Theoretical Note

Theoretical Note for "Segmentary Lineage Organization and Conflict in Sub-Saharan Africa"

Jacob Moscona

M.I.T.

Nathan Nunn

Harvard University and CIFAR

James A. Robinson

University of Chicago

14 April 2020

1. Introduction

In this note we develop a formal model which allows us to compare the differences in the incidence of conflict between segmentary lineage (SL) and non-segmentary lineage (NSL) societies. We are also particularly interested in deriving predictions for conflict onset and offset. Given the nature of our empirical analysis, we focus on within-group (i.e., localized) conflict and conflict between a group and the national government (i.e., civil conflict).

One consequence of the specific goal of this note is that other interesting aspects of the differences between segmentary lineage and non-segmentary lineage societies tend to be modeled in a relatively reduced-form way. An alternative strategy, would be to also develop these other aspects. However, one is always limited in what one can do within one model. Thus, we decided to focus on generating the predictions that are particularly important for a better understanding of our empirical analysis.

We begin in the next section with a static extensive form game of conflict where we focus on how the probability that a within-group conflict starts (i.e., onset) and the scale of conflict once it has started (i.e., escalation) differ between segmentary and non-segmentary lineage societies. We then turn to these same issues but examining conflict between a group and the government.

We then embed the first model of intra-society conflict in a fully dynamic model of conflict which allows us to examine both conflict onset and conflict offset. We sketch the dynamic extension of the model of conflict with the government and end by discussion some of the modeling decisions we have made.

2. A Static Model

A. *Intra-Group Conflict*

Consider a society which is split into two sub-groups, $1, 2$, with population sizes N_1 and N_2. For simplicity, we assume $N_1 = N_2 = N$. The group could be a segmentary lineage society or not. For segmentary lineage societies each sub-group is a segment. Sometimes, in the aid of simplicity, we abuse notation a little by using 1 and 2 to refer both to individuals from sub-group 1 and 2 as well as the group itself.

Intra-group conflict can take place between two individuals in different sub-groups, and it can also escalate so as to take place between the groups. In this initial subsection we focus on comparing the extent of such conflict in a SL to that in a NSL.

Each agent in the model has an exogenous endowment of income, denoted R, and conflict takes place over these resources. There is a great deal of evidence that humans are hard wired to avoid arbitrary conflict and even dislike it (e.g., Greene, 2014). Thus, conflict only occurs when some dispute arises, or some 'pretext for conflict' or conflictual situation occurs. This could be because your cows have strayed onto my field. Or your son has got my daughter pregnant. I loaned you some money, but now you are refusing to pay me back or even denying that you ever were given a loan. We assume that there is some exogenous probability that a situation occurs which is potentially conflictual so that a dispute can take place. That is, with probability x^s for $s \in \{SL, NSL\}$ there is some pretext for an individual of sub-group 1 to initiate a conflict and with probability θx^s there is a pretext for an individual of sub-group 2 to initiate a conflict. It is assumed that $x^s(1+\theta) < 1$. We allow x^s to vary between segmentary linage and non-segmentary lineage groups. For simplicity, we assume that individuals never have conflicts with members of their sub-groups.[1]

If a person in sub-group 1 gets a chance to initiate a conflict, he can attack an individual of group 2 in an attempt to steal their endowment. If he does so, then the probability that he wins depends on: his own 'power', which is increasing in the number of supporters he has and decreasing in the number of supporters of his opponent; and also a random shock. A key difference between segmentary lineage and non-segmentary lineage societies is that in the former, if an individual becomes involved in a conflict, he can ask all the members of his segment to support him. If he does so, they are bound to support him.[2] In non-segmentary lineage societies, individuals are not able to call on support like this.

To model the outcome of conflict, if initiated, we are inspired by the 'contest function' approach to model the 'power' of a person or group. Think of 1 as being from group 1 and 2 as being from group 2. If they get into a conflict then the probability that $i = 1, 2$ wins depends on their power, which is given by the function

$$p_i(e_1, e_2), \tag{1}$$

where e_1 and e_2 denote the conflict inputs of player 1 and 2. We treat these as exogenous and from now on set them equal to 1. The key property we require is that p_i is not homogenoeus of degree zero so that $p_i(N, N) > p_i(1, 1)$.[3]

To see how the power of each of the two groups translates to win probability, assume that if a player i, who has a conflict opportunity, initiates conflict, then he wins if $p_i(e_1, e_2)$ is sufficiently large; namely, greater than some χ which is drawn from a probability distribution F. If the

[1]This assumption is without loss of generality and only made to keep the analysis simple.

