it is m^*. If the cost exceeds the benefit, the group should refrain from cooperating with outsiders and ends up with enjoying interactions only with peers. This implies that, *an ethnic group which lacks the means of creating a social order fails to cooperate with other ethnic groups.* Such a case with very inefficient monitoring corresponds to the strategy profile σ_2.

Second, the tight network between groups, represented by p, is helpful for interethnic cooperation. Frequent interactions across groups generate large benefits for both sides, making costly monitoring worthwhile. Conversely, cooperation is difficult for groups with weak networks. This implication matches with historical evidence.[9]

[9] In eighteenth century Ottman Empire, according to Dumont (1982:223), "in the eyes of the sedentary population, Jewish peddlers, ragpickers, tinkers and cobblers seemed just as dangerous as Gypsy sellers of

Third, in comparison with Lemma 1, it tells that the condition for dual policing equilibrium is weaker than that for spiral equilibrium in the sense that monitoring is employed ($m^* > 0$) as a remedy for recovering incentives for cooperation when the collective sanction of spiral one is ineffective for supporting inter-group cooperation. Or, one can say that spiral equilibrium corresponds to a special case of dual policing one in that $m^* = r(m^*) = 0$. However, while dual policing equilibrium is supported for a wider range of parameter values, the payoff from it is smaller than the spiral one because of the cost for monitoring. Thus, peers' monitoring is unnecessary and redundant if the network across groups is large enough (large p) or/and if individuals are patient enough (large δ).

Fourth, P1 shows that m^* falls in T^{con}, implying that as the conflict becomes longer, it becomes more effective, so that the required level of monitoring monotonically fall. The optimal equilibrium takes the very long periods of the conflict in the absence of noise ($T^{con} \to \infty$).

Fifth, the dual policing equilibrium is irrelevant of the anonymity of outsiders. I.e., the ethnic conflict might be employed as collective sanction in the best (payoff-maximizing) equilibrium even if members in a group are recognized as individuals by those in the other group as long as such information can not pass across the ethnic border. It is because in the dual policing equilibrium, *the collective sanction works not for directly deterring individual transgressions, but for creating a regulatory regime by which more effective sanctions on the culprit by his peers can be imposed.* In other words, for making up for incapability of monitoring and sanctioning, members in a group informally delegate these roles to members in the other group. Thus, the occasional large-scale violence between ethnic groups might be explained by the purpose of building up the social order as well as by the anonymity of wrongdoers. Historical evidence, as shown in introduction, suggests that spirals of violence were triggered by individual crimes even when the criminals were known.

4 The Model with Noisy Interactions

4.1 The Game in the Presence of Mistakes

The previous section dealt with the model of an idealistic society in the sense that there is no possibility of mistakes. Even though the dual policing equilibrium σ_4 can go back to "on the path" in the presence of a single mistake, it is still unknown how robust it is

charms and fortune-tellers. ... When some incident occurred in a locality, the scapegoat was always the same: the accusations were directed at a band of Gypsies or a Jewish ragpicker who had wandered through some time earlier." Futhermore, "numerous anti-Jewish riots were accompanied by boycott. As soon as some trouble occurred, Christians forbade Jews access to their quarters and stopped trading with Jewish bazaar merchants." Clearly, Jewish and Gypsy merchants were targeted due to their isolation or separation in comparison with local inhabitants.

for a certain fraction of mistakes. This section develops the model for the more plausible case in which a small portion of players may occasionally defect in out-group interactions. Accidental defections may be caused by misinterpretation, limitation of rationality or loss of self control such as laziness, drunkenness, capricious emotion or distraction. This section takes these possibilities into account.

To be precise, suppose that a cooperative action taken by a member in group I is occasionally perceived as defection by the opponent of the other group with probability ε_I. For simplicity, we assume that mistakes can happen only out-group interactions and that no mistake are allowed for intra-group interactions.[10] Also, we introduce an additional restriction on payoffs in in-group matches that $\alpha^{in} = 1 + \beta^{in}$.[11] This restriction is set to make the analysis tractable and to reduce the complexity of algebra in proofs without losing important implications.

4.2 Equilibrium and Condition

The strategy profile employed in the game with noise is as follows:

5. *Dual policing equilibrium* (modified) σ_5. For in-group pairings, play as in σ_4 except that $T^{pun} = 1$.[12] For out-group pairings, play as in σ_4 except that groups enter the conflict phase if the number of players in either group I who defect against outsiders in a period exceeds a cutoff level Q_I.[13] The level of monitoring m_I^* is set as in σ_4 (by maximizing the expected payoff).

By the strategy profile σ_5, a player cooperates with his peers unless he matches with those who are found to have defected in the previous period. Due to the presence of mistakes, each group allows a certain amount of observed defections, and people cooperate with one another beyond the ethnic border as long as the amount of defections is negligible. The parameter Q_I denotes the degree of "tolerance" of a group toward the other group I. The restriction that $T^{pun} = 1$ is the mildest constraint possible, by proposition 1, to support the equilibrium. This restriction is intended to simplify the subsequent argument.

