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Does Inequality lead to Conflict?

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Abstract

This paper presents a simple model to show how distributional concerns can engender social conflict. We have a two period model, where the cost of conflict is endogenous in the sense that parties involved have full control over how much conflict they can create. We find that anticipated future inequality plays a crucial role in determining the level of conflict in the current period. The model also provides an explanation for why similar levels of inequality may exhibit drastically different levels of conflict. Further, we argue that the link between inequality and conflict may be non-monotonic.

Keywords: conflict, wealth inequality, Nash bargaining

JEL classification: C78, D31, D74, D90

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1 Introduction

This paper presents a simple model showing how distributional concerns can engender social conflict. We focus on the phenomena of intra-state conflict that has become common in recent years (Stewart et al. 2001). It is usually manifested in terms of widescale demonstrations, protests, strikes and sometimes violent rebellions, leading to severe disruption of economic activity.[1] This can weaken a country's institutions and severely impede its economic progress. In fact, many of the states in the poorest regions of the world, have gone through serious intra-state conflict in the recent past. From this one may be tempted to deduce that when countries are very poor, the competition over resources can be intense, eventually leading to serious conflict. While this may be true, not all countries that have suffered serious conflict have mass destitution. For instance, Sri Lanka, which has gone through serious conflict all through the last two decades, ranks highly when it comes to quality of life indicators such as life expectancy and literacy.[2]

Although it is possible that conflict may exacerbate the existing levels of poverty and inequality, the object of this paper is to investigate the causal role of inequality in fostering conflict. This has been emphasized in a number of recent papers. MacCullouch (2001), after controlling for several factors such as income, military expenditure and country and time specific effects, do find that higher inequality can lead to higher conflict. Nafziger and Auvinen (2000) using an improved inequality data set and a broader definition of conflict find a strong link between inequality and war. Other studies such as Alesina and Perrotti (1996), Cramer (2003), World Bank (2003), point to economic inequality as an important cause of conflict.[3]

[1] See Nafziger et al. (2000) and Sachs (1989).

[2] Sri Lanka has suffered from serious ethno-religious conflict between the Sinhalese majority and the Tamil minority since the early eighties. For details about the insurgency in Sri Lanka refer to: http://www.onwar.com.

[3] Collier and Hoeffler (2000) does not find any significant impact of inequality on conflict. However, for the problems with their paper refer to Cramer (2003) and Nafziger

We provide a theoretical framework to analyze the link between inequality and conflict. In particular our emphasis is on wealth inequality and conflict. In mainly agrarian economies, for example, land inequality closely reflects wealth inequality and the distribution of land can be a source of discontent. In Central American countries, such as El Salvador and Guatemala, strong reliance on agro based exports led to an extremely disproportionate amount of land in the hands of a few rich and powerful interests. This resulted in serious conflict with those who have been dispossessed (Brockett, 1988). But inequality in assets is not just limited to land inequality. One of the important reasons for conflict in Angola and the D.R. Congo was for the control of the natural resources.[4] The share (or the lack of share) of the different groups in these resources can be seen as the source of asset inequality.

The emphasis on this asset based inequality does not in any way reduce the importance of other factors, historical, ethnic or religious, in creating conflict. In fact our analysis presumes the polarization of a society into rival groups. How these groups are formed and the ensuing tensions between them are essential part of any description of conflict. We take these group formations as given.[5] Instead, the question that we address here is, given an already bifurcated society, what sparks the conflict? This is where asset inequality comes to bear.

To demonstrate how inequality and conflict are interlinked, we use a two period repeated game framework which is similar to Garfinkel and Skaperdas (2000) and Skaperdas and Syropoulous (1996). However, unlike those models, the groups directly choose the level of conflict, rather than choosing between productive and defensive activities.[6] Another difference with

and Auvinen (2002, p.156).

[4]'Q&A: D R Congo Conflict', B.B.C News, December 15, 2004 and 'Country Profile: Angola', B.B.C News, May 3, 2005. Available at http://news.bbc.co.uk.

[5]For the dynamics of group formations see Garfinkel (2004a, 2004b).

[6]Addison et al.(2003) and Benhabib and Rustichini (1996) also take a similar approach.

the previous papers lie in how the joint output is distributed. In standard choice theoretic models, the share of each group depends on the amount of resources the groups invest in enhancing their relative capability to capture a larger share of the output. In contrast, we presume an underlying social contract between the groups when it comes to the distribution of joint outputs. This contract may be arrived at through some bargaining process between the groups. In this sense our model is closer to Bannerjee and Duflo (2000) and Rodrik (1998).

The shares of the groups, in our model, depend on the relative levels of wealth. If a group is relatively wealthy, then presumably it can have more leverage in the bargaining and thus be able to appropriate a larger share of the output. The current level of wealth inequality is then reflected in a more skewed distribution of income in the future. Whilst Skaperdas and Syropoulous (1997) discusses distributional issues in the context of conflict, it is in a static framework. Also, unlike their model, ours does not allow conflict in the absence of inequality.[7] Further, one of the features of their model is that, groups with higher appropriative capabilities enjoy a larger share of the output. By specifying a stable social contract through the distribution rule, our model refrains from such an anarchic situation.

Yet we are able to demonstrate how wealth inequality can tip a peaceful society to conflict. We go on to show that even if wealth and income was equally shared, conflict may still arise, so long as there was a possibility of future inequality. Taking the analysis further, we argue that conflict just does not simply increase with inequality and the disadvantaged groups are not the only one to engage in conflict. At higher levels of inequality both the advantaged and the disadvantaged groups may engage in conflict which is what we often see when repressive measures are undertaken by (governments

[7] In a similar context, Benhabib and Rustichini (1996) presents a dynamic model, but they also allow for conflict under perfect equality. Further, unlike ours, the groups in their paper do not incur any cost in the current period to initiate conflict.

aligned to) the advantaged group to suppress the conflict initiated by the disadvantaged group. We also find that there are discontinuities in the link between inequality and conflict. Our model, therefore, provides a plausible explanation as to why countries with inequality levels close to each other may exhibit drastically different levels of conflict. More interestingly as inequality rises the potential increase in conflict may be high enough to act as an disincentive for groups to participate in production processes, the sharing of the output of which is the main source of conflict. In fact we show that the link between inequality and conflict is non-monotonic[8].

The plan of the paper is as follows. In the next section, we describe the basic structure of the model used in the paper including the production technology, the consumption decisions made by the groups, the social contract and the stages of the game between the groups. Section 3, we focus on the initiation of conflict. In particular which group engages in conflict first and what triggers the conflict. In Section 4, we analyze in detail how future inequality and current levels of conflict may be related. The following section discusses some extensions of the model and Section 6 concludes the paper with some discussion about the policy implications of our results.

2 Model: Basic Framework

2.1 Production

Consider two groups, i and j, involved in production of an output over two time periods, t and $t+1$. The groups either decide to produce the output jointly or to produce on their own. In the beginning of period t groups i and j are endowed with wealth w_t^i and w_t^j respectively. Each period the groups are also endowed with one unit of indivisible human capital. Let

[8] In a paper, recently brought to our attention, Milante (2004) also finds a non-monotonic relation between wealth inequality and conflict. However the structure of the model and the general result differ significantly from ours.

$h_t^m \in \{0, 1\}$ represent the level of human capital used for joint production by any group m.

Output under own production for group m is,

$$Y_t^m = \begin{cases} w_t^m \text{ when } h_t^m = 0 \\ 0 \text{ when } h_t^m = 1 \end{cases}, \tag{1}$$

where wealth w_t^m, and human capital $(1 - h_t^m)$, are used as inputs.

For the joint production case, we assume that the groups divide a given level of output say R_t in each period.[9] The joint output is given by

$$Y_t = \begin{cases} R_t \text{ when } h_t^i = 1 \text{ and } h_t^j = 1 \\ 0 \text{ when } h_t^i = 0 \text{ or } h_t^j = 0 \end{cases}. \tag{2}$$

We would assume that $R_t \gg w_t^i + w_t^j$, that is, the joint output is far greater than the combined total of each groups own production. Both groups receive a part of the joint output according to some distribution rule, which is discussed next.

2.2 Social Contract

Social contract or the sharing rule is of crucial importance in any conflict model. This paper, will not be an exception in that regard. In the literature, the distribution rule (know as 'contest success functions') is a proportional sharing rule, with an emphasis on a winner-takes-all feature. This kind of sharing rule is appropriate in analyzing situations of war, where there is an element that the victor commands all the resources. However, most conflict that we see today, are intra-state conflict, be it peaceful protests

[9]We could on the other hand, allow the joint output to depend on the current wealth levels. In that case, however, we will have to rule out sequential investments. This means that in period t if the parties decide to produce jointly, they invest their wealth in the joint production. The output in period t then depends on the total level of wealth invested. In the next period, in case of joint output, there will be no need for additional investments.

or civil war. In those cases the winner-takes-all feature may not be appropriate. In such circumstances, we may find the loser still getting some share of the resources, albeit, a very small share. This is a highly desirable property, especially for conflict situations and not all distribution rules share that property (Hirshleifer, 1989).