[2]The ethnographic literature on segmentary lineage societies illustrates the many mechanisms, such as the preservation of honor or status that induce this support (see Mathew, 2017).

[3]For an example of such a non-homogeneous function in the conflict literature see Blavatskyy (2010) and (see also Garfinkel and Skaperdas, 2007). This model allows there to be a draw such that if $p_i(e_1, e_2)$ is the probability that i wins, we have that $p_1(e_1, e_2) + p_2(e_1, e_2) < 1$. Now Blavatskyy proves that (1) can have the representation

$$p_1(e_1, e_2) = \frac{f(e_1)}{1 + f(e_1) + f(e_2)},$$

where f is some increasing function. Given this, the probability of a draw is

$$1 - p_1(e_1, e_2) - p_2(e_1, e_2) = \frac{1}{1 + f(e_1) + f(e_2)}.$$

If $f(e_i) = e_i$, then the probability of a draw is

$$\frac{1}{1 + Ne_1 + Ne_2},$$

which is decreasing in N. Hence,

$$\frac{\partial(p_1 + p_2)}{\partial N} > 0.$$

This creates a simple form of non-homogeneity.

individual who initiates the conflict wins they take the δR, while the other party, who we call the defender, loses everything. We assume that $\delta < 1$ to model the idea that conflict is costly. If the initiator loses, the opponent manages to protect their endowment and there is no redistribution of endowments. In the case of a draw, there is also no redistribution of endowments. Before the realization of χ, only the probability of a society experiencing conflict will be unknown.

If conflict is costly, rational players have an incentive to bargain to avoid it. As is well known (e.g., Fearon, 1995, Powell, 2006), to have conflict in equilibrium one must have some reason why bargaining would not be efficient. We choose a simple reason for this here and model the parties as being unable to credibly commit to an agreement which stops conflict.

Our static model follows the one developed by Acemoglu and Robinson (2006). Consider now the following extensive form game.

1. Nature decides whether or not group 1 or group 2 gets to take advantage of a potentially conflictual situation. Whoever is chosen is the potential initiator.
2. The group who can be attacked can promise a transfer of rents Z to the initiator to compensate him for not attacking.
3. The threshold χ is determined from F.
4. The initiator decides whether to attack and, if so, whether to call up his segment (if he is from a SL society).
5. The defender chooses whether to defend himself and to call up his segment (if from a SL society) or not.
6. If the initiator attacks, conflict payoffs are determined.
7. If no conflict has taken place, then the defender can give Z to the initiator.

We solve this game by backward induction. We first focus on characterizing the pure strategy subgame perfect equilibrium of this model for an individual from a segmentary lineage society and an individual from a non-segmentary lineage society and then compare the equilibrium probability of conflict onset and the scale of conflict for both types.

The first observation from backward induction is that if there is no conflict then the defender will offer zero rents. Thus any offer of rents in exchange for avoiding conflict is not credible.

Now moving to stage 3 of the game. Irrespective of whether or not the attacking player has or has not mobilized his segment (if a member of a segmentary lineage group) it is a dominant strategy, if possible, to mobilize your segment if attacked. This does not incur any cost, but it unambiguously increases the probability of winning a conflict. Moving back to stage 2 of the game it is also true that it is a dominant strategy to mobilize your segment if you decide to fight.

Now consider stage 5. If an individual from group i has the opportunity to attack then if $p_i(N,N) > \chi$ (setting $e_1 = e_2 = 1$), they will defeat the defender. This event happens with probability $F(p_i(N,N))$. Note that in this case if they attack they get δR which is strictly positive, while if they do not attack they get zero (in additon to their own endowment). It is immediate that if a player is given the opportunity to attack, they will do so (and if they are from a segmentary lineage group they will call for the support of their segment).

This analysis implies that the probability that a conflict occurs in a SL society is

$$\mathcal{P}_{SL}{=}x^{SL}\left[F(p_1(N,N)) + \theta F(p_2(N,N))\right]. \tag{2}$$

The first term in the square brackets is the probability that a conflict occurs when a member of segment 1 gets the chance to initiate one. The second term is the analogous probability of a conflict when it is a member of segment 2 that gets the chance to initiate.