[10] This assumption might be justified if "cultural homogeneity helps to minimize errors of interpretation" (Hechter (1989:178)).

[11] As becomes clear later, the condition $\alpha^{in} = 1 + \beta^{in}$ guarantees that the loss by peers' punishments is unaffected by the opponent's state (cooperator or defector).

[12] Due to the presense of noise, the strategy profile for in-group pairings is no loner renegotiation-proof (both action profiles of (C,C) and (D,D) are allowed), but we continue to employ it.

[13] Whereas the ethnic conflict in σ_5 is conditioned only on events in the previous period, a more realistic condition would be the accumulation of past events. Moore (1978:105), for example, argues that the dispute between Tallensi and Nyakyusa in western Africa is enlarged by "the prior or nascent structural oppositions and competition between groups." Fearon and Laitin (2003) also provide the similar argument on civil wars after 1990s that "the prevalence of internal wars is the result of an accumulation of protracted conflicts since the 1950s rather than a sudden change associated with a new, post-Cold War international system."

The derivation of related payoffs is somewhat involved, so we leave the detailed calculation of payoffs in the Appendix, and let us simply define the ex ante payoff in σ_5, which can be divided into three components: payoffs from in-group matches, payoffs from out-group matches, and the monitoring cost, denoted as $V_I(m_I) = V_I^{in}(m_I) + V_I^{out} - m_I$ for each group I. (Among them, only V_I^{out} is independent of m_I.) Also, for notational convenience, let H_I be the expected payoff of a player in group I from the stage game when he is matched with an outsider (E.g., $H_A = (1-\varepsilon_A)(1-\varepsilon_B) + \alpha^{out}\varepsilon_A(1-\varepsilon_B) - \beta^{out}(1-\varepsilon_A)\varepsilon_B$), and let $\phi(Q_I, k)$ be the probability that among k interactions, the number of defections in group I is less than or equal to Q_I if everyone conforms ($\phi(Q_I, k) = \left(\sum_{j=0}^{Q_I} C_j^k (1-\varepsilon_I)^{k-j} (\varepsilon_I)^j\right)$, where $C_j^k = \frac{k!}{j!(k-j)!}$). So, the product of $\phi(Q_A, k)$ and $\phi(Q_B, k)$ equals the probability that the peace phase continues to the next period.

The condition for inter-ethnic cooperation is as follows.

Proposition 2 *The strategy profile σ_5 forms a SPNE if and only if $p < \frac{\beta^{in}}{1+\beta^{in}}$, $\delta \geq \frac{\beta^{in}}{(1-p)(1+\beta^{in})}$ and there exists m_I such that $V_I(m_I) \geq 1-p$ and that for each group $I \in \{A, B\}$ with $I \neq J$,*

$$\begin{aligned} & r(m_I)\,\delta(1-p)\left(1+\beta^{in}\right) + \left(\phi(Q_I,k) - \phi(Q_I-1,k-1)\right)\phi(Q_J,k)\,\frac{1-\delta^{T^{con}}}{1-\delta}V_I^{out} \\ \geq\ & (1-\varepsilon_J)\,\alpha^{out} - H_I. \end{aligned} \qquad (P2)$$

The smallest $m_I \in [0, p]$ satisfying P2 is chosen as the equilibrium level m_I^*.

The proof appears in the Appendix.

The interpretation of the condition is the following. The first two inequalities are conditions for cooperation among peers. These are very close to those in proposition 1. The condition $V_I(m^*) \geq 1-p$ corresponds to the condition $m^* \leq p$ in proposition 1, meaning that if the monitoring is too costly for policing, the group gives it up and the norm of inter-ethnic cooperation will break down. The condition P2, which is the incentive constraint for out-group matches, implies that the dual sanction is so effective for members not to intentionally defect. The term $\phi(Q_I, k) - \phi(Q_I-1, k-1)$ shows that the change in probability of entering the conflict phase by an intentional (or strategic) defection.

According to this equilibrium, minor events between ethnic groups could unexpectedly destroy the inter-ethnic norm, and group-based reprisals may follow, involving large portions of members in groups who seemed to have kept peaceful relations for a long time.[14] This may explain sudden but ferocious events such as the genocide of Rwanda in 1994 or the

[14] The unpredictable fall of inter-ethnic norm is also pointed out by Arfi (2000).

communal violence between Christian Copts and Muslims in southern Egypt in 2000.[15]

4.3 Concession or Confrontation

In the rest of this section, we investigate how the change in a group's tolerance Q_I influences the maintenance of peace and the risk of conflict. For simplicity, we confine attention to the case that $Q_I = Q$ and $\varepsilon_I = \varepsilon$ for $I \in \{A, B\}$.

