Polarization, Fractionalization and Conflict

Joan Esteban, Instituto de Análisis Económico (CSIC)

Debraj Ray, New York University and Instituto de Análisis Económico (CSIC)*

September 2006, revised September 2007

* We are thankful to Han Dorussen, Glenn Martin, Gerald Schneider, Marta Reynal-Querol and three anonymous referees. Esteban gratefully acknowledges support from the Polarization and Conflict project CIT-2-CT-2004-506084 funded by the European Commission-DG Research Sixth Framework Programme, Barcelona Economics (XREA), Generalitat de Catalunya, Ministerio de Educación y Ciencia grant no. SEJ2006-00369 and the Instituto de Estudios Fiscales. Ray is grateful for support from the National Science Foundation under grants 0421852 and 0241070. Contact: joan.esteban@iae.csic.es and debraj.ray@nyu.edu.

Summary (285 words)

This article provides a theoretical framework that distinguishes between the occurrence of conflict and its severity, and clarifies the role of polarization and fractionalization in each of these cases. The analysis helps in ordering the various definitions, and in providing explanations for the empirical observations on the relationship between conflict on the one hand, and polarization or fractionalization on the other. The behaviour of players in conflict is described as a game, and equilibrium payoffs to all players are computed. The status quo is characterized by a set of political institutions that channel the different opposing interests and turn them into a collective decision, with a second set of payoffs. Groups rebel against the status quo political institution whenever the latter set payoffs is dominated by the former. When society is highly polarized, the potential cost of rebellion is extremely high, and this cost may serve as the guarantor of peace. So in highly *polarized* societies, the occurrence of open conflict should be rare but its intensity very severe, whenever it happens. On the other hand, highly *fractionalized* societies are prone to the occurrence of conflict, but its intensity will be moderate. It matters, therefore, whether one studies the intensity of conflict, *conditional on conflict breaking out*, or the likelihood that conflict actually occurs. Specifically, it is shown that: (i) measures of fractionalization and polarization tend to run in opposite directions, (ii) the onset of conflict critically depends on the political system in place, (iii) the occurrence of conflict and the intensity of conflict also tend to move in opposite directions, (iv) the relationship between polarization or fractionalization and conflict is non-monotonic and (v) the intensity of conflict depends positively on the degree of polarization.

Introduction

A recent upsurge of empirical studies on the causes of conflict attempts to connect various features of the distribution of relevant characteristics (typically ethnicity or religion) to conflict. There are several distributional indices (polarization, fractionalization or Lorenz-domination) as well as various specifications of conflict (onset, incidence or intensity). Overall, the results are far from clear, and combined with the mixture of alternative indices and notions of conflict it is not surprising that the reader may come away thoroughly perplexed.

The aim of this article is to provide a theoretical framework that permits us to distinguish between the occurrence of conflict and its severity and that clarifies the role of polarization and fractionalization in each of these cases. Our analysis brings together strands from three of our previous contributions: on polarization (Esteban & Ray, 1994; and Duclos, Esteban & Ray, 2004), on conflict and distribution (Esteban & Ray, 1999) and on the viability of political systems (Esteban & Ray, 2001).

Interest in the connections between inequality and conflict is not new. Political scientists have been much concerned with these issues; see, for instance, the prominent contributions by Brockett (1992), Midlarsky (1988), Muller & Seligson (1987), and Muller, Seligson & Fu (1989). Midlarsky (1988) and Muller, Seligson & Fu (1989) had already voiced their reservations with respect to the standard notions of inequality as an appropriate tool for conflict analysis. To go even further back, Nagel (1974) had argued that the relationship between inequality and conflict should be non-linear. Indeed, as Lichbach's (1989) survey concludes, the empirical studies on the relationship between inequality and conflict--and these typically posit a linear relationship--have only come up with ambiguous results.