Consider now the analogous situation in a non-segmentary lineage society. It is immediate that conflict occurs with probability

$$\mathcal{P}_{NSL}{=}x^{NSL}\left[F(p_1(1,1)) + \theta F(p_2(1,1))\right]. \tag{3}$$

The main difference between (2) and (3) is that in a non-segmentary lineage society, a conflict is between individuals. In a segmentary lineage society, it escalates to a conflict between segments that comprise N individuals.

By assumption on the form of the contest function $p_i(N,N) > p_i(1,1)$ for $i = 1,2$. Since F is an increasing function $F(p_i(N,N)) > F(p_i(1,1))$, this implies that if a potentially conflict-prone situation arises then a conflict is more likely to start in a segmentary lineage society. This is intuitive because a member of a segmentary lineage group can call up members of their segment and this makes for a greater probability of success, even if the other segment can do the same thing. This is due to the the non-homogeneity of the contest function.

An important point is that this property itself does not necessarily imply that $\mathcal{P}_{SL} > \mathcal{P}_{NSL}$. This is because it is also plausible that $x^{SL} < x^{NSL}$. In fact the ethnographic evidence suggests exactly this. As Evans-Pritchard (1940) pointed out, because the Nuer were so militarized and so effective at fighting, that the society, though stateless, innovated various types of mechanisms to mediate and prevent conflicts from breaking out. He described the activities of the leopard skin chiefs who were in effect professional mediators who immediately intervened in order to try to defuse a potentially conflict prone situation. In Pashtun society, again stateless assemblies known as jirgas play the same role (Ginsburg, 2011). In Tiv society, there was a moot (Bohannan, 1968). A non-institutional factor which has the same effect of reducing potential conflicts is the extent of hospitality. Ginsburg (2011, p. 101) notes "The Pashtunwali is conventionally described as comprising three key concepts: melmastia, hospitality; badal, revenge; and nanawati, submission or asylum." A Pashtun has to follow these concepts in order to maintain their honor. Why would hospitality towards others, including strangers and even known criminals be so important, even to the extent that it extends to U.S. Navy Seals (Luttrell, 2008)? One idea is that this is exactly because it is a way of defusing conflicts before they start and reducing the potential for conflictual situations to emerge. This exact argument is also made by Colson (1974) in her study of hospitality amongst the Tonga of Zambia.

Note now that in this symmetric case, $p_1(N,N) = p_2(N,N)$ hence $F(p_1(N,N) = F(p_2(N,N))$. Therefore, we can define the following critical value of x^{SL}, which we denote $\hat{x}^{SL}$:

$$\hat{x}^{SL} \equiv x^{NSL} \frac{F(p_i(1,1))}{F(p_i(N,N))}. \tag{4}$$

This is the value of x^{SL} that generates an equal probability of conflict in segmentary lineage and non-segmentary lineage groups.

Given this, we now have the following result about the relative probability of conflict in the two types of societies.

Proposition 1: If a conflict starts it is always of a higher scale in a segmentary lineage society. Nevertheless, if $x^{SL} \in [0,\hat{x}^{SL})$ then the probability that a conflict begins in a segmentary society is lower. For $x^{SL} \geq \hat{x}^{SL}$ the probability of conflict onset is higher in a segmentary lineage society.

The proposition stresses that in general it is ambiguous whether conflict onset is higher or lower in a segmentary lineage group compared to a non-segmentary lineage group. If the segmentary lineage society manages to initiate institutional solutions, like leopard skin chiefs or jirgas which keep x^{SL} low, then the probability of conflict onset in a SL can be lower. However, this is not necessarily the case.

In using the word 'scale' here we refer to the number of people involved in a conflict. To take this to the data it is reasonable to assume that a larger conflict in these terms is also associated with more deaths. Therefore scale refers to both the number of participants and fatalities.

Equation (4) has some intuitive comparative static properties. In particular, if SL get more effective at mobilizing individuals for conflict, then $\frac{F(p_i(1,1))}{F(p_i(N,N))}$ falls and the corresponding critical value of x^{SL} also falls. It becomes even more important to create social structures that reduce the potential for conflict.