An intuition tells that as groups become "concessive" (referring to a rise in Q), the risk of conflict is reduced, and as a result, the expected payoffs may rise. By raising the cutoff level of the conflict, a group can successfully avoid the conflict and improve its welfare. On the other hand, a fall in Q may have a harmful effect. As a group becomes concessive, it becomes less likely that a single defection leads to the conflict. Knowing that, a member in the target group might be more tempted to take a deviant behavior. Thus, even if a group kindly regards the other group's wrongdoings as mistakes or misinterpretations, such concession may cause more deviant actions by destroying the incentive to conform.

In short, there are two effects of concession on the inter-ethnic cooperation: (i) to reduce the risk of collective violence; (ii) to deteriorate the incentive to conform. The latter (non-desirable) effect could be recovered by either of the following remedies. One is to make the threat of inter-group war more effective by extending the length of the conflict. This remedy indicates the trade-off about the conflict between its frequency and length. To make ethnic conflict infrequent, one must bear the longer periods of violence to support cooperation. The other remedy is to strengthen the in-group policing by further monitoring. By this remedy, peers' policing reinforces the weakened threat of collective violence.

Either remedy potentially reduces the welfare of the group. Thus, there is a trade-off among three variables: Q, T^{con} and m_I. Once Q and T^{con} are given, m_I is determined by Condition P2. The optimal choice of concession or confrontation highly depends on the efficiency of monitoring $r(m)$.

Proposition 3 *(i) For a group with efficient monitoring, concession monotonically reduces the risk of conflict and improves its welfare. The length of the conflict can be short to sustain the inter-ethnic norm. (ii) For a group with inefficient monitoring, the choice of concession or confrontation does not matter. It can not sustain inter-ethnic norms due to the lack of policing regime. (iii) For a group with the intermediate level of efficiency for monitoring,*

[15] "The Rwandan capitol dissolved into terror and chaos" one day after the assassination of the presidents of Rwanda and Burundi, according to *The New York Times*, Apr., 8, 1994, sect. A. Though other latent factors should not be ignored, this event is proven to have led to the genocide.

The communal violence in southern Egypt was triggerd by a Muslim customer's murder of a Christian shopkeeper who refused to apologize about his insult on the Muslim. But, another potential cause may be Christian Copts' complaints about the goverment's discriminatory policy against Christians. For details, see *The Economist*, Jan., 8, 2000; *The Financial Times*, Feb., 8, 2000.

only the mild range of tolerance can sustain inter-ethnic norms and enhance the group's welfare. Extreme ranges of concession or confrontation will harm the group's welfare, and further it may destroy the inter-ethnic norm. The length of the conflict may be required to be long enough to sustain the norm.

The proof appears in the Appendix.

In the case with efficient monitoring (i), inter-ethnic norm is very unlikely to break down if groups tolerate a large number of misconducts each other. As a result, the observed interactions between groups look like the in-group policing equilibrium in Fearon and Laitin (1996), in which "individuals ignore transgressions by members of the other ethnic group, correctly expecting that the culprits will be identified and sanctioned by their own ethnic brethren." The other trivial case (ii) is that if either of groups lacks the means of monitoring, it can not construct social order, and inter-ethnic cooperation is very unlikely.

In the remaining case (iii), if each group does not possess the efficient monitoring, they can not ignore transgressions since ignoring them may call for further transgressions. Therefore, *groups without strong social controls can not eliminate the risk of collective violence and must suffer from more frequent and longer disputes than those with strong social controls.* In other words, groups without strong social orders must provoke the conflict for demonstrating that threats are in reality.[16] From historical observation, Jewish communities of Turkey in nineteenth century successfully reduced the socioeconomic antagonisms from non-Jewish ones and alleviated their economic and social backwardness by reinforcing the social control on management of communal business and by promoting the alliance among Jewish subgroups Dumont (1982:229).[17] This example tells that strong social control helped to create and maintain peaceful and cooperative relations, and it could be supportive evidence of the theory.

These implications can be confirmed by a numerical example shown in Table 2. It deals with three cases for each of $Q = 0, 1, \ldots, 8$: (a) intermediate efficiency of monitoring without noise, (b) intermediate efficiency of monitoring with noise, and (c) efficient monitoring with noise. The second column from the left shows the probability $\phi(Q, k)^2$ that the peace phase continues to the next period. It can be seen that as Q increases, the peace phase is more likely to be maintained. In the case with intermediate efficiency of monitoring (b), the payoff is maximized at a medium range of Q. The inter-ethnic cooperation can not be sustained

[16] A similar observation of competition and collusion is theorized for oligopolistic markets (Green and Porter (1984)).

[17] In his words (pp. 229-30), "These manifestations of brotherhood caused not only an improvement in the plight of the most disadvantaged strata. They also helped reduce socioeconomic antagonisms which, since the sixties, troubled the life of some communities", and "the various programs of the alliance in order to alleviate the economic and social backwardness of the Jewish communities of Turkey proved, on the whole, very effective."