Keeping this in mind, we propose the 'split-the-difference' sharing rule,[10]

$$d_t^i = Y_t^i + (1/2).(R_t - Y_t^i - Y_t^j), \quad (3)$$

$$d_t^j = Y_t^j + (1/2).(R_t - Y_t^i - Y_t^j), \quad (4)$$

where i and js share of the joint output, given by d_t^i and d_t^j, depends on the difference in the wealth between the groups. Equal levels of wealth, will result in equal distribution of the pie. Note that both groups have equal bargaining power under this sharing rule, but more general rules can be used.

2.3 Conflict

While both the groups have some control over the production aspect (in the sense that they can choose between joint and own production), they have little control over the sharing rule of the joint output. In such a case, if group i is unhappy with its share of the joint output, d_t^i, it can resort to conflict. This can take the form of destruction of the other groups share. There is no direct appropriation of the opponents share. Our model, therefore, does not discuss looting[11].

However, when one group indulges in conflict, it not only harms their opponent, but also effects it's own income, albeit not to the same extent. Let n_t^i and n_t^j represent the level of conflict engaged by group i and j respectively

[10] This is the same as the Nash Bargaining Solution with equal bargaining power, which has easy intuitive interpretations and strong axiomatic foundation (Muthoo, 1999).

[11] Refer to Azam (2002) for a model that includes looting.

in time t. The net income of the groups will be

$$y_t^i = (1 - kn_t^i).(1 - n_t^j).d_t^i, \quad (5)$$

$$y_t^j = (1 - n_t^i).(1 - kn_t^j).d_t^j, \quad (6)$$

where $k < 1$ reflects limited self damage. Further, we assume that no group has the ability to destroy each others initial level of wealth. It may be that initial levels of wealth are better protected than their respective shares from the joint output. Hence if own production takes place then net income of each group will be

$$y_t^i = w_t^i \quad \text{and} \quad y_t^j = w_t^j. \quad (7)$$

The total amount of conflict in period t in the society, denoted by n_t, should involve some aggregation of the level of conflict by both groups. Although, different aggregation rules are possible, in this paper we consider the 'additive' aggregation rule, where the total conflict is the sum of the level of conflict engaged in by each group.

$$n_t = n_t^i + n_t^j. \quad (8)$$

2.4 Consumption and Savings

Both groups choose a level of consumption (and therefore a certain level of savings) and a level of conflict each period, to maximize the group's lifetime utility. The groups, however, have to incur a mobilization cost for engaging in conflict. The cost of mobilization increases at an increasing rate with the level of conflict. A group, say m, would maximize the following,

$$V^m(c_t^m, c_{t+1}^m, n_t^m, n_{t+1}^m) = c_t^m - \frac{1}{2}.(n_t^m)^2.d_t^m + \rho[c_{t+1}^m - \frac{1}{2}.(n_{t+1}^m)^2.d_{t+1}^m],$$

$$\text{s.t. } c_t^m + s_t^m = y_t^m, \quad (9)$$

$$c_{t+1}^m + s_{t+1}^m = y_{t+1}^m,$$

$$c_t^m, c_{t+1}^m, n_t^m, n_{t+1}^m \geq 0, \quad (10)$$

where c_t^m and s_t^m are the level of consumption and savings for group m in period t and $\rho < 1$ is the discount factor. $\left(\frac{1}{2}.(n_t^m)^2.d_t^m\right)$ captures the mobilization cost of conflict.

Wealth in period $t+1$ for group m is

$$\begin{aligned} w_{t+1}^m &= r^m.s_t^m, \text{ when } h_t^m = 0, \\ &= r^m.(s_t^m + w_t^m), \text{ otherwise.} \end{aligned}$$

where r^m is the interest factor on the gross savings in period t. These r^ms refer to differential opportunities each group faces. For example, the interest factors may well depend on people's talents and abilities, or differential access to asset markets, or sheer good fortune. This heterogeneity will be the crucial element which will drive the conflict in this paper. Here, we will refer to the difference in the interest factors between the groups as the wealth inequality in $t+1$. For most of the paper we will assume, without loss of generality, that group j is the fortunate (or the advantaged) group and group i is the unfortunate (or the disadvantaged) group. Therefore, inequality $I = (r^j - r^i)$.[12]

[12] If $w_t^i = w_t^j$ and $s_t^i = s_t^j$, then $I = (r^j - r^i)$ is a monotonic function of the Gini coefficient (G), i.e. $I = f(G)$ and $f' > 0$.

2.5 The Game

Recall that the distribution rule is fixed for the whole game. Hence it is a two period game with each period consisting of the following two stages:

Stage 1: Knowing the distribution, the groups can decide either to produce on their own ($h_t^i = 0$, or $h_t^j = 0$), or to produce jointly ($h_t^i = 1$, and $h_t^j = 1$).

Stage 2: If they decide to produce jointly, then each party decides on the level of conflict, that is, (n_t^i and n_{t+1}^i) for group i and (n_t^j and n_{t+1}^j) for group j.

Let (n_t^{i*}, n_t^{j*}) represent the equilibrium level of conflict and h_t^{i*}, and h_t^{j*} represent the equilibrium human capital input of group i and j respectively for the joint output.

Definition 1 *A sub game perfect equilibrium is given by the quadruplet* (n_p^{i*}, n_p^{j*}, $h_p^{i*}(n_p^{i*}, n_p^{j*})$, $h_p^{j*}(n_p^{i*}, n_p^{j*})$), $p = t$, $t+1$ *such that each players choice is a best response to the other player and satisfies sequential rationality.*

We shall use the backward induction approach to find the subgame perfect equilibrium of the game.

3 Who Initiates Conflict and Why?

In this section we investigate which of the two groups, the disadvantaged (group i) or the advantaged (group j), initiates the conflict. The advantaged group may initiate conflict because it is more ‘greedy’. On the other hand the disadvantaged group may engage in conflict because of genuine ‘grievances’. The central hypothesis in this section is that conflict may arise out of anticipated future inequality rather than current inequality. We start by establishing the conditions under which neither of the groups will engage in conflict and then derive the levels of inequality that leads to conflict.

First we show that in the most general case the groups will not engage in conflict in the final period irrespective of the level of inequality.

Proposition 1 *No group will engage in conflict in the last period.*

Proof: In period 2 group i will maximize the following

$$\begin{aligned} V^i_{t+1}(s^i_{t+1}, n^i_{t+1}) &= \max\{c^i_{t+1} - \frac{1}{2}.(n^i_{t+1})^2.d^i_{t+1}\}, \\ \text{s.t. } c^i_{t+1} + s^i_{t+1} &= y^i_{t+1} = (1 - k.n^i_{t+1}).(1 - n^j_{t+1}).d^i_{t+1}, \end{aligned}$$

where $d^i_{t+1} = (1/2)(R_{t+1} + w^i_{t+1} - w^j_{t+1})$ (using (3) and (4)). From the first order conditions we get,

$$\frac{dV^i_{t+1}}{ds^i_{t+1}} = -1 < 0,$$

which implies $c^i_{t+1} = y^i_{t+1}$. Further, since $(dy^i_{t+1}/dn^i_{t+1}) \leq 0$,

$$\frac{dV^i_{t+1}}{dn^i_{t+1}} = \frac{dy^i_{t+1}}{dn^i_{t+1}} - n^i_{t+1}.d^i_{t+1} < 0.$$

Hence $n^i_{t+1} = 0$. Similarly for group j. Q.E.D.

What about conflict in period t? For analytical tractability we will start with the assumption that for both groups savings in proportional to the level of income, i.e. $s_t = \alpha.y_t$,[13] where $\alpha \leq (1/2)$. We investigate the condition under which group i and j will initiate conflict in period t, if joint output is produced.

Proposition 2 *Group i initiates conflict if $\gamma < \frac{1}{2}.(r^j.\frac{d^j_t}{k.d^i_t} - r^i)$, and group j initiates conflict if $\gamma < \frac{1}{2}.(r^i.\frac{d^i_t}{k.d^j_t} - r^j)$ where $\gamma = \frac{(1-\alpha)}{\rho.\alpha} > 0$.*

[13] This is not a very restrictive assumption since similar conditions can be derived from the model without affecting the results. Suppose $r^j \geq r^i$. So long as $\rho.r^i \geq 1$ (i.e. marginal future gain from saving outweighs the marginal loss of current consumption) and there is minimum level of consumption each period for both groups, i.e. $c^i_t \geq \underline{c}$, $c^j_t \geq \underline{c}$, it implies that $s^i_t = y^i_t - \underline{c}$ and $s^j_t = y^j_t - \underline{c}$. It can be checked that the results that follow under the assumption $s_t = \alpha.y_t$ for both groups, will also go through for these alternative specification.