In the area of economics, the analysis of the link between distribution and conflict was largely inspired by a desire to study pathways between inequality and growth.[1] Certainly the possibility that inequality is a determinant of social conflict and --- via this route --- impedes growth is a contender for one of the

[1] See Bénabou (1996) for a deep and comprehensive survey.

more important pathways. The most recent round of interest in this connection was triggered by the contribution of Easterly & Levine (1997) who shifted the emphasis to ethnic fractionalization rather than economic inequality, but continued to emphasize the "reduced-form" connections with growth. Among the more relevant contributions to the literature on inequality and conflict are Alesina, Baqir & Easterly (2003), Collier (1998, 2001), Collier & Hoeffler (2004), Fearon & Laitin (2003), Hegre, Ellingson, Gates & Gleditsch (2001), La Porta, Lopez de Silanes, Shleifer & Vishiny (1999), Montalvo & Reynal-Querol (2005), Østby (2008), Reynal-Querol (2002a) and Schneider & Wiesehomeier (2006).

But the empirical results are ambiguous, if not controversial. By and large, it is fair to say that most of the literature fails to find any significant evidence of ethnic fractionalization as a determinant of conflict. Fearon & Laitin (2003), and more recently Hegre & Sambanis (2006), could not identify a link between fractionalization and conflict. This negative finding is underlined by Montalvo & Reynal-Querol (2005) who obtain, instead, a significant relationship between ethnic *polarization* and the incidence of conflict. Collier & Hoeffler (2004) also argue that the contested dominance of one large group rather than fractionalization increases the probability of civil conflict. However, Schneider & Wiesehomeier (2006), using a different data set and focusing on onset, rather than incidence, of conflict obtain that fractionalization is a better predictor of low-level conflict than polarization.

Our purpose is to provide a simple theoretical framework that might help in ordering the various definitions, and in providing some explanations for the variety of empirical observations. To do this, we follow Esteban & Ray (2001).[2] We first model the behaviour of players in case of conflict as a game and compute the equilibrium payoffs to all players. The status quo against which groups might rebel is characterized by a set of political institutions that channel the different opposing societal interests and turn them into a collective decision. Examples of such institutions range from democracies with proportional representation over to autocratic oligarchies and to single-ruler dictatorships. It is a caricature, but not an extreme one, to represent these institutions as

[2] This line is also adopted in Reynal-Querol (2002b).

alternative functions mapping the share of the population supporting each interest group into particular collective decisions.

In this article, we take political institutions as given and disregard any potential endogeneity. As Lipset & Rokkan (1967) stressed, political systems might be endogenous, influenced by the particular social structure of the country. But if this is the case, why societies fail to adapt their institutions so as to always prevent domestic conflict? A number of arguments have been put forward explaining why society might be unable to reach institutional arrangements that prevent conflict. The most notable contributions have been made by Powell (2004, 2006), Fearon (1995) and Leventoglu & Slantchev (2007). We shall not pursue this line of inquiry here and will take the political system as given.

Concerning the onset of conflict, we assume that groups rebel against the incumbent political institution whenever the outcome is worse than what they can obtain through conflict. What the groups fight for we also consider to be exogenous. In contrast, Powell (2004) and Wagner (2000) consider conflict as an integral part of the bargaining process that will ultimately establish new sharing rules.

We distinguish between the intensity of conflict, *conditional on conflict breaking out*, and the likelihood that conflict actually occurs. The point that we make is simple. When society is highly polarized, there may actually be a wider range of status-quo allocations that groups are willing to accept. This is because the potential cost of rebellion is so high that serves as the guarantor of peace.If conflict is very costly as it will be in highly polarized societies, it is easier to find an agreement that is Pareto superior to the conflict regime. But, if conflict were to occur for some reason, its intensity would be higher in polarized societies. It follows that the intensity of conflict (conditional on its occurrence) and the likelihood of conflict may move in opposite directions with respect to changing polarization.