It is worth reflecting on the importance of the commitment problem in this model. By construction and due to the nature of the extensive form of the game, the defender cannot credibly promise to give a sum of money to the initiator to avoid conflict. If such a promise were credible it would always stop the conflict. This follows from the fact that the expected utility of the defender in a conflict is $(1 - F(p(N,N)))\,R$ while the expected utility of the initiator is $F(p(N,N))\delta R$. Thus there exists a payment Z such that

$$\begin{aligned} R - Z &\geq (1 - F(p(N,N)))\,R \quad \text{and} \\ Z &\geq F(p(N,N))\delta R. \end{aligned}$$

For example, let $Z = R - (1 - F(p(N,N)))\,R$, the substituting this value of Z into the second inequality we find

$$R - (1 - F(p(N,N)))\,R > F(p(N,N))\delta R \quad \text{since} \quad \delta < 1.$$

Therefore, if such a payment were credible, then, since conflict is costly, there always exists a payment from the defender to the initiator that would avoid the conflict.

B. *Civil Conflict*

We now adapt the model to examine conflict between members of a society (either segmentary lineage or not) and the government of the nation in which it is located. The critical issue here is what to assume about the objectives of the government. We are dealing with African societies where, even if they are relatively democratic compared to the post-independence period as a whole, in the period our data covers, it is difficult to imagine that the government is maximizing social welfare. Rather, it seems more plausible that those in power are maximizing their own payoff subject to the constraint that they need some coalition to support them and/or they need to buy off enough people to avoid social unrest (Padro i Miquel, 2007, Francois, Rainer and Trebbi, 2015). In reality, their ability to buy people off is subject to a great deal of uncertainly and to random shocks.

We adapt the model of the previous section in the following way. Imagine that the government is purely self-interested and trying to maximize tax revenues T. Society is composed of two ethnic groups, one has segmentary lineages and the other does not. Each group has N agents. The key difference between the two is that we assume that if a member of the segmentary lineage groups calls on this lineage mates to mobilize in a conflict, they will do so. By contrast, this is not the case in non-segmentary lineage groups. As before, each agent has an endowment R. The government moves first and announces a level of lump-sum taxation T, which it imposes on each person. In the spirit of the previous model, we also assume that the government moves last and so anything other than the maximal level of T (namely R) is not credible.

Rather than assuming that society can overthrow the government, we assume more realistically that any individual can resist the government in the sense that he can refuse tax demands if he gets the chance. Whether or not an individual successfully resists taxation depends on his power. We model this in exactly the same way as we did before. Individual i has a level of power p_i. If he resists the government, he is successful if $p_i > \chi$, where χ is drawn from F. The power of a person is increasing in the number of individuals he can mobilize for his cause. Specifically, we let the power of i be $p_i(N_i, G)$ where we take G, representing the 'input' of the government, which is taken as given. In this model taxation is of individuals. The key assumption is that in a non-segmentary linage society, everyone is on their own to resist, while in a segmentary linage society, people can coordinate to resist as a group. This implies that as before $p_i(N, G) > p_i(1, G)$.

To ameliorate this possibility, the government can rationally decide to allocate capacity to controlling the members of different groups. We model this in the following way. Let μ^s be the amount of capacity allocated to controlling the members of society $s \in \{SL, NSL\}$. There is a cost of accumulating capacity which we assume for simplicity is quadratic and normalized by the amount of resources so as to make the optimal strategy independent of this, i.e., $\frac{NR}{2}(\mu^s)^2$. We think of $1 - \mu^s$ as being the probability that a member of society i gets the chance to resist. This person will be chosen randomly.

Consider now the following extensive form game.

1. The government announces a tax level T and invests in the amount of capacity μ^s to allocate to segmentary lineage and non-segmentary lineage groups.

2. Nature decides whether or not the members of either group can resist.

3. The threshold χ is determined from F.

4. A randomly chosen member of society $s \in \{SL, NSL\}$ decides whether to resist or not. If resistance is successful, then all the members of his group keep their endowments.

5. If no resistance/conflict takes place, or if the resistance is unsuccessful, then the government decides whether to levy T or some other level of taxation.