Proof: First let us take the case of group i. Since $n^i_{t+1} = n^j_{t+1} = 0$ and $s^i_{t+1} = s^j_{t+1} = 0$ (from Proposition 1), in period t, group i will choose n^i_t such that it maximizes the following:

$$\begin{aligned} V^i &= c^i_t - \frac{1}{2}(n^i_t)^2.d^i_t + \rho c^i_{t+1} \\ \text{s.t. } c^i_t + s^i_t &= y^i_t = (1 - k.n^i_t).(1 - n^j_t).d^i_t \\ c^i_{t+1} &= y^i_{t+1} = (1/2).(R_{t+1} + r^i(s^i_t + w^i_t) - r^j(s^j_t + w^j_t)). \end{aligned}$$

where $d^i_t = \frac{R_t + w^i_t - w^j_t}{2}$. Therefore using the first order condition and $s^i_t = \alpha y^i_t$ and $s^j_t = \alpha y^j_t$, one can show,

$$\frac{dV^i_t}{dn^i_t} = -(1-\alpha).(1-n^j_t).k.d^i_t - n^i_t.d^i_t + \frac{\rho.\alpha}{2}(r^j(1-k.n^j_t).d^j_t. - r^i(1-n^j_t).k.d^i_t). \tag{11}$$

Similarly from group js first order condition we get,

$$\frac{dV^j_t}{dn^j_t} = -(1-\alpha).(1-n^i_t).k.d^j_t - n^j_t.d^j_t + \frac{\rho.\alpha}{2}(r^i(1-k.n^i_t).d^i_t. - r^j(1-n^i_t).k.d^j_t). \tag{12}$$

Plugging $n^i_t = n^j_t = 0$, in the above equations, the conditions under which group i and j will initiate conflict is respectively given by

$$\begin{aligned} \gamma &< \frac{1}{2}.(r^j.\frac{d^j_t}{k.d^i_t} - r^i), \\ \gamma &< \frac{1}{2}.(r^i.\frac{d^i_t}{k.d^j_t} - r^j), \end{aligned} \tag{13}$$

where $\gamma = \frac{(1-\alpha)}{\rho.\alpha} > 0$. Q.E.D.

To have a better understanding of the conditions under which groups will initiate conflict, (13), we shall discuss some relevant scenarios. First we discuss the case when there is perfect equality both in the current and the future period. Next we derive the conditions for the case where there is perfect equality in the current period but inequality in the future period.

The third discussion is centered on inequality in both the current and the future period and finally we discuss the case of inequality in the current period but not in the future.

For simplicity we assume the proportion of 'self-damage' $k = (1/2)$ and normalize group is interest rate $r^i = 1$. Under this assumption, when there is full equality (i.e. $r^j = r^i = 1$ and $w_t^i = w_t^j$), one can interpret γ (or more appropriately the inverse of γ) as a virtual discount factor: present loss from saving against future benefit from higher consumption.

Corollary 1 *Under full equality neither group engages in conflict if* $\gamma > (1/2)$.

Corollary 1 directly follows from (13) under the assumptions of full equality. Q.E.D.

To understand the impact of the current and future wealth inequality on conflict, we must ensure that atleast when both current and future wealth are equal there is no conflict in our model. Since the savings rate, $\alpha \leq (1/2)$, implies $\gamma \geq 1$, in our model, none of the groups will engage in conflict under current and future equality.

Let us continue to assume that in the current period there is no wealth inequality. However, due to some anticipated shock,[14] group j earns a higher rate of interest on the savings, relative to group i, i.e. $r^j > r^i$. Given other things remaining the same, this will mean that there will be inequality in period $(t + 1)$ only, and group j will be the wealthier group. Note that the future wealth inequality is driven by the difference in the rate of returns accruing to each group, i.e. $I = (r^j - r^i)$. We will show that when the inequality is high enough, it will be beneficial for group i to initiate conflict in period t. Note that here we are talking about which group will initiate the conflict, the presumption being that there is no conflict to begin with.

[14] The shock is fully anticipated by both groups in our model. We later discuss the case where the shocks may not be fully anticipated.

Corollary 2 *Let* $w_t^i = w_t^j = 0$ *. Group* i *will prefer to initiate conflict in period* t *if the inequality is substantial, that is,* $I > \gamma - (1/2)$*, where* $\gamma > 0$*. There will be no conflict in period* $(t+1)$*.*

The condition for group i easily follows from (13). From Corollary 1 we know that group j will not initiate conflict when $r^j = r^i = 1$. Therefore, when $r^j > 1$, given that $\gamma > 1$, it will be the case that group j will not initiate conflict in period t. Q.E.D.

In this case, even though there was equality in period t, a situation of conflict still arose. The disadvantaged group anticipated that in period $t+1$, the other group will have higher wealth and hence will receive a larger share of the joint output. Therefore, it was in the interest of the group with anticipated lower wealth in period $t+1$, to engender conflict in the first period so as to reduce the other group's bargaining advantage.[15] This is similar to Skaperdas and Syropoulous (1996) where they show that in the presence of 'strategic time dependence',[16] future concerns can reduce cooperation in the current period. Notice that the anticipated future inequality as such may not lead to conflict. The difference has to be high enough to make it worthwhile for the disadvantaged group to initiate conflict.

Next, we analyze the link between inequality in period t and conflict. Let $w_t^j > w_t^i$. Given this, we discuss two cases: (a) where rates of return on savings are the same across groups and (b) where the rates of return vary such that both groups have the same level of wealth in period $t+1$. The first case reflects the point that the initial wealth inequality is carried through in period $t+1$. In fact, if the rate of return on the savings are positive, then the wealth inequality in the next period will be magnified. The second case looks into where the rates of return are such that it acts as

[15] Hirshleifer (1991) and Durham et al. (1998) also find that the disadvantaged group initiates the conflict.

[16] In our model, the time dependence comes through the savings in the current period, which translates in to wealth in the next period and that determines the next period share of the output.

a mitigating factor for future inequality. Therefore in the second case we have a situation where there is inequality in the current period but there is no future inequality.

First consider the case where the rate of returns will be the same whereas there is wealth inequality to begin with. Since $r^j = r^i$ this implies that in period $t+1$, $w^j_{t+1} > w^i_{t+1}$.

Corollary 3 *Given $w^j_t > w^i_t$, group i will not initiate conflict if the joint production technology is highly efficient. Otherwise, there is a possibility that group i will initiate conflict.*

Suppose the joint product R_t is large enough for $(d^j_t/d^i_t) \simeq 1$. Then given $r^j = r^i = 1$, and $k = (1/2)$, from (13) we get that for group i to initiate conflict in this situation, $\gamma < (1/2)$, which violates the condition of Corollary 1. Hence there will be no conflict in this situation. However, if R_t is not large enough, then $w^j_t > w^i_t$, will imply $(d^j_t/d^i_t) > 1$ which from (13) one can show will lead to lead group i to initiate conflict. Q.E.D.

Finally consider the case where wealth inequality exists in the first period but not in the future periods, i.e. $w^j_t > w^i_t$ and r^i, r^j are such that $w^i_{t+1} = w^j_{t+2}$.[17] Irrespective of the level of inequality in the current period, we will show here that, in the absence of future inequality there may not be any conflict in the society.

Corollary 4 *Let $w^j_t > w^i_t$ and $w^i_{t+1} = w^j_{t+1}$. There will be no conflict in the society.*

Proof: Using (3) and (4) $w^i_{t+1} = w^j_{t+1}$ implies $y^m_{t+1} = y^j_{t+1}$. In the absence of conflict or no savings in period $(t+1)$, $c^i_{t+1} = c^j_{t+1} = (R_{t+1}/2)$. This means there will be no gains in the future from engaging in conflict in the current period. We also know that conflict in the current period has

[17]Notice that r^i and r^j will depend on (n^i_t, n^j_t). To be more precise, for every (n^i_t, n^j_t), we will be able to find (r^i, r^j) such that $w^i_{t+1} = w^j_{t+1}$.

a mobilization cost and further results in a decrease in consumption in the current period. Hence none of the groups will have an incentive to engage in conflict in the current periods. Therefore $n_t^i = n_t^j = 0$. Q.E.D.

What the above corollary clearly show is that initial inequality does not play any role in engendering conflict. What matters is anticipated future inequality. Therefore, a high inequality today will not lead to conflict as long as in the future the inequality in reduced. Hence standard empirical exercises may find that current inequality does not significantly affect conflict, but it will be wrong to infer that inequality plays no role in fostering conflict. In fact it is quite the opposite. In this situation, unlike Garfinkel and Skaperdas (2000) and Skaperdas and Syropoulous (1996), in presence of 'strategic time dependence', the 'long shadow' of the future can help reduce conflict and increase cooperation.

4 Future Inequality and Equilibrium Level of Current Conflict

Future inequality plays a key role, since in its absence, there will be no conflict. The previous section mainly dealt with the issue of whether conflict will be initiated or not. In this section we demonstrate the link between future inequality and conflict in more depth. Specifically we are interested to know what happens to the level of conflict once one group has initiated it. Does the other group also join in the conflict? How much will the level of conflict be that each group chooses? What we find is that, under certain restrictions on the parameters, it is the case that once conflict is initiated, for some levels of inequality, only the disadvantaged group engages in conflict in equilibrium. However, when levels of conflict are high, both groups engage in the conflict. Later we use these results to uncover the link between inequality and conflict.

The best-response functions of each group can be derived from their first order conditions. For group i, (from (11)) it is,

$$n_t^i = \frac{\rho.\alpha}{2}[r^j.(1 - k.n_t^j) - r^i.k.(1 - n_t^j)] - (1 - \alpha).k.(1 - n_t^j).$$

This can be written as,

$$n_t^i = A + B.n_t^j, \tag{14}$$

where $A = \left[\frac{\rho.\alpha}{2}(I + \frac{1}{2} - \gamma)\right]$ and $B = \left[\frac{\rho.\alpha}{2}\left(\gamma - \frac{I}{2}\right)\right]$. $A \geq 0$ represents the amount of conflict group i will engage in when it initiates the conflict and B is the change in is level of conflict when group j changes its level of conflict.