Q	$\phi(Q,k)^2$	(a) $\varepsilon = 0, l = 10^4$ $T^{con}=1$	$T^{con}=10$	(b) $\varepsilon = .01, l = 10^4$ $T^{con}=1$	$T^{con}=10$	$T^{con}=\infty$	(c) $\varepsilon = .01, l = 10^2$ $T^{con}=1$	$T^{con}=\infty$
0	.1340	.9901	1	$1-p$	$1-p$	$1-p$	.9523	.9045
1	.5413	-	-	$1-p$	$1-p$	$1-p$	.9669	.9094
2	.8476	-	-	.9095*	.9149	.9066	.9841	.9246
3	.9636	-	-	.9049	.9264*	.9313*	.9930	.9571
4	.9931	-	-	.9005	.9116	.9244	.9956	.9853
5	.9989	-	-	$1-p$	.9016	.9059	.9961	.9943
6	.9999	-	-	$1-p$	$1-p$	$1-p$	.9962	.9959
7	1.000	-	-	$1-p$	$1-p$	$1-p$	.9962	.9962
8	1.000	-	-	$1-p$	$1-p$	$1-p$	.9962*	.9962*

Table 2: Ex ante per-period payoffs V from σ_5 for parameter values $n = 1000$, $k = 100$, $p = .1$, $\delta = .95$ with the monitoring function $r(m) = \left(\frac{m}{lp}\right)^{10}$ and for payoffs $\alpha^{in} = 1.5$, $\beta^{in} = .5$, $\alpha^{out} = 1.5$, $\beta^{out} = 2$. The payoff $V = 1 - p$ means that interethnic cooperation is not sustainable.

either for too small or for too large Q. Also, it can be observed that the longer periods of conflict T^{con} achieves the larger expected payoff, since it helps to save the monitoring cost. The optimal length of the conflict T^{con} depends on the monitoring function $r(m)$. On the other hand, in the case with efficient monitoring (c), the expected payoff is larger for larger Q. In contrast to (b), the shorter length of conflict T^{con} is preferred. Because the in-group policing can be achieved very efficiently in (c), it does not have to rely on the threat from outside. The result confirms the prediction of the theory that variations in inter-ethnic conflict can be explained by variations in intra-ethnic social control.

5 Concluding Remarks

In this section, we first summarize the questions presented in introduction and provide solutions for them predicted by the theory, then we suggest limitations of the theory and offer future research agenda.

Why does collective violence occur even when the identity of wrongdoers is known? We found the causes of ethnic conflict in lack of internal policing regimes rather than in lack of information. Our theory implies that ethnic conflict might be triggered by individual misbehaves for asking group liability and for urging the target group to develop an internal social control that reduces deviant behaviors and contributes to social order. This implication is highly contrast to the existing theories which looked the difficulty of cooperation in the anonymity of wrongdoers. Outside sanctioners may rely on members in a group for policing, because peers are in a good position in terms of monitoring and/or sanctioning, and thus their control of potential wrongdoers can be more effective than control by outsiders. This mechanism of group conflict is widely observed in historical literature.[18]

Why do ethnic groups in one region suffer from frequent and long disputes, while those in another area peacefully coexist?. Variations in frequency and duration of ethnic conflict would be explained by variations in capability of intra-group policing and/or variations in the strength of the network between groups. Especially in our model, the cost for monitoring group members' behaviors and the frequency of interactions matter for the occurrence of ethnic conflict. As a result, an equilibrium with strong internal controls looks like Fearon and Laitin's (1996) in-group policing equilibrium, in which intra-group sanctioning is expected by either group, whereas an equilibrium with weak internal controls like their spiral equilibrium, in which cooperation is sustained solely by external sanctioning.

What helps to reduce the risk of ethnic conflict under decentralized institutional arrangements? From the above argument, it is immediate that groups' high capabilities of policing its members and a tight network between groups are both supportive factors for peaceful and cooperative relations. Without strong internal policing, the group must rely on the outside threat to deter individual transgressions. For groups with strong social control, concessive policy is more desirable than confrontational policy for reducing the risk of collective feuding.

How can the present model be further developed? Although it is assumed that in the model, sanctioning can be exerted without taking any cost on sanctioners, it is more plausible that sanctioning activities take some cost, and that makes social order more difficult to sustain. Sanctioning can be costly both for peers and outsiders. For outsiders, as we argued, the infrequency of interactions is the potential problem for effectiveness of sanctioning. Also, it should not be neglected that sanctioning would be painful for closed peers because of altruistic concerns among them (Bernheim and Stark (1988)). If so, costly sanctioning makes cooperation more difficult especially when group characterized by altruism.[19]

[18] For more examples, see Colson (1974:41) for Eskimo around Point Barrow and Reid (1999:92) for North American Indians.