Solving the game by backward induction it is clear that at stage 5, the government sets $T = R$. Anticipating this, at stage 4, if an individual can resist taxation, then it is optimal for them to do so; if they do not resist their payoff is 0, while if they successfully do so their payoff is $R > 0$. However, one only gets the chance to resist with probability $1 - \mu^s$. Now moving to stage 1, the government chooses μ^s to solve the following maximization problem

$$\max_{\mu^s} \left\{ \mu^s NR + (1 - \mu^s)(1 - F(p_i^s))NR - \frac{NR}{2} (\mu^s)^2 \right\}.$$

The first term in the maximand is the probability that the government is effective in controlling society s, stopping any potential rebellion and thus gleaning the tax revenues R from each of the N persons. The second term is the probability that government capacity fails to do this times the probability that rebellion by an individual of society i is unsuccessful, which is $(1 - F(p_i^s))$, times the number of people N. Here we index the contest function p_i^s by s. The expected revenues of the government are, $\sum_{i=1}^{N}(1 - F(p_i^s))R$ which is simply $(1 - F(p_i^s))NR$ by symmetry. With probability $(1 - \mu^s)F(p_i^s)$ government capacity fails, but the revolt is successful, in which case the government receives zero so this term drops out of the maximand. The final term is the cost of μ^s.

Now since $F(p_i^{SL}) > F(p_i^{NSL})$ it follows from the first-order conditions of the maximization problem that $\mu^{SL} > \mu^{NSL}$. These are

$$F(p_i^s) = \mu^s \text{ for } s \in \{SL, NSL\}.$$

Intuitively, because segmentary lineage societies are more effective at fighting and resisting central government demands, it is rational for a self-interested government to allocate more resources to controlling members of a segmentary lineage society.

We can now use this simple model to return to the probability that a conflict breaks out in a segmentary lineage society and a non-segmentary lineage society. In either society, this is $(1-\mu^s)F(p^s)$.

As before, the ability of segmentary lineage groups to better mobilize combatants means that conditional on there being a potential for resistance, the probability of conflict breaking out is higher. However, this does not necessarily mean the total (i.e., unconditional) probability of conflict is higher. This is because the potential for resistance may be lower in a segmentary linage group. In our first model, we modeled this as exogenous, though it is well motivated by the ethnographic literature. Here, we have derived this feature as an endogenous outcome of the optimal strategy by the government through its choice of μ^s.

Note that the probability of conflict onset is lower in a segmentary lineage society than in a non-segmentary lineage society if

$$\begin{aligned}(1-\mu^{SL})F(p^{SL}) &< (1-\mu^{NSL})F(p^{NSL}) \text{ or if} \\ (1-F(p^{SL}))F(p^{SL}) &< (1-F(p^{NSL}))F(p^{NSL})\end{aligned}$$

The derivative of $F(p^{SL})(1-F(p^{SL}))$ with respect to N is $F'(1-2F)$ which since $F'>0$, is positive for $F<\frac{1}{2}$ and negative for $F>\frac{1}{2}$. Hence define a function of N, $\Psi_i : \mathbb{R}_+ \longrightarrow [0,1]$, where $\Psi_{SL}(N) = F(p_i^{SL}(N,G))(1-F(p_i^{SL}(N,G)))$. Ψ_{SL} is clearly non-monotone. However, observe that $\Psi_{SL}(0)=0$, while $\Psi_{SL}(1) = F(p_i^{SL}(1,G))(1-F(p_i^{SL}(1,G)))$. For $N \in [0,1]$ we have $\Psi_{SL}(0) \leq \Psi_{NSL}(1)$. However, this is not the interesting part of the parameter space. Ψ_i is increasing up to the point N^* such that $F(p_i^{SL}(N^*,G)) = \frac{1}{2}$, and decreasing for $N > N^*$ and by continuity there exists an $\tilde{N} > N^*$ such that for all $N \geq \tilde{N}$, $\Psi_{SL}(N) \leq \Psi_{NSL}(1)$. We assume that $N^* > 1$. Therefore,

Proposition 2: There exists an $\tilde{N} > N^*$, as defined above, such that for all population sizes $N \in (1,\tilde{N})$ the probability of conflict onset is higher in a segmentary lineage society than in a non-segmentary lineage society. However, for $N > \tilde{N}$ the probability of conflict onset is lower in a segmentary lineage society. The scale of conflict is always strictly larger in a segmentary lineage society.