Clearly whether $B \lesseqgtr 0$, will depend on $2\gamma \lesseqgtr I$. The intuition for the change in slope is the following. V^i is affected by n^i in mainly three ways: a negative effect on present consumption, a negative effect on future income through own savings and future wealth, and a positive effect on future income through other group's low savings and low future wealth. In addition, there is the direct cost of engaging in conflict. When inequality is sufficiently high ($I > \gamma - \frac{1}{2}$), the third effect can be sufficient to induce group to initiate conflict. This is the one which depends on the level of inequality, the other two does not. Moreover, as n^j changes the marginal effect (first) is lower, that is, the marginal loss to current consumption is likely to be lower. The third positive effect also depends n^j but because of the self damage factor, k, the rate at which the marginal benefit depends is given by $I(1 - (n^j/2))$. Hence when I is not too large ($I < 2\gamma$), the first effect dominates in marginal terms and a high n^j leads to a high n^i (positive slope). For large values of I, the opposite is true, and a high n^j makes conflict less attractive to group i.

Group js best-response function (from (12)) is,

$$n_t^j = \frac{\rho.\alpha}{2}[r^i.(1 - k.n_t^i) - r^j.k.(1 - n_t^i)] - (1 - \alpha).k.(1 - n_t^i),$$

which can be written as

$$n_t^j = C + D.n_t^i, \tag{15}$$

where $C = \left[\frac{\rho.\alpha}{2}\left(\frac{1}{2} - \left(\gamma + \frac{I}{2}\right)\right)\right]$ and $D = \left[\frac{\rho.\alpha}{2}\left(\gamma + \frac{I}{2}\right)\right]$.

Since group j is the advantaged group, one can show $C < 0$ (using Corollary 2) and $D > 0$.

When inequality is low ($I \leq \gamma - (1/2)$), we know from Corollary 2 that none of the groups will engage in conflict. In other situations the equilibrium level of conflict will be determined based on the best response functions of the two groups. We discuss the case of high inequality, i.e. when $I > \widehat{I}$ (we define $\widehat{I}$ later) but we first consider the case when $(\gamma - (1/2)) < I \leq \widehat{I}$, which we describe as medium inequality.

4.1 Medium Inequality and Conflict

We split the discussion of medium inequality in to two cases: (a) $(\gamma - (1/2)) < I \leq 2\gamma$, and (b) $2\gamma < I \leq \widehat{I}$.

When $(\gamma - (1/2)) < I < 2\gamma$, the best response functions of the groups are shown in the diagram below.

Insert Figure 1.

Before discussing the equilibrium we first describe the best response functions.

Consider the best response function of group i given by (18). In Figure 1, it translates to an intercept A with gradient $(1/B)$. Given the bounds on the level of inequality, it is easy to establish that $0 < A \leq 1$ and $0 <$

$B < 1$. Similarly, the best response function of group j, has intercept $0 < (-C/D) < 1$ where $C < 0$ and gradient $D < 1$. Notice that in the presence of non-negativity constraints on levels of conflict, $C < 0$ implies that the best response function for group j extends to the origin, with a kink at $n_t^i = (-C/D)$.

Further one can show that, given $\gamma > 1$, $(-C/D) > A$ and $D < 1 < (1/B)$. Hence group is reaction function is steeper than group js. This reflects the fact that group j has more to loose by escalating the conflict and hence would increase its own level of conflict at a lower rate than group i.

We now describe the equilibrium. Group i will choose $n_t^i = A$, when $n_t^j = 0$ (from Corollary2). Reading from group js reaction function we see that given $n_t^i = A$, it is best for group j to choose $n_t^j = 0$. Hence ($n_t^{i*} = A$, $n_t^{j*} = 0$) is the equilibrium. Group j, the advantaged group, does not engage in conflict.

The intuition is simple. $(-C/D)$ reflects the level conflict engaged by group i that will be tolerated by group j. Hence, so long as the level of conflict (which is group is intercept term A) is less than $(-C/D)$, group j shall not engage in conflict.

Next consider the case where $2\gamma < I \leq \widehat{I}$. The implication of $I > 2\gamma$ is that the slope of the group is reaction function now becomes negative. So beyond this point, if the advantaged group engages in conflict, the disadvantaged group will reduce its level of conflict. But how will the equilibrium levels of conflict change? Figure 2 shows the reaction functions of the two groups under this situation.

Insert Figure 2.

From Figure 2, it becomes clear, that it may be possible that in equilibrium, group j still does not engage in conflict, whereas group i which was already engaged in conflict, now will increase their level of conflict (which follows from (14)) since inequality has increased. Therefore the equilibrium level of conflict is given as follows.

Proposition 3 *The equilibrium level of conflict, given medium inequality, is* $(n_t^{i*} = A, n_t^{j*} = 0)$.

Therefore, when one of the groups engages in conflict and the other refrains from conflict. This is, unlike Benhabib and Rustichini (1996) and Skaperdas and Syropoulous (1997), where both groups always end up engaging in conflict, although only one group might have started it.

4.2 High Inequality and Conflict.

It is clear from the above discussions that whether the advantaged group really engages in conflict will depend on what is happening to the intercept terms of the best response functions for both the groups, as inequality rises. For us, the level of inequality where $(-C/D) = A$, will become the benchmark for high inequality. Anything below that level will represent medium or low inequality. As shown in the Appendix (Proposition A1), there exists a level of inequality $\widehat{I}$ such that $(-C/D) = A$.

We know (see equation (A1) in the Appendix) that, $\partial(-C/D)/\partial I > 0$ and $\partial A/\partial I > 0$. In fact, when $I > 2\gamma$, it will certainly be the case that as inequality increases, the intercept A will increase faster than the intercept $(-C/D)$. Therefore, $I > \widehat{I}$ implies that $(-C/D) < A$. Note that, unlike the earlier cases, since $\widehat{I} > 2\gamma$, $B < 0$. Intuitively this means that at high levels of inequality, the disadvantaged group, will lower its own level of conflict if the other group engages in conflict.

The best response functions for both groups would now be the following:

Insert Figure 3.

What about the equilibrium level of conflicts under high inequality?

Solving the two best response functions (14) and (15), the equilibrium levels of conflict for both groups are

$$n_t^{i*} = \frac{A + B.C}{(1 - B.D)}, \quad (16)$$

$$n_t^{j*} = \frac{AD + C}{(1 - B.D)}, \quad (17)$$

where $C < 0$ and $B < 0$. Since $(-C/D) < A$ and $B < A$, we can be sure that $n_t^{i*} > 0$ and $n_t^{j*} > 0$. One can easily check that $0 < n_t^{i*} \leq A \leq 1$ and $0 < n_t^{j*} \leq 1$. Although both the groups now engage in conflict, whether $n_t^{i*} > n_t^{j*}$ or $n_t^{j*} > n_t^{i*}$ will depend on the parameters.

Hence, (n_t^{i*}, n_t^{j*}) is a unique pure strategy equilibrium.[18]

Proposition 4 *The equilibrium level of conflict, when $I > \widehat{I}$, is ($n_t^{i*} > 0$, $n_t^{j*} > 0$).*

At higher levels of inequality, the level of conflict initiated by group i, is greater than what group j can tolerate, that is, $A > (-C/D)$. Hence group j engages in conflict to counter the conflict initiated by group i. But this takes the over all level of conflict to such a high that group i now finds it beneficial to reduce its level of conflict, which then leads group j to reduce its own level of conflict, and the process continues until an equilibrium is reached.

4.3 Inequality and Total Conflict

So far we have solved for the equilibrium level of conflicts under different levels of inequality. This gives us the equilibrium in stage 2 of the game. Now working backwards, using these equilibrium values, we shall determine what will happen in stage 1, that is, whether groups will choose joint production or own production. Note, that there is no conflict under own production.

[18] There is a possibility of a cyclical equilibrium which we rule out (see Proposition A2 in the Appendix).

This will allow us to derive the link between inequality and the over all level of conflict (given by (8)).

Low Inequality: When inequality level is low, such that $I \leq (\gamma - (1/2))$, then none of the groups will engage in conflict. Group i, the disadvantaged group, would not initiate conflict since the difference in inequality is not high enough to merit engaging in conflict, a part of the cost of which it has to bear. Since the disadvantaged group does not initiate conflict, the advantaged group does not engage in conflict in equilibrium either. Therefore, $n_t^* = n_t^{i*} + n_t^{j*} = 0$. Since, $w_t^i = w_t^j$, and $n_t^{i*} = n_t^{j*} = 0$, it implies that $y_t^i = (R_t/2) > Y_t^i$ and $y_t^j = (R_t/2) > Y_t^j$. Hence, both groups will decide to go for joint production.

The subgame perfect equilibrium of the game is given by the following proposition.

Proposition 5 *For the level of inequality $I \leq (\gamma - (1/2))$, the subgame perfect equilibrium is $(n_t^{i*} = 0,\ n_t^{j*} = 0,\ h_t^{i*}(n_t^{i*}, n_t^{j*}) = 1,\ h_t^{j*}(n_t^{i*}, n_t^{j*}) = 1)$.*

From Proposition 1, we know that there will be no conflict in period $(t+1)$ and hence both the groups will decide to produce the joint output, that is, it will be the case that $(n_{t+1}^{i*} = 0,\ n_{t+1}^{j*} = 0,\ h_{t+1}^{i*}(n_{t+1}^{i*}, n_{t+1}^{j*}) = 1,\ h_{t+1}^{j*}(n_{t+1}^{i*}, n_{t+1}^{j*}) = 1)$, irrespective of the level of the inequality. Therefore, for the rest of the discussions we do not explicitly state the subgame perfect equilibrium in period $(t+1)$.