Also, Israeli policies toward Palestine after the Oslo accords give another example. The Netanyahu administration conditioned the progress of the 'Road Map' for peace on the Palestinian Authority's fulfillment of obligations, including the cessation of terrorist attacks. The Sharon administration's demand includes "the removal of the Palestine leader, Yasir Arafat, and strict limits on Palestinian security forces." These policies look very much like the threat of external sanction for deterring transgressions in the target group.

For details, Schmemann, S., "Netanyahu Hints at Delay in Further Pullbacks After Hebron Move," *New York Times*, 8 October 1996, sect. A. Miller, J., "Sharon Tentatively Backs Plan for Palestinian State," *New York Times*, 5 December 2002, sect. A.

[19] Oppositely, altruism may make outsider's sanctioning more effective. Reid (1999:93) reports that for some North American Indians, sanctioning was not imposed on the murderer, but on his dearest friend. It is because the death of the dearest friend was considered to be more painful for the murderer than that of himself.

Throughout the paper, we refrained from allowing for more than two ethnic groups in the model, but allowing more than two groups may give significant implications. Bendor and Mookherjee (2005) investigate such a variation with unrestricted information for each player and show the superiority of universalistic norms, at stabilizing cooperation, to communitarian ones. However, as our model assumed, restriction on information may harm the stability of cooperation with a large set of communities. As in the case of Jewish community in eighteenth century Ottoman Empire, the collective reputation about each group's capability of social control would matter for cooperation.[20] Other immediate extensions of the present model such as different types or groups with unequal size are discussed in Fearon and Laitin (1996).

Although our focus was solely on inter-ethnic interactions, collective sanctions are broadly observed in various fields of research such as law, team production, microcredit, academic coauthorship, international sanctions or political parties (Levinson (2003)). Collective sanction could generate internal controls for solving collective action problems in these fields, but its effectiveness is still remaining mostly unknown. Both empirical and theoretical investigations in the fields are being waited.

APPENDIX

Proof of Lemma 1.[21] Because of the homogeneity of individuals and the symmetry of groups, it suffices, without loss of generality, to show that incentive constraints hold for individual i of group A after any history. Also, by the optimality principle of dynamic programming, it is sufficient to check that one-shot deviations are unprofitable in any state (Fudenberg and Tirole (1991:108-10)).

Before proceeding the proof, for convenience, define the system of states as $s_t = (t_0, t_1, t_2, \ldots, t_n)$, where t_0 denotes the number of periods remaining in the conflict phase, and t_i for $i = 1, \ldots, n$ denotes the number of periods remaining in individual i's punishment phase. Individual i is in the normal phase when $t_i = 0$, and the state is in the peace phase when $t_0 = 0$. For σ_2 does not have inter-group cooperation, let $t_0 = 0$. Also, let n_{t+l} be the number of players in A except i who will not be in punishment phase in period $t + l$, and $q_{t+l} = \frac{n_{t+l}}{n-1}$ be the probability that player i is paired with a cooperator in period $t + l$ if i is paired in-group.

(i) For σ_2 to form a SPNE, all the incentive constraints must be satisfied in all the states s_t; a cooperator i ($t_i = 0$) has no incentive (1a) to cooperate with an in-group defector, (1b) to defect against an in-group cooperator, and (1c) to cooperate with an out-group player; as well as a defector i ($t_i > 0$) has no incentive (2a) to cooperate with an in-group

[20] See supra footnote 7.

[21] The proof of Lemma 1 is fundamentally from the Appendix of Fearon and Laitin (1996). The simplified version of the proof is put for the subsequent proofs.

defector, (2b) to defect against an in-group cooperator, (2c) to cooperate with an out-group player. Since it is immediate that cases 1a, 1c, 2a and 2c are satisfied for any s_t, we confine attention to conditions for 1b and 2b.

For 1b, if he defects, he will gain the additional payoff of $\alpha^{in} - 1$ in the current period, while the expected loss will be $\sum_{l=1}^{T^{pun}} \delta^t (1-p)\left(q_{t+l}\left(1+\beta^{in}\right) + (1-q_{t+l})\,\alpha^{in}\right)$, where $1 + \beta^{in} = 1 - \left(-\beta^{in}\right)$ is the loss if i is paired with a cooperator and α^{in} is the loss if i is paired with a defector. Thus, the incentive constraint for 1b is

$$\sum_{l=1}^{T^{pun}} \delta^t (1-p)\left(q_{t+l}\left(1+\beta^{in}\right) + (1-q_{t+l})\,\alpha^{in}\right) \geq \alpha^{in} - 1. \tag{1b}$$

This constraint must hold for any q_{t+l}, and it is most restrictive when the loss is minimized. Since $\alpha^{in} \leq 1+\beta^{in}$, the loss is minimized in the state in which q_{t+l} takes the smallest possible value for each period of $l = 1, \ldots, T^{pun}$, and that happens when all i's peers defected in period $t-1$, giving the values of $q_{t+l} = 0$ for $1 \leq l \leq T^{pun} - 1$ and $q_{t+T^{pun}} = 1$.