The proposition shows that for civil conflicts too, it is ambiguous whether or not conflict onset is higher in a segmentary lineage society. This is intuitive. If a conflict starts then the probability that such a society can resist the government is higher. However, anticipating this the government can try to avoid such conflicts by investing more in preventing them ex ante. Whether or not this effect us sufficiently strong to offset the first effect depends on parameters. Proposition 2 indicates that if N is sufficiently large, then the induced effect more than offsets the fighting effectiveness of the SL and $\mathcal{P}_{SL} < \mathcal{P}_{NSL}$.

3. A Dynamic Extension

A. *Intra-Group Conflict*

We now turn to a dynamic environment, where we consider the previous model of intra-group conflict as a stage game within a dynamic game. Time is discrete and we consider a society as being infinitely lived and again being divided into two segments (if it is a segmentary lineage society) or two parts (if it is not a segmentary lineage society). Agents are infinitely lived and discount the future by the factor $\beta \in (0{,}1)$. We restrict attention to pure strategy Markov perfect equilibria (MPE), examining strategies that are only conditional on the state of the game and not the history of play.

There are three types of states: peace, denoted P, in which the stage game is the extensive form game studied above; conflict initiated (in the previous period) by a person i of one of the groups, denoted $C|\,i$; and conflict initiated by a member of the other group j, denoted $C|\,j$. We extend the static game to a dynamic game by assuming that if one of the parties initiates a conflict it induces a transition to a different state with a different stage game.

Consider peace where no conflict has occurred in the previous period. Let the value associated with this state be $V_i^s(P)$ for individual i of society $s \in \{SL, NSL\}$. This has the following recursive representation in a segmentary lineage society:

$$
\begin{aligned}
V_i^{SL}(P) \;=\;& (1 - x^{SL}(1+\theta))\left[R + \beta V_i^{SL}(P)\right] \\
& + x^{SL}\left((1 - F(p_i(N,N))) + \theta(1 - F(p_j(N,N)))\right)\left[R + \beta V_i^{SL}(P)\right] \\
& + x^{SL} F(p_i(N,N))\left[(1+\delta)R + \beta V_i^{SL}(C|\,i)\right] \\
& + x^{SL}\theta F(p_j(N,N))\beta V_i^{SL}(C|\,j)
\end{aligned}
$$

We use the notation $F(p_i(N,N))$ to be the probability that if i gets a pretext to start a conflict, then he will do so if his power is greater than χ. Similarly, $F(p_j(N,N))$ is the analogous probability for an individual from the other segment $j \neq i$. This calculation is now more complex since in the dynamic model if a conflict is initiated, this doesn't just have consequences for payoffs today, but it also induces a transition in the state and therefore has future payoff consequences. We use $V_i^{SL}(C|\,i)$ to denote the value of being in a conflict state which was initiated by i and $V_i^{SL}(C|\,j)$ the value of a conflict state initiated by j. As we shall argue shortly, $V_i^{SL}(C|\,i) > V_i^{SL}(P)$ (and $V_i^{SL}(C|\,j) > V_i^{SL}(P)$) so as in the static model, if an agent gets a chance to initiate a conflict, it is profitable to do so. Therefore, we abuse notation slightly to keep things simple and write directly the expressions for the win probabilities as $F(p_i(N,N))$ and $F(p_j(N,N))$ in the Bellman equation. This keeps notation to a minimum.

Although the Bellman equation looks slightly complicated, it has a straightforward interpretation as an extension of the static model. The first line is the probability that no potential conflict situations arise in any period times the payoff in this event (when there can be no conflict) R followed by the discounted continuation value of staying in the peace state. The second line also represents a situation where the peaceful state recurs. This can also happen when there is the potential for conflict, but the realizations of χ are sufficiently high that neither player can overpower the other. In this event, there is again peace, a flow payoff of R, and a discounted continuation value of $\beta V_i^{SL}(P)$. The next two lines capture the situation when there is conflict in equilibrium. In the third line, with probability x^{SL} a pretext occurs which allows i to initiate a conflict, which he wins with probability $F(p_i(N,N))$. If he does so, then his expected payoff is $(1+\delta)R + \beta V_i^{SL}(C|\,i)$. $(1+\delta)R$ represents his own endowment plus the remainder of the endowment of the other agent gleaned through conflict. He also gets the continuation value $\beta V_i^{SL}(C|\,i)$ since the game transitions to a conflict state, the details of which we spell out below. In the final line of the Bellman equation, we have the situation where instead of i getting the conflict opportunity and the low cost realization, it is j, a player from the other segment, that does so and overpowers him. This event happens with probability $F(p_j(N,N))$. In this case i gets the flow payoff of zero and a discounted continuation value $V_i^{SL}(C|\,j)$, which captures the fact that it is j who has initiated and been successful in the conflict.