When the cost of conflict is low, the parties will more easily reject proposals that slightly depart from what they can get through conflict.[3] In the spirit of the

[3] This point is also made by Mann (2005). In his 'thesis' 4.b he posits that when an ethnic group is large and perceives that it can eliminate the small one at a low cost it will do so.

fractionalization vs polarization controversy this argument can be summarized as follows. Highly fractionalized societies might be more prone to the onset of conflict, but the intensity of such conflict will be moderate. In highly polarized societies, the occurrence of conflict should be rare but its intensity very severe. We develop this argument and show that: (i) measures of fractionalization and polarization tend to run in opposite directions, (ii) the onset of conflict critically depends on the political system in place, (iii) the occurrence of conflict and the intensity of conflict also tend to move in opposite directions, (iv) the relationship between polarization or fractionalization and conflict is non-monotonic and (v) the intensity of conflict depends positively on the degree of polarization.[4]

Our article is organized as follows. We begin by comparing the indices of fractionalization and polarization. Next, we develop a simple model of conflict based on the general class studied in Esteban & Ray (1999). In order to present the ideas in their starkest form, we then study the occurrence and intensity of conflict focusing on the case of just two opposing groups. This case permits a neat understanding of the causes of intensity of conflict and the causes of its occurrence. However in the case of two groups the notions of fractionalization and polarization are indistinguishable from each other. We generalize the results to the case of an arbitrary number of groups. Now polarization and fractionalization perform differently. We end the article with some concluding remarks.

Polarization and Fractionalization

The index of fractionalization *F* is intended to capture the degree to which a society is split into distinct groups. The measure has been widely used in studies that attempt to link ethnolinguistic diversity to conflict, public goods provision, or growth (see, e.g., Collier & Hoeffler, 1998; Fearon & Laitin, 2003; Easterly & Levine, 1997; Alesina, Baqir & Easterly, 1999; and Alesina et al., 2003).

[4] This discussion can shed light on the controversy on the stabilizing or destabilizing effects of 'polarity'; a classic in the international relations literature; see, e.g., Waltz (1964) and Deutsch & Singer (1964). Powell (1999), although from an approach different than ours, also finds that the probability of conflict is minimal in the two extreme cases of a very uneven or an equal distribution of power and benefits.

Let n_i be the share of the population belonging to group i, $i = 1,\ldots,G$. The fractionalization index is defined as the probability that two randomly chosen individuals belong to different groups. The probability that an individual of group i is chosen is n_i. Hence that probability that if chosen she is matched with someone from another group is $n_i(1-n_i)$. It follows that the probability that any two individuals belong to different groups is

$$F = \sum_i n_i(1-n_i) = 1 - \sum_i n_i^2 \qquad (1)$$

F is a strictly quasiconcave function of the population share vector. From this strict quasiconcavity we can derive the following properties of F.

(a) Any transfer of population from a group to a smaller one increases F;

(b) For a given *number* of groups, G, F is maximized at the uniform population distribution over these groups;

(c) Over the set of uniform distributions F increases with the number of groups; and

(d) The split of any group with population n into two new groups with n' and n'', $n' + n'' = n$, increases F.

Esteban & Ray (1994) conceptualize polarization as the sum of inter-personal 'antagonisms'. Antagonism results from the interplay of the sense of group identification (group size) and the sense of alienation with respect to other groups (inter-group distance, b_{ij}). Alternative notions of polarization not based on the identity/alienation framework have been proposed by Wolfson (1994), Wang & Tsui (2000), Reynal-Querol (2002c), and Zhang & Kanbur (2001). An alternative and considerably cruder specification of polarization which also does not account for intra-group homogeneity is the concept of dominance that Collier (2001) introduced. It qualifies societies as 'dominated' if the largest group contains between 45 and 90% of the population.

Esteban & Ray's polarization measure[5] P can be written as

$$P(\sigma,\mathbf{b}) = \sum_{i}\sum_{j\neq i} n_i^{1+\sigma} n_j b_{ij} \quad (2)$$

where **b** is the matrix of inter-group distances and σ is a positive parameter that captures the extent of group identification. Esteban & Ray (see also Duclos, Esteban & Ray, 2004) derive restrictions on σ that bound it to be less than 1.