For 2b, the gain from the deviation is β^{in} while i loses the payoff of $\sum_{l=t_i}^{T^{pun}} \delta^l (1-p)$ $\left(q_{t+l}\left(1+\beta^{in}\right) + (1-q_{t+l})\,\alpha^{in}\right)$ by the deviation at state t_i. The loss is minimized when $t_i = T^{pun}$ and $q_{t+T^{pun}} = 1$ for any l. Thus, the constraint is reduced to

$$\delta^{T^{pun}} (1-p)\left(1+\beta^{in}\right) \geq \beta^{in}. \tag{2b}$$

Because $\delta^{T^{pun}}$ decreases in T^{pun}, it is necessary that $\delta(1-p)\left(1+\beta^{in}\right) \geq \beta^{in}$ by 2b with $T^{pun} = 1$. On the other hand, $T^{pun} = 1$ with appropriate values of q_{t+l} (i.e., $q_{t+T^{pun}} = 1$) gives $\delta(1-p)\left(1+\beta^{in}\right) \geq \alpha^{in} - 1$. Thus, since $\alpha^{in} \leq 1 + \beta^{in}$, 1b holds whenever 2b holds. 2b with $\delta < 1$ leads to $p < \frac{1}{1+\beta^{in}}$, provided $T^{pun} = 1$.

(ii) In addition to the constraints in σ_2, σ_3 requires the constraint for inter-group cooperation. I.e., a player i, regardless of t_i, has no incentive (1d,2d) to defect against an outsider when $t_0 = 0$. The benefit from the deviation is $\alpha^{out} - 1$, and the loss is $p\sum_{t=1}^{T^{con}} \delta^t$. The constraint is

$$\delta \frac{1-\delta^{T^{con}}}{1-\delta} p \geq \alpha^{out} - 1. \tag{1d,2d}$$

Q.E.D.

Proof of Proposition 1. For the strategy profile σ_4 to constitute a SPNE, in addition to constraints for in-group pairings in σ_2, the following constraints must hold for out-group pairings: a cooperator i ($t_i = 0$) has no incentive (1c') to cooperate if $t_0 > 0$, (1d') to defect if $t_0 = 0$; and a defector i ($t_i > 0$) has no incentive (2c') to cooperate if $t_0 > 0$, (2d') to defect if $t_0 = 0$. Since 1c' and 2c' are trivially satisfied, let us focus on 1d' and 2d'.

For 1d', the gain from the deviation is $\alpha^{out} - 1$. An individual who defects will be punished by peers with probability $r(m_A)$, and he will trigger the conflict. Thus, the loss is $r(m_A)\sum_{t=1}^{T^{pun}}\delta^t(1-p)\left(q_{t+l}\left(1+\beta^{in}\right)+(1-q_{t+l})\alpha^{in}\right)+\sum_{t=1}^{T^{con}}\delta^t p$. The condition requires

$$r(m_A)\sum_{t=1}^{T^{pun}}\delta^t(1-p)\left(q_{t+l}\left(1+\beta^{in}\right)+(1-q_{t+l})\alpha^{in}\right)+\delta\frac{1-\delta^{T^{con}}}{1-\delta}p\geq\alpha^{out}-1. \qquad \text{(1d')}$$

For 2d', since the loss of $r(m^*)\sum_{l=t_i}^{T^{pun}}\delta^l(1-p)\left(q_{t+l}\left(1+\beta^{in}\right)+(1-q_{t+l})\alpha^{in}\right)+\sum_{t=1}^{T^{con}}\delta^t p$ is minimized when $t_i=T^{pun}$ and $q_{t+T^{pun}}=1$ by the same way as in 2b, the condition is

$$r(m_A)\delta^{T^{pun}}(1-p)\left(1+\beta^{in}\right)+\delta\frac{1-\delta^{T^{con}}}{1-\delta}p\geq\alpha^{out}-1. \qquad \text{(2d')}$$

where the condition $q_{t+T^{pun}}=1$ for any s_t is used.

By taking $q_{t+l}=0$ for $1\leq l\leq T^{pun}-1$ and $q_{t+T^{pun}}=1$ for 1d', it can be seen, as in the proof of Lemma 1 (i), that 1d' holds whenever 2d' holds, given $T^{pun}=1$. With the fact that the LHS of 2d' falls in T^{pun}, conditions 1d' and 2d' can be reduced as just 2d'. Moreover, since m^* is selected so as to minimize the cost and $r(m)$ increases in m (by assumption), the equality for 2d' holds in equilibrium. Finally, for inter-group interactions to be beneficial to each group, it must be that $m^*\leq p$. *Q.E.D.*

Ex ante payoffs. To derive the condition for σ_5 to be an equilibrium, we first suppose that such an equilibrium exists and calculate all the related payoffs, then examine incentive constraints, which will be shown subsequently. Let $K=\frac{k}{n-1}$ and $K_{-1}=\frac{k-1}{n-1}$, where K is the fraction of members in A except i who were paired out-group in the last period if i was paired with a peer in that period, and K_{-1} the fraction of members in A except i who were paired out-group in the last period if i was paired with an outsider in that period.