Note that in both of the last lines, following Blavatskyy (2010), there is implicitly the possibility of a draw, in which case the assumption is that the player initiating conflict does not grab the R

of his opponent. In this case, we still assume that conflict has been initiated and that we therefore transition to a conflict state.

We now write down a related recursive relationships for the conflict state. The key assumption is that once conflict has been initiated, it becomes irrelevant whether a pretext for starting a conflict arises. Thus, the stochastic process that generates such pretexts is not relevant to payoffs or the extensive form of the state game. We also assume that whichever party initiates the transition out of a peace state dominates the subsequent conflict state. The value $V_i(C|\,i)$ therefore satisfies

$$\begin{aligned} V_i^{SL}(C|\,i) &= R + F(p_i(N,N))\left[\delta R + \beta V_i^{SL}(C|\,i)\right] \\ &\quad + (1 - F\left(p_i(N,N)\right))\,\beta V_i^{SL}(P). \end{aligned}$$

The interpretation of this follows from above and the observation that we are now assuming that if i initiates conflict, then the game goes into a state where i can continue with conflict, or can switch back to peace. The first term in the Bellman equation is the flow payoff R which is guaranteed in this state, plus the probability that i initiates a conflict times the payoff. This is made up of the net endowment from a member of the other group, δR, plus the discounted continuation payoff of staying in the conflict state. The final term in the equation covers the situation where the realization of χ is high so that the game switches back to peace and the value $V_i^{SL}(P)$ recurs.

There is an analogous Bellman equation for $V_i^{SL}(C|\,j)$. This is:

$$V_i^{SL}(C|\,j) = F(p_j(N,N))\beta V_i^{SL}(C|\,j) + (1 - F(p_j(N,N)))\left[R + \beta V_i^{SL}(P)\right]$$

Now with probability $F(p_j(N,N))$, j successfully takes i's endowment so the flow payoff is zero and i stays in the state $C|\,j$. With probability $1 - F(p_j(N,N))$ player j experiences a high realization of χ, peace returns and i enjoys the flow payoff R.

With these equations in hand, we can return to justifying our imposition of the formulas $F(p_i(N,N))$ and $F(p_j(N,N))$ in the expression for $V_i^{SL}(P)$ above. In the dynamic model, the static benefit of initiating conflict is again $F(\cdot)\delta R$, but there is a future consequence in that the state changes. Hence, our imposition can only be justified if $V_i^s(P) - V_i^s(C|\,i) < 0$, which we now argue.

Fact: $V_i^s(P) - V_i^s(C|\,i) < 0$ for $s \in \{SL, NSL\}$.

While this inequality can be established by some straightforward algebra, it is also intuitive from the Bellman equations. Consider $V_i^{SL}(C|\,i)$. This value is made up of the flow payoff R for sure, plus the probability of being able to predate on j and gaining δR and the probability that this fails with a transition back to $V_i^{SL}(P)$. Both elements are present in the formula for $V_i^{SL}(P)$. The first is weighted by something smaller than 1. Moreover, $V_i^{SL}(P)$ incorporates the probability that j gets the chance to predate on i, something not allowed in $V_i^{SL}(C|\,i)$. Hence it must be true that $V_i^{SL}(C|\,i) > V_i^{SL}(P)$. The extension to a non-segmentary lineage society is immediate, hence, establishing the Fact.

From this, we can see that in a state P, in a segmentary lineage society, the probability of conflict onset is

$$x^{SL}\left[F(p_i(N,N)) + \theta F(p_j(N,N))\right],$$

exactly as in the static model. Now observe that analogously, we have that the probability that a conflict begins in a NSL is

$$x^{NSL}\left[F(p_i(1,1)) + \theta F(p_j(1,1))\right].$$

Of more interest here is the probability of conflict offset. In a segmentary lineage society, this is given by either $1 - F(p_i(N,N))$ or $1 - F(p_j(N,N))$. The probability of conflict offset in a non-segmentary lineage society is $1 - F(p_i(1,1))$ which is clearly greater than the probability in a segmentary lineage society.

We can now state the main result of this section.