Medium Inequality: Next consider the level of inequality, I, such that $(\gamma - (1/2)) < I \leq \widehat{I}$. Under this situation we had shown (Proposition 3) that $(n_t^{i*} = A,\ n_t^{j*} = 0)$. The overall level of conflict then is

$$n_t^* = n_t^{i*} + n_t^{j*} = \left[\frac{\rho.\alpha}{2}(I + \frac{1}{2} - \gamma)\right]. \qquad (18)$$

Differentiating with respect to I we get, $\partial n_t^*/\partial I = \rho.\alpha/2 > 0$, i.e. as the level of future inequality increases, overall conflict will also be on the rise.

However, on the question of own or joint production whether both the groups will decide for joint production or not depends on their initial level of wealth. Since the initial level of wealth are same, using (5) and (9) we can show that the sufficient condition for groups to participate in joint production is $(2 - A - A^2).R_t > 4w_t^i$. The equilibrium can be characterized as follows.

Proposition 6 *Given* $(\gamma - (1/2)) < I \leq \widehat{I}$, *and* $(2 - A - A^2).R_t > 4w_t^i$, *the subgame perfect equilibrium is* ($n_t^{i*} = A$, $n_t^{j*} = 0$, $h_t^{i*}(n_t^{i*}, n_t^{j*}) = 1$, $h_t^{j*}(n_t^{i*}, n_t^{j*}) = 1$).

High Inequality: For $\widehat{I} < I \leq \overline{I}$,[19] the overall level of conflict will be the total of (16) and (17) i.e.

$$n_t^* = n_t^{i*} + n_t^{j*} = \frac{A + (-B)(-C) + AD - (-C)}{1 + (-B).D}. \tag{19}$$

In the Appendix (Proposition A3) we show that $(\partial n_t^* / \partial I) > 0$. This means that as inequality increases further, the level of conflict also increases.

One may ask the question, whether total conflict has increased or decreased under this situation. Note, here the disadvantaged group reduces its own level of conflict. Since in this case $(-B) < 1$, the decrease of conflict by the disadvantaged group is more than made up by the increase in the advantaged groups conflict. Therefore, the overall level of conflict increases, by more than it would have, under the increased level of inequality if the advantaged group did not join in.

On the question of joint or own production under high inequality, we shall first show that when inequality reaches $\overline{I}$, groups will prefer own production. This will also establish the case for a non-monotonic relation between

[19] Let $\overline{I}$ (the maximum level of inequality) be the level of inequality such that $\max(n_t^{i*}, n_t^{j*}) = 1$. If $n_t^{i*} > n_t^{j*}$, one can show that $\overline{I} = \frac{\frac{4}{\rho.\alpha} - 1}{2 - \frac{\rho.\alpha}{4}} + \frac{2 - \frac{\rho.\alpha}{2}}{2 - \frac{\rho.\alpha}{4}}\gamma$. On the other hand if $n_t^{j*} > n_t^{i*}$, then $\overline{I}$ is that level of inequality at which $n_t^{j*} = 1$. Since, $\partial n_t^{i*} / \partial I > 0$, this implies that now $\overline{I} < \frac{\frac{4}{\rho.\alpha} - 1}{2 - \frac{\rho.\alpha}{4}} + \frac{2 - \frac{\rho.\alpha}{2}}{2 - \frac{\rho.\alpha}{4}}\gamma$.

inequality and conflict. For the high inequality case, whether $n_t^{j*} > n_t^{i*}$ or $n_t^{j*} < n_t^{i*}$ depends on parametric specifications. Let us consider the case where $n_t^{i*} > n_t^{j*}$. Since by definition, at $\overline{I}$, $\max(n_t^{i*}, n_t^{j*}) = 1$, this implies that at $\overline{I}$, $n_t^{i*} = 1$ and from (17), $n_t^{j*} = (\rho.\alpha/4)$. Using (5) and (9), group is payoff from joint production is

$$(1-\alpha)(1-\frac{\rho.\alpha}{4})\frac{R_t}{4} - \frac{R_t}{4} + \rho.(R_{t+1} + \alpha.(1-\frac{\rho.\alpha}{4})\frac{R_t}{4} + w_t^i - r^j w_t^j). \quad (20)$$

On the other hand group is payoff under own production will be

$$(1-\alpha)w_t^i + \rho.(R_{t+1} + \alpha.w_t^i - r^j.\alpha.w_t^j). \quad (21)$$

Subtracting (21) from (20) and rearranging terms we get

$$-\left(1-(1-\frac{\rho.\alpha}{4})((1-\alpha)+\rho.\alpha)\right)\frac{R_t}{4} - ((1-\alpha)-\rho.\alpha)\,w_t^i - r^j.(1-\alpha).w_t^j < 0,$$

since, $(1-\alpha) \geq \alpha > 0$ and $0 < \rho < 1$. Therefore group i will drop out of joint production before inequality reaches $\overline{I}$. In this case even if we assume that the level of consumption in period t for group i is higher under joint production than own production, still group i will prefer own production. The intuition is that the increased cost of mobilization is greater than the benefits the increased conflict brings in the future. Similarly one can also show that when $n_t^{j*} > n_t^{i*}$, and at $\overline{I}$, $n_t^{j*} = 1$, group i will prefer own production to joint production.

Note, since both groups engage in joint production at $\widehat{I}$ but decide for own production at $\overline{I}$, there must exist some $\widetilde{I} \in \left(\widehat{I}, \overline{I}\right)$ such that

$$\min\left[V_S^i - V_J^i,\ V_S^j - V_J^j\right] = 0, \quad (22)$$

where for any group m, V_S^m and V_J^m represents its total benefit from own production and joint production. This condition shows the level of inequality in which atleast one of the group will be indifferent between joint production and own production.

We therefore discuss the possibility of two cases: (a) $\widehat{I} < I < \widetilde{I}$ and (b) $\widetilde{I} \leq I \leq \overline{I}$. When $\widehat{I} < I < \widetilde{I}$ groups will continue to be in joint production and the equilibrium will be as given next.

Proposition 7 *Given $\widehat{I} < I \leq \widetilde{I}$, the subgame perfect equilibrium is* $(n_t^{i*} > 0,\ n_t^{j*} > 0,\ h_t^{i*}(n_t^{i*}, n_t^{j*}) = 1,\ h_t^{j*}(n_t^{i*}, n_t^{j*}) = 1)$.

However, when $\widetilde{I} \leq I \leq \overline{I}$, clearly either group i or group j drops out of joint production and since in our model own wealth is indestructible, we get the following equilibrium.

Proposition 8 *Given $\widetilde{I} \leq I \leq \overline{I}$, the subgame perfect equilibrium is* $(n_t^{i*} > 0,\ n_t^{j*} > 0,\ h_t^{i*}(n_t^{i*}, n_t^{j*}) = 0,\ h_t^{j*}(n_t^{i*}, n_t^{j*}) = 0)$.

The above proposition shows that under some circumstances there will be no joint production. Hence, unlike other cases, although ex-ante there is a possibility of conflict, ex-post no conflict will take place.

So where does all this leave us when it comes to the question about the link between inequality and conflict? As is clear from the above discussion that until $\underline{I}$, there will be no conflict, since inequality is low. However, beyond $\underline{I}$, we know there is a positive amount of conflict since the disadvantaged group now joins in the conflict. Hence we see a discontinuous jump in the level of conflict. Conflict now increases steadily with increase with inequality until $\widehat{I}$. Then from $\widehat{I}$ onwards both groups are engaged in conflict and the overall level of conflict also increases. Therefore we see another discontinuous jump at $\widehat{I}$. Now as inequality increases, conflict again steadily rises until it reaches $\widetilde{I}$. At $\widetilde{I}$, for group i, high levels of conflict makes joint production inviable. This can be captured in the following diagram.

Insert Figure 4.

Therefore one can state the following proposition.

Proposition 9 *The relationship between inequality and conflict is discontinuous and non-monotonic.*

The discontinuity between inequality and conflict is at three levels of inequality: $\underline{I}$, $\widehat{I}$ and $\widetilde{I}$. Around each of these levels, there will be sharp changes in the level of conflict. To be more specific, consider the inequality levels $(\underline{I}+\epsilon)$ and $(\underline{I}-\epsilon)$, where ϵ is close to zero. Both the inequality levels are quite similar but they exhibit different levels of conflict. For $(\underline{I}-\epsilon)$ there shall be no conflict while $(\underline{I}+\epsilon)$ will lead to conflict. Thus, we may be able to find countries, with similar levels of inequality but very different levels of conflict.

We would like to emphasize that the non-monotonicity in our model results from a sharp change in the level of conflict arising out groups preferring own production beyond a certain level of inequality. Although, Milante (2004) also finds a non-monotonic relationship, unlike ours, this is reflected in an inverted-U relationship between inequality and conflict. Hence, in his model, over a certain level of inequality, there is a gradual decrease of conflict as inequality rises.

5 Discussions

In this section we discuss changes to some assumptions so far made in this model and how they impact the results. In particular we deal with three of the assumptions: (a) the rate of savings are the same for both the groups, (b) the proportion of 'self damage' is equal for both groups, and (c) the issue of perfect information.

Rate of savings. Suppose instead of having the same savings rate, consider without loss of generality, that $\alpha^i < \alpha^j$. Further assume that $w_t^i = w_t^j$ and $r^j = r^i$. This would mean that $w_{t+1}^i = w_{t+1}^j$, and therefore from the distribution rule it would be obvious that $y^i_{t+1} < y^j_{t+1}$. Group i again is the disadvantaged group and it can be shown using (11) that if

$$\left(\alpha^j - \frac{\alpha^i}{2}\right) > \frac{(1-\alpha^i)}{\rho.r},$$

then group i will initiate conflict. The rest of the analysis will follow through, so long as now our inequality measured the difference between the two savings rate, i.e. $I = (\alpha^j - \alpha^i)$. Along with this if we had assumed that $r^j > r^i$ the results in the previous sections will only be amplified. However, if $\alpha^i > \alpha^j$ and at the same time $r^j > r^i$, the results derived in the earlier sections will now depend on which of these has greater impact. Obviously, since the relative rate of return and the relative rate of savings are going in opposite direction, the results in the earlier sections will be dampened. Since we were interested in understanding the impact of inequality on conflict, distilling all else, we had assumed $\alpha^i = \alpha^j$.

Proportion of 'self damage'. Thus far we have assumed that the proportion of self damage, k, is the same for all the groups and $k = (1/2)$. As mentioned earlier, for $0 < k < 1$, all the results derived earlier will hold. Here we shall discuss a few cases when k takes extreme values and when the k varies between groups.

First, when $k = 0$ for both groups, the reaction function of group i and j are, respectively, (derived from (14) and (15)) $n^i_t = (\rho.\alpha/2).r^j$ and $n^j = (\rho.\alpha/2).r^i$. Clearly, now both groups will engage in conflict irrespective of the level of inequality and the level of conflict will depend on the rate of return of the rival group. This is not surprising, since $k > 0$ makes it costly for groups to engage in conflict by reducing both their current and future levels of consumption. The overall level of conflict will be higher now.

Next, let $k = 1$ for both the groups. Recall that the way conflict works in this model is that under high inequality, the disadvantaged group wants to reduce the amount of income devoted to savings by the advantaged group so that even with a relatively higher return, the advantaged group does not receive a higher level of the output in the future. Now with $k = 1$, this will be extremely costly. Under this assumption, so long as $r^j > r^i$, from (14) and (15) the reactions functions of group i and j will be

$$\begin{aligned} n_t^i &= \frac{\rho.\alpha}{2}(I - 2\gamma).\left(1 - n_t^j\right), \\ n_t^j &= -\frac{\rho.\alpha}{2}(I + 2\gamma).\left(1 - n_t^i\right). \end{aligned}$$

Thus, group i, the disadvantaged group will be the only group involved in conflict and that too when $I > 2\gamma$. Group j, irrespective of the level on inequality and group is level of conflict, will not engage in conflict. It is easy to see if the level of self damage of group i is, $k^i = 0$ and of group j is, $k^j = 1$, then the earlier result will be just amplified in the sense that now group i will engage in conflict irrespective of the level of inequality and group j will never engage in conflict. On the other hand, if $k^i = 1$ and $k^j = 0$, group j will always engage in conflict and group i will engage in conflict only when inequality is high, i.e. $I > 2\gamma$. In this situation, unlike the standard results, it will be the advantaged group which will engage in conflict.

Information. Our model assumes that groups have perfect foresight. Hence they can anticipate future inequalities perfectly. This, however, is not very realistic. One way to bring in imperfect information in the model would be to assume that both the groups know the distributions of r^j and r^i. In that case the inequality will then be given by $I = E(r^j) - E(r^i)$, where $E(r^j)$ is the expected rate of return for group j and $E(r^i)$ is the expected rate of return for group i. Hence, (13), which shows the conditions under which groups will initiate conflict, can now be written as

$$\gamma < \frac{1}{2}.(E(r^j).\frac{d_t^j}{k.d_t^i} - E(r^i)),$$
$$\gamma < \frac{1}{2}.(E(r^i).\frac{d_t^i}{k.d_t^j} - E(r^j)),$$

for group i and j respectively. One can easily check that the reaction functions of the groups also remain same, except that now inequality is in terms of the difference in the expected rate of returns. Hence, all the results that we have discussed earlier will also go through for a case of imperfect foresight. In the event of complete uncertainty, however, the analysis will be more complex and will depend on the groups behaviour. If, for instance, the groups presume that the rate of returns are going to be the same, then obviously there will be no reason for conflict arising from future inequality.

6 Conclusion

The purpose of the paper was to analyze the interlinkages between inequality and conflict. In our analysis we find that although inequality may cause conflict, the impact of inequality on conflict is not straightforward. Since conflict is costly for both groups, societies with low levels of inequality, in our model, show no conflict. It is only when inequality increases beyond a certain level, the disadvantaged group initiates the conflict. At higher levels of inequality both groups engage in conflict. Thus, our model is able to capture both rebellion by the disadvantaged group and also the suppression by the advantaged group. El Salvador and Guatemala are examples where the state acting on behalf of the advantaged group unleashed severe repression to curb insurgencies.

When inequality reaches extreme levels, the economy goes back to subsistence levels as the high output joint production sector is not developed for fear of severe rebellion. For instance, the Bougainville rebellion, arising out of a concern for the local environment and the lack of benefits to the local populace, led to the closure of copper mines, thus leading to a decline in the income of the region.[20]

Our analysis shows the crucial role future inequality plays. Current inequality will not lead to conflict, if in the future there is less inequality. On the other hand, current equality does not stop conflict from taking place if the future inequality is significant. For instance, the B.B.C. (April 16, 2002) reported: 'Millions of state employed workers in India have gone on nationwide strike to protest against *proposed* changes to labour laws in the country, which have been described "anti-worker"'(Italics added). Clearly, concerns about possible future inequalities had played a dominant role in precipitating the strike. Similarly, in Sri Lanka, when the government failed to guarantee the rights of Tamils (and also curtailed their access to higher education) did the Tamil insurgency begin in earnest. The government policies were seen as a potential source of future inequality where the Tamils would loose out significantly.

This brings us to the policy implications of our results. Since the future plays an important role in fostering conflict, one has to put in place policies that will reduce future inequality. For example, the warring factions in Sudan have now decided to split future profits from the oil wells equally.[21] If such egalitarian rules can be institutionalized and implemented, then reasons for conflict will definitely diminish. However, typically if one of the groups becomes 'weaker' (maybe due to exogenous shocks) in terms of bargaining, the stronger groups tend to capture a higher share of the joint output and that is when the problems start again.[22] This may explain why so many

[20]See Bougainville-The Long Struggle to Freedom by Moses and Rikha Havini. Available at http://www.eco-action.org/dt/bvstory.html.

[21]'SHRO-CAIRO Position on Sudan Peace Deal and Constitutional Panel', Sudan Tribune, May 7, 2005. Available at http://www.sudantribune.com.

[22]Infact the current hostilities in Sudan started after the discovery of oil in the south, which none of the parties were aware of when signing the Addia Ababa peace deal in 1972

peace agreements fail. What is implicit here is that enforceable contracts are not viable and therefore parties cannot forge some kind of ex-ante contract to avoid conflict. If, however, we allow for long term interaction between the groups, there may be a possibility of overcoming the incomplete contract problem. What the structure will be of such long term contracts under uncertainty is an issue for future research.

(Humam Rights Watch, 2003).

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A Appendix

First we formally show the existence of a level of inequality, which clearly demarcates high inequality from medium or low inequality in our model. Referring back to Figure 2, A is the intercept term of group is reaction function and $(-C/D)$ is group js, both of which are dependent on the level of inequality. We define the lower bound of the high inequality interval as the level of inequality at which $(-C/D) = A$.

Proposition A.1 *There exists a level of inequality, $\widehat{I}$, where $(-C/D) = A$.*

Proof: Let $f = ((-C/D) - A)$. Further,

$$\frac{\partial(-C/D)}{\partial I} = \left(\frac{2}{2\gamma + I}\right)^2 \text{ and } \frac{\partial A}{\partial I} = \frac{(1-\alpha)}{2\gamma}. \tag{A1}$$

Hence,

$$\frac{\partial f}{\partial I} = \left[1 - \frac{(1-\alpha)\left(\gamma + \frac{I}{2}\right)^2}{2\gamma}\right] < 0 \text{ for } I \geq 2\gamma.$$

We know that for $I \leq 2\gamma$, $(-C/D) > A$, which implies that at $I = 2\gamma$, $f > 0$. Now consider the level of inequality I such that $A = 1$. At this level $I > 2\gamma$, and $A = 1 > (-C/D)$ (since $D > (-C)$ for all I). Hence for $I = \overline{I}$, $f < 0$. Therefore, by the Intermediate Value Theorem we can find an $\widehat{I} \in (2\gamma, \overline{I})$ such that at $\widehat{I}$, $f = 0$, implying $(-C/D) = A$. Further since $\partial f/\partial I < 0$ for all $I \geq 2\gamma$, $\widehat{I}$ will be unique. Q.E.D.

Next, we show that there is no possibility of a cyclical equilibrium, where the level of conflict fluctuates between high conflict and no conflict. Figure 5, below, shows such a case.

Insert Figure 5.

We know that the disadvantaged group initiates the conflict, and in this case the equilibrium level of conflict by group i would be A. Given this, group j, the advantaged group, reacts with such a high level of conflict as to force group i to drastically reduce the level of conflict it engages in. Once that happens, it may lead to a situation where in equilibrium, group j then does not engage in conflict at all, which then makes group i resume conflict at the level A, leading to a cyclical equilibrium.

Proposition A.2 *There will be no cyclical equilibrium if* $I < \left(\sqrt{\frac{(1-\alpha)^2}{4}+1}\right)\frac{4}{(1-\alpha)}\gamma$.

Proof: We know that the disadvantaged group i, initiates the conflict. So to begin with $n_t^i = A$. Given this, using the reaction functions, $n_t^j = C + D.A$, which will lead group i, to choose $n_t^i = A + B.(C + D.A)$. From Figure 2 it is clear that so long as $n_t^i = A + B.(C + D.A) > (-C/D)$, group j will indeed choose $n_t^j > 0$. Note that both $B < 0$ and $C < 0$.

Therefore $n_t^j > 0$ if

$$A + B.(C + D.A) > (-C/D),$$

which implies

$$(A - (-C/D))(1 + B.D) > 0.$$

For the high inequality case we know $(A - (-C/D)) > 0$, and therefore the above inequality holds if $(1 + B.D) > 0$, where $B < 0$, which will be the case if

$$\frac{\rho.\alpha}{2}\left(\frac{I}{2} - \gamma\right).\frac{\rho.\alpha}{2}\left(\frac{I}{2} + \gamma\right) < 1.$$

Working through the algebra one can show that the above inequality implies $I \leq \left(\sqrt{\frac{(1-\alpha)^2}{4}+1}\right)\frac{4}{(1-\alpha)}\gamma$. The only restriction so far placed on the upper bound for I is that under high inequality $n_t^{i*} \leq 1$ and $n_t^{j*} \leq 1$, i.e. $\overline{I} \leq \frac{\frac{4}{\rho.\alpha}-1}{2-\frac{\rho.\alpha}{4}} + \frac{2-\frac{\rho.\alpha}{2}}{2-\frac{\rho.\alpha}{4}}\gamma$. It can be established for $\alpha \in (0, 1/2]$ and $0 < \rho < 1$, $\frac{\frac{4}{\rho.\alpha}-1}{2-\frac{\rho.\alpha}{4}} + \frac{2-\frac{\rho.\alpha}{2}}{2-\frac{\rho.\alpha}{4}}\gamma \leq \left(\sqrt{\frac{(1-\alpha)^2}{4}+1}\right)\frac{4}{(1-\alpha)}\gamma$. Hence in our model, there will be no cyclical equilibrium. Q.E.D.

Finally, we show that under high inequality, the total level of conflict will increase with inequality. Recall that in this case the disadvantaged group reduces its level of conflict and the advantaged group increases its level of conflict, with increase in inequality.

Proposition A.3 *For all* $I > \widehat{I}$, $(\partial n_t/\partial I) > 0$.

Differentiating both group's best response functions (i.e. (14) and (15)) with respect to I we get

$$\begin{aligned}
\frac{\partial n_t^i}{\partial I} &= \frac{\partial A}{\partial I} - \frac{\partial(-B)}{\partial I}.n_t^j - (-B)\frac{\partial n_t^j}{\partial I}, \\
\frac{\partial n_t^j}{\partial I} &= -\frac{\partial(-C)}{\partial I} + \frac{\partial D}{\partial I}.n_t^i + D\frac{\partial n_t^i}{\partial I}.
\end{aligned}$$

Solving these for group i we get,

$$(1 + (-B).D)\frac{\partial n_t^i}{\partial I} = \frac{\partial A}{\partial I} - \frac{\partial(-B)}{\partial I}.n_t^j + (-B)\frac{\partial(-C)}{\partial I} + (-B)\frac{\partial D}{\partial I}.n_t^i.$$

Noting that $n_t^j \leq 1$; $\frac{\partial A}{\partial I} > \frac{\partial(-B)}{\partial I} > 0$ and $\frac{\partial(-C)}{\partial I} > 0$; $\frac{\partial D}{\partial I} > 0$, the above equation implies $\frac{\partial n_t^i}{\partial I} > 0$. Similarly the result will hold for group j. Since both $\frac{\partial n_t^i}{\partial I} > 0$ and $\frac{\partial n_t^i}{\partial I} > 0$, we can conclude $\frac{\partial n_t}{\partial I} > 0$. Q.E.D.

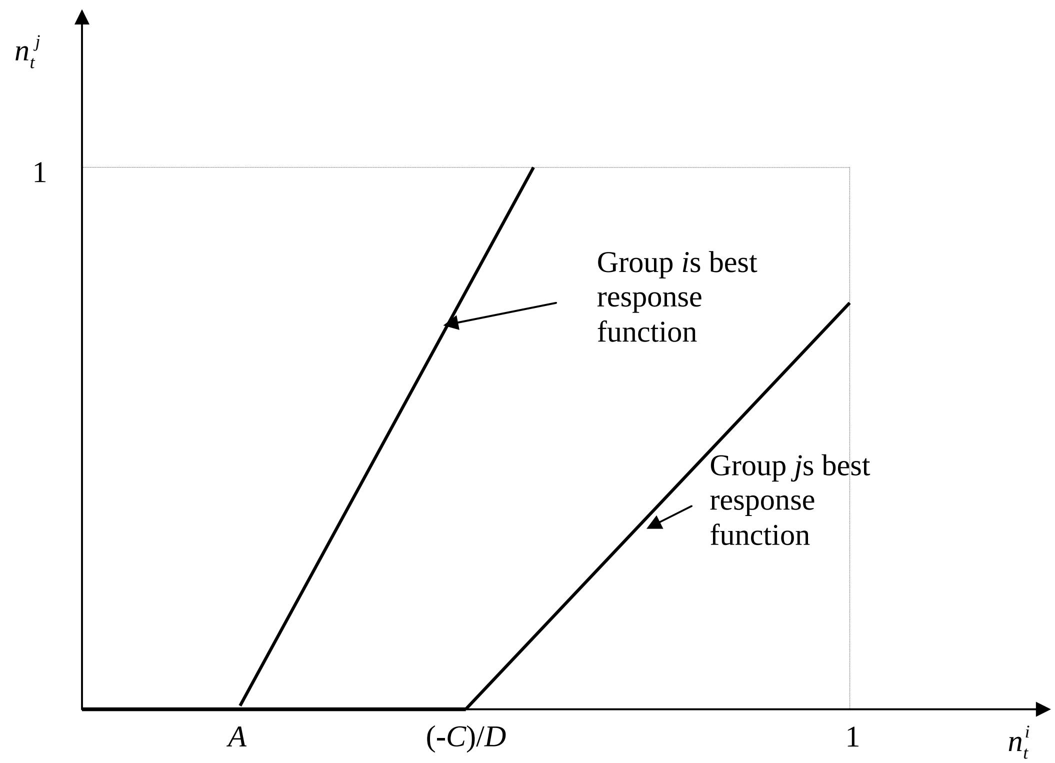

Figure 1: Best response functions of both groups under medium inequality when *B*>0. Equilibrium is at *A*.

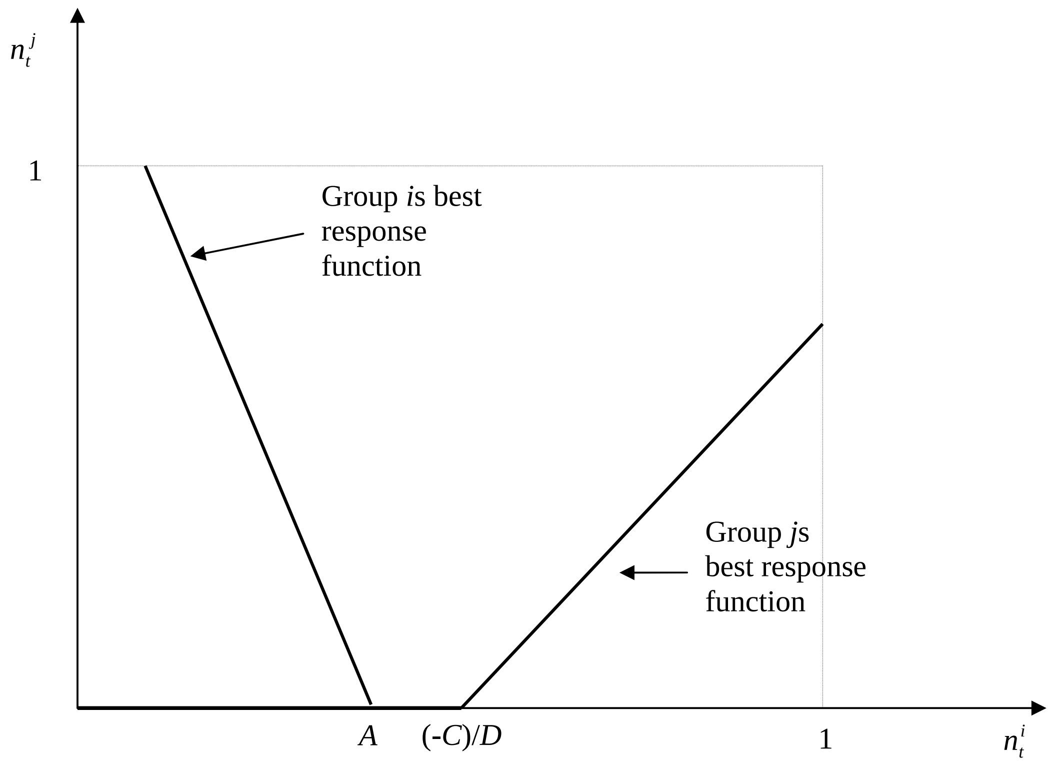

Figure 2: Best response of both groups under medium inequality when (B<0). Equilibrium is at *A*.

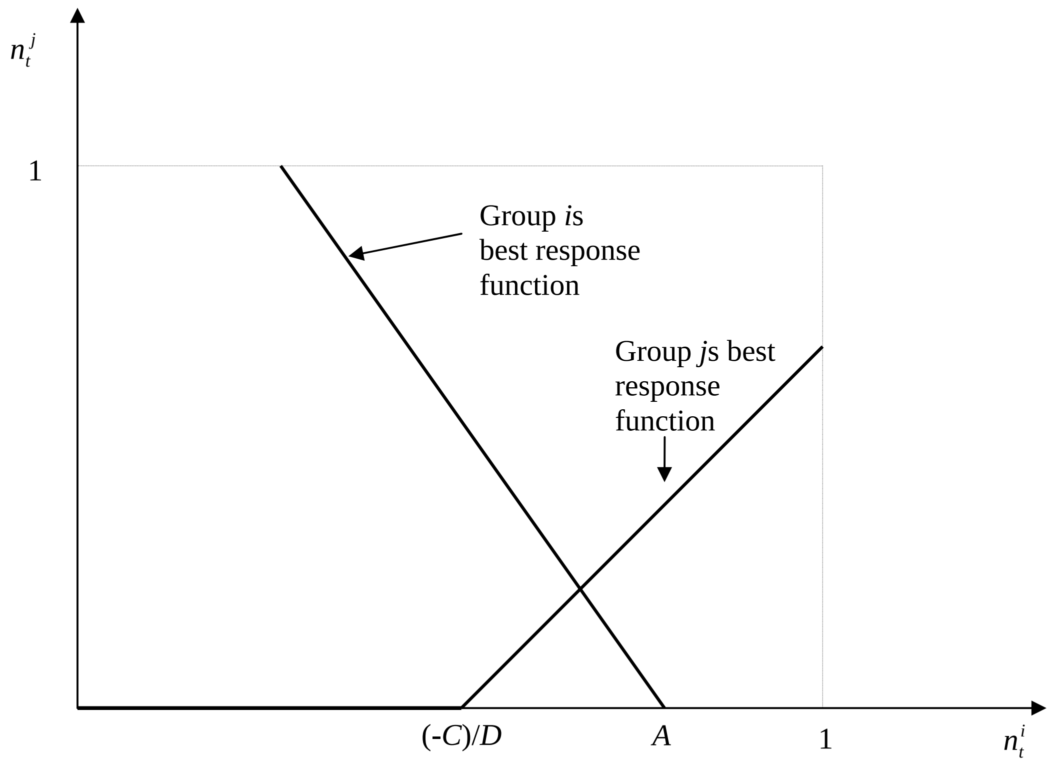

Figure 3: Pure strategy equilibrium under high inequality.

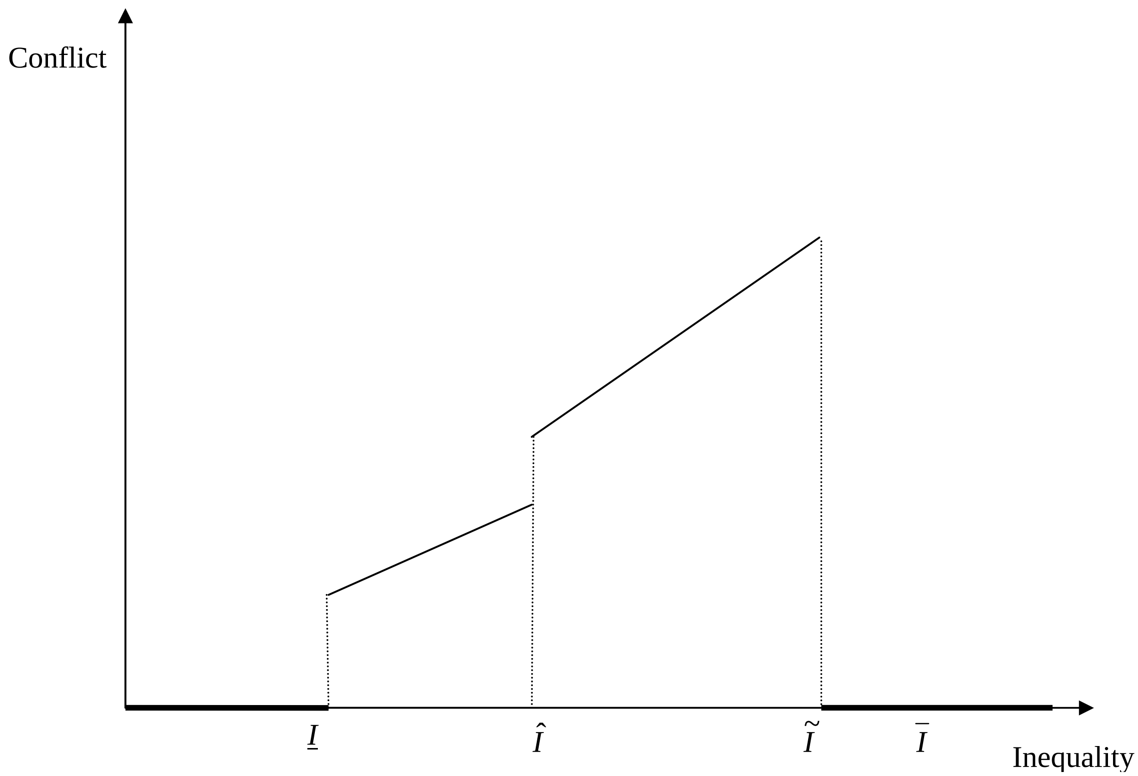

Figure 4: Link between inequality and conflict.

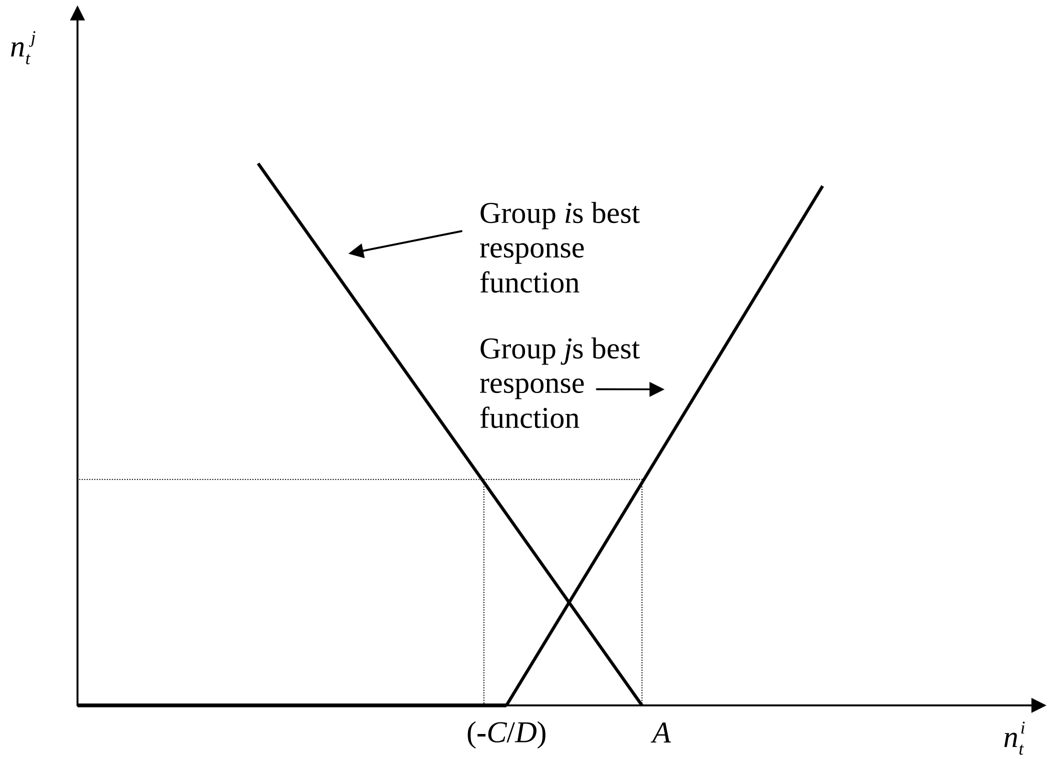

Figure 5: Possibility of a cyclical equilibrium under high inequality.