The ex ante payoff from in-group matches can be shown as $V^{in}=(1-\delta)(1-p)+(1-p)\delta\widehat{V}^{in}$, where

$$\begin{aligned}\widehat{V}^{in} &= p\varepsilon_A r(m_A)\left(K_{-1}\varepsilon_A r(m_A)0+1-K_{-1}\varepsilon_A r(m_A)\left(-\beta^{in}\right)\right)+p\left(1-\varepsilon_A r(m_A)\right)\\ &\quad \left(K_{-1}\varepsilon_A r(m_A)\alpha^{in}+1-K_{-1}\varepsilon_A r(m_A)\right)+(1-p)\left(K\varepsilon_A r(m_A)\alpha^{in}+1-K\varepsilon_A r(m_A)\right).\end{aligned}$$

Notions $K_{-1}\varepsilon_A r(m_A)$ and $1-K_{-1}\varepsilon_A r(m_A)$ in the first bracket give probabilities of meeting with "a defector" and of "a cooperator" (terms from σ_2) in the current period, respectively. Notions in other brackets follow in similar ways. $p\varepsilon_A r(m_A)$ gives the probability that the player defected and was punished in the out-group match of the last period.

For the ex ante expected payoff from in-group matching, recall that H_A is the expected payoff of a player in group A from the stage game when he is paired with an outsider: $H_A=$

$(1-\varepsilon_A)(1-\varepsilon_B)$ $+\alpha^{out}\varepsilon_A(1-\varepsilon_B)$ $-\beta^{out}(1-\varepsilon_A)\varepsilon_B$ and that $\phi(Q_I,k)$ is the probability that $\phi(Q_I,k)=\sum_{j=0}^{Q_I}C_j^k(1-\varepsilon_I)^{k-j}(\varepsilon_I)^j$. Thus, the product $\phi(Q_A,k)\phi(Q_B,k)$ denotes the probability that the peace phase continues to the next period. The ex ante expected payoff from in-group matching is $V^{out}=(1-\delta)pH_A+$ $(1-\delta)\delta$ $(\phi(Q_A,k)\phi(Q_B,k)V^{out}$ $+(1-\phi(Q_A,k)\phi(Q_B,k))\delta^{T^{con}}V^{out})$, or

$$V^{out}=\frac{(1-\delta)pH_A}{1-\delta\left(\left(1-\delta^{T^{con}}\right)\phi(Q_A,k)\phi(Q_B,k)+\delta^{T^{con}}\right)}.$$

Proof of Proposition 2. For the strategy profile σ_5 to constitute a SPNE, the following incentive constraints are needed for in-group interactions: in the normal phase, (1a") not to cooperate with a defector, (1b") not to defect against a cooperator, and in the punishment phase, (2a") not to cooperate with a defector, (2b") not to defect against a cooperator.

Also, for out-group matches, the following incentives must be given to player i: (1c",2c") not to cooperate when $t_0>0$, regardless of whether he is in the normal phase ($t_i=0$) or not ($t_i=1$), and also to players, (1d") not to defect when $t_0=0$ in the normal phase; (2d") not to defect when $t_0=0$ in the punishment phase. Since 1a", 1c", 2a" and 2c" are trivially satisfied regardless of parameter values, let us focus only on 1b", 1d", 2b" and 2d".

For 1b", if a player defects in an in-group match, he will gain the additional payoff of $\alpha^{in}-1$ today. In the next period, he will match with a peer with probability $1-p$, and furthermore the peer will be in the punishment phase with probability $K\varepsilon_A r(m_A)$, and be in the normal phase with probability $1-K\varepsilon_A r(m_A)$. By the punishment, the payoff falls from α^{in} to 0 if the peer is a defector and from 1 to $-\beta^{in}$ if he is a cooperator. Hence, the incentive constraint is $\delta(1-p)$ $[K\varepsilon_A r(m_A)\alpha^{in}$ $+(1-K\varepsilon_A r(m_A))\left(1+\beta^{in}\right)]\geq\alpha^{in}-1$. Since $\alpha^{in}=1+\beta^{in}$, it can be shown as:

$$\delta\geq\frac{\beta^{in}}{(1-p)\left(1+\beta^{in}\right)}. \tag{1b"}$$

Using $\delta<1$, it is immediate to show that $p<\frac{\beta^{in}}{1+\beta^{in}}$.