Proposition 3: (*i*) If a conflict starts, it is always of a larger scale in a segmentary lineage society. (*ii*) If $x^{SL} \in [0, \hat{x}^{SL})$, then the probability that a conflict begins is lower in a segmentary society. If $x^{SL} \geq \hat{x}^{SL}$, then the probability that a conflict begins is higher in a segmentary lineage society. (*iii*) The probability of conflict offset is always lower in a segmentary lineage society.

To reflect again on credibility, we note that the form of the static game embedded in the dynamic does not eliminate the potential for resolving the commitment problem. This is because history dependent strategies could be used. We have ruled this out by restricting attention to Markov strategies. Nevertheless, even if history dependent strategies examined, there would be some part of the parameter space in which the credibility problem persists (see Acemoglu and Robinson, 2006, Chpt. 6).

B. *Civil Conflict*

We now extend our static model of conflict between the government and society to a dynamic model. We assume that if resistance to the government's taxation is successful, then the game transitions to a state where the capacity of the government to control conflict, as modeled by μ^i, collapses. Again, think of the static model as representing a peace state. Imagine that a member of a segmentary lineage group manages to initiate successful resistance to government taxation. We again focus on Markov perfect equilibria so that the credibility problem remains and conflict occurs in equilibrium. This induces a transition to a conflict state where $\mu^i = 0$, but the government can still attempt to levy taxes and citizens can try to resist. Call this state $C|\, i$. Then the value of this state to an individual i from a segmentary lineage group would be:

$$V_i^{SL}(C|\, i) = F(p_i(N, G)) \left[R + \beta V_i^{SL}(C|\, i)\right] + (1 - F(p_i(N, G)))\beta V_i^{SL}(P).$$

In this model, it is immediate that while the probabilities of conflict onset for a segmentary lineage group compared to non-segmentary lineage group are as in the static model, the probability of conflict offset is always smaller in a segmentary lineage group. This follows the fact that $1 - F(p_i(N, G)) < 1 - F(p_i(1, G))$ since $F(p_i(N, G)) > F(p_i(1, G))$.

4. Discussion of Assumptions

We now discuss some of the modeling decisions that we have made. The main decision is to assume exogenously that if someone from a segmentary lineage society gets into a conflict, then they can call up their segment to aid them. A member of a non-segmentary lineage society does not have this ability. Naturally one could extend the model so that a member of a non-segmentary lineage society could offer financial inducements to members of its own sub-group in order to get them to support them. In some circumstances this may induce members of the sub-group to come to the persons aid. In the current model, there would be no disutility to coming to aid, so such payments could even be small to break indifference. The absence of costs assumed here is made only for simplicity. Assuming away the issue of whether or not such inducements would be credible, there would still be some part of the parameter space where it would not be optimal or feasible to make such payments.

Our model also does not provide microfoundations for why members of a segmentary lineage group do indeed come to the aid of members of their segment. Modeling this would involve taking notions of kinship much more seriously, perhaps along the lines of Hamilton (1964); also see Henrich and Henrich (2007). While we regard this as a very interesting project, our aim here has been to take this aspect of segmentary lineage organization as given so that we can draw out its implications for conflict onset and offset.

In studying differences in intra-group conflict between segmentary lineage and non-segmentary lineage groups, we made use of a particular non-homogeneity in the contest function. Whether or not such non-homogeneity exists is an empirical question. Clearly, it is needed for the results of this model in the case of intra-group conflict, although not for the results when a SL is in contest with the government. Here we have simply used the fact that a simple and well known and tractable version of a contest function has this property.

5. Summary of Findings

We have developed static and dynamic versions of two types of conflictual situation. The first is a setting of the possibility of conflict between two groups from the same society – i.e., within-group conflict. The second is a setting where individuals in a society may choose to rebel against the government – i.e., civil conflict. We have examined the relationship between a society having segmentary lineages – and with it obligations for lineage mates to come to the aid of their kin if a conflict occurs – and the likelihood that a conflict starts (onset) and the scale of the conflict conditional on it starting (escalation).

We find that for both the static and the dynamic versions, that the relationship between the onset of either type of conflict and segmentary lineage organization is ambiguous. Segmentary lineage groups can make it more or less likely that conflicts will start. However, conditional on conflicts beginning, the conflicts of segmentary lineage groups are larger in scale. In reality, this means they involve more combatants, have more battle deaths, and last longer.

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