A situation of particular relevance is the case in which individuals in each group feel equally alien towards all groups other than their own. That is, $b_{ij} = b_i$ for all $j\neq i$. In this case P reduces to

$$P(\sigma,\mathbf{b}) = \sum_{i} n_i^{1+\sigma}\left(1-n_i\right)b_i \quad (3)$$

Observe that if we set $\sigma = 1$ and $b_i = 1$ for all i we obtain the measure of polarization introduced by Reynal-Querol (2002c), $P(1,\mathbf{1})$,a special case of (2).

It is also true that we can formally set $\sigma = 0$ in (3), as well as $b_i = 1$ for all i, to arrive at the measure of fractionalization (1). We emphasize that this is a formal and not a conceptual connection: for (3) to be a measure of polarization it is necessary that σ be strictly positive. Nevertheless, it is useful to record that

$P(0,\mathbf{1}) = F$ (4)

where the entry **1** stands for the matrix of all 1's.

In order to simplify the computations, in this article we shall work with the special class of polarization indices, $P(1,\mathbf{1})$, that is

$$P(1,\mathbf{1}) = \sum_{i} n_i^2(1-n_i) \quad (5)$$

[5] Esteban & Ray (1994) examine the main properties of this measure. The interested reader can also see Duclos, Esteban & Ray (2004) for a measure of polarization for continuous distributions.

In order to examine the properties of $P(1,\mathbf{1})$ we start by observing that it is the sum of the function $p(n) = n^2(1-n)$ evaluated at the different n_i. But now $p(.)$ is convex or concave as n <(>) 1/3. Therefore, we have the following properties for $P(1,\mathbf{1})$.

Properties of $P(1,\mathbf{1})$

(a') A transfer of population from a group to a smaller one increases $P(1,\mathbf{1})$ if both groups are larger than 1/3. If the two groups are smaller than 1/3 the equalization of populations will bring $P(1,\mathbf{1})$ down;

(b') For any given number of groups, $P(1,\mathbf{1})$ is maximized when the population is concentrated on two equally sized groups only;

(c') Over the set of uniform distributions $P(1,\mathbf{1})$ decreases with the number of groups, provided that there are at least two groups to begin with; and

(d') The split of a group with population n into two groups with n' and n'', $n' + n'' = n$, increases $P(1,\mathbf{1})$ if and only if $n \geq 2/3$.

The contrast between the properties of fractionalization and of the family of polarization measures clearly shows that the two behave quite differently from each other, except when there are just two groups. The essential difference is clear: fractionalization is maximal when each individual is different from the rest while polarization is maximal when there are only two types of individuals.

A Model of *War and Peace*

Conflict

In modeling conflict we follow Esteban & Ray (1999). Related models of conflict may be found in Hirschleifer (2001), Grosmann (1991,1994) and Skaperdas (1992,1996).

We concentrate on a special case studied in Esteban&Ray (1999): the class of conflict games called *contests*. Assume that there are *G* alternatives, $i = 1,\ldots,G$. Individuals differ in the alternative they like the most and are indifferent over the other available alternatives. Individuals in a specific group *i* are all alike, in that they like alternative *i* the best, and the difference in valuation between their most preferred alternative and any other is the common value b_i.[6] Let n_i denote the relative size of group i. Note that the alternatives here are *public goods* because their valuation by the individuals is independent of the number of beneficiaries.

By a *political system* we shall refer to a particular way of choosing among the different alternatives. By *conflict* we mean a challenge to such a system, which is costly. Specifically, we take the following view. Conflict entails resource contributions r_i (to be determined presently) from every member of group *i,* so that the overall contribution of group *i* is $n_i r_i$. In the absence of a political rule, the particular alternative that will eventually come about is seen by the players as probabilistic. The probability that alternative *i* will be established is assumed to be equal to the resources $n_i r_i$ expended by group relative to the total resources *R* expended. In short, the probability of success p_i is just

$$p_i = \frac{n_i r_i}{\sum_j n_j r_j} \equiv \frac{n_i r_i}{R} \quad (6)$$

where *R* is the sum of all the group contributions. In the sequel, we shall take this very *R* to be a measure of the overall intensity of conflict (or wastage) in the society.

To understand how contributions are determined, suppose that there is a utility cost of spending r_i; call it $c(r_i)$.[7] Take this function to be of the constant-elasticity form

[6] Notice that *b* appears in (2), and the same notation is used again here. This is deliberate, as the `distance' between two groups may be viewed as one group's utility distance between its preferred outcome and that of the other group.

[7] One could also have taken the line of measuring the cost in terms of the utility loss incurred. We have opted to use the resources expended, *R*.

$$c(r_i) = \frac{r_i^{1+\alpha}}{1+\alpha}, \text{ with } \alpha > 0 \quad (7)$$

Given the resources expended by the others, the expected utility of an individual of group *i* when spending r_i is

$$u_i(\boldsymbol{r}) = p_i b_i - c(r_i) = \frac{n_i r_i}{\sum_j n_j r_j} b_i - \frac{r_i^{1+\alpha}}{1+\alpha} \quad (8)$$

Expected utility is clearly concave in r_i and hence the utility maximizing level of expenditure can be characterized by the first order condition:

$$\frac{n_i}{\sum_j n_j r_j}\left(1 - \frac{n_i r_i}{\sum_j n_j r_j}\right) b_i = \frac{n_i}{R}(1-p_i) b_i = r_i^{\alpha} \quad (9)$$

An *equilibrium* of the conflict game is a vector $\boldsymbol{r}$ such that (9) is satisfied for all $i = 1, \ldots, G$.

There is always an equilibrium of the conflict game. Esteban & Ray (1999) demonstrate, furthermore, that if $\alpha \geq 1$ then such an equilibrium is unique.[8]

In order to simplify the computations we shall focus on the case of symmetric valuations, with $b_i = 1$ for all *i*, and $\alpha = 1$.

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[8] This model is admittedly simple. However, we wish to make two points here. One is that our model has been conceived as a benchmark case so that in some cases the consequence of deviating from our assumptions can be inferred. The second point is that some of the assumptions are less restrictive than they look. To exemplify the first point, start by taking the case of identical payoffs. If we drop this assumption, the player with the higher payoffs will put more resources into conflict and will have higher win probability and a higher equilibrium expected utility. The opposite will happen with the players with lower payoff. It follows that the high payoff player will be more inclined to challenge the existing political system. Similarly, we can easily figure out what would happen if the marginal cost of conflict were higher for one player over the other. Let us now turn to our second point. In the model we allow for asymmetric group sizes. But notice that *n* simply is a parameter that turns a given effort cost (measured in utiles) into effective influence on the win probabilities. Therefore, *n* can be interpreted as capturing all the factors that may influence the effectiveness of a given effort. This can include differential wealth, power or group motivation as well as sheer population size.

Multiplying both sides of (9) by $\frac{n_i}{R}$ we see that

$$\left(\frac{n_i}{R}\right)^2 (1 - p_i) = p_i \quad (10)$$

and transposing terms, we conclude that

$$p_i = \frac{n_i^{\ 2}}{n_i^{\ 2} + R^2} \quad (11)$$

The equilibrium value of *R* has to be such that the sum of the probabilities adds up to unity. In view of (11), this condition implies that

$$\sum_i \frac{n_i^{\ 2}}{n_i^{\ 2} + R^2} = 1 \quad (12)$$

There exists a value of *R* that solves (12), and it is unique. The LHS of (12) is strictly decreasing in *R*. Using (10), it is immediate that when *R* goes to zero the LHS tends to *G > 1* and that when *R* tends to infinity the LHS tends to zero. This establishes the claims of existence and uniqueness.

Substituting the equilibrium *R* into (11) yields the equilibrium probabilities for each group's preferred alternative to be implemented.

In order to obtain a useful expression for equilibrium payoffs we multiply both sides of (9) by $\frac{r_i}{2}$ to see that

$$\frac{1}{2} p_i (1 - p_i) = \frac{1}{2} r_i^{\ 2} \equiv c(r_i) \quad (13)$$

Using (13) in (8) yields

$$u_i(\boldsymbol{r