For 1d", the expected loss from the deviation is the sum of the loss by peers' punishment $\delta(1-p)r(m_A)$ $\left[K_{-1}\varepsilon_A r(m_A)\alpha^{in}+\right.$ $\left.(1-K_{-1}\varepsilon_A r(m_A))\left(1+\beta^{in}\right)\right]$ and that by the conflict $(\phi(Q_A,k)-\phi(Q_A-1,k-1))\phi(Q_B,k)$ $\delta\frac{1-\delta^{T^{con}}}{1-\delta}V^{out}$. On the other hand, the expected gain from defection is $(1-\varepsilon_B)\alpha^{out}-H_A$. Thus, the constraint is

$$\begin{aligned}&r(m_A)\delta(1-p)\left(1+\beta^{in}\right)+(\phi(Q_A,k)-\phi(Q_A-1,k-1))\phi(Q_B,k)\delta\frac{1-\delta^{T^{con}}}{1-\delta}V^{out}\\ \geq\ &(1-\varepsilon_B)\alpha^{out}-H_A. \end{aligned}\tag{1d"}$$

Because the group selects the smallest m_A that satisfies the constraint, the equality must hold for 1d" with m^*.

For 2b", the constraint is exactly the same as in 1b" because of $T^{pun} = 1$ and $\alpha^{in} = 1 + \beta^{in}$. Similarly, for 2d", the constraint is the same as in 1d". All the constraints for individuals above can be summarized to 1b", 2d" for type 2 and $p < \frac{\beta^{in}}{1+\beta^{in}}$. *Q.E.D.*

Proof of Proposition 3. Since the effect of the change in Q on equilibrium is solely in the incentive constraint 1d", we must investigate how the constraint 1d" is affected by the change. So, at the beginning of the proof, we show the effects of Q on V^{out} and on $\phi(Q,k) - \phi(Q-1,k-1)\,\phi(Q,k)$ (both of them are in the LHS of 1d").

For the effect on V^{out} $\left(= \frac{(1-\delta)pH_A}{1-\delta\left(\left(1-\delta^{T^{con}}\right)\phi(Q,k)^2+\delta^{T^{con}}\right)}\right)$, since $\phi(Q,k)$ rises in Q, V^{out} is increasing in Q. Also, as $Q \to k$, $\phi(Q,k)$ converges to one, and hence V^{out} converges to pH_A.

On the other hand, we claim that the effect on $(\phi(Q,k) - \phi(Q-1,k-1))\,\phi(Q,k)$ is non-monotonic. Using the fact that $\phi(Q,k) = (1-\varepsilon)\,\phi(Q,k-1) + \varepsilon\phi(Q-1,k-1)$ (dividing k interactions into one and the remaining $k-1$ interactions),

$$\begin{aligned}
\phi(Q,k) - \phi(Q-1,k-1) &= (1-\varepsilon)\,\phi(Q,k-1) + \varepsilon\phi(Q-1,k-1) - \phi(Q-1,k-1) \\
&= (1-\varepsilon)\,\phi(Q,k-1) - (1-\varepsilon)\,\phi(Q-1,k-1) \\
&= (1-\varepsilon)\sum_{j=0}^{Q} C_j^{k-1}(1-\varepsilon)^{k-1-j}(\varepsilon)^j - (1-\varepsilon)\sum_{j=0}^{Q-1} C_j^{k-1}(1-\varepsilon)^{k-1-j}(\varepsilon)^j \\
&= (1-\varepsilon)\,C_j^{k-1}(1-\varepsilon)^{k-1-Q}(\varepsilon)^Q .
\end{aligned}$$

Thus, the term $\phi(Q,k) - \phi(Q-1,k-1)$ rises in Q unless it exceeds its mean $(k-1)\,\varepsilon$ (of $k-1$ interactions). Then, it falls and converges to zero as $Q \to k$. I.e., it has a U-shaped relationship with Q. Because V^{out} is increasing in Q with convergence to pH_A at the maximum, the second term of the LHS in 1d" also has a U-shaped relationship. This non-monotonic effect of Q on 1d" influences the required level of monitoring m^* for satisfying 1d".

(i) For groups with efficient monitoring (for which an extreme example is that $r(m) \doteqdot 1$ for any $m \geq 0$), the cost for monitoring is so low that they can avoid conflict by raising Q without incurring cost. (ii) For groups with inefficient monitoring (for which an extreme example is that $r(m) \doteqdot 0$ for any $m \geq 0$), the cost for monitoring is so high that they can not sustain cooperation. (iii) For groups with the intermediate level of efficiency for monitoring, because the second term of the LHS in 1d" has a U-shaped relationship with Q, the optimal level of policing $r(m^*)$ must have an inverted U-shaped relationship for 1d" to bind. Correspondingly, the path of the optimal monitoring m^* depicts like an inverted

U with Q. Due to the monitoring cost m^*, either low Q or high Q can not be optimal (depending on the monitoring function $r(m)$). In such cases, payoffs may fall below the payoff only from intra-group interactions $1-p$, and inter-group cooperation is impossible. *Q.E.D.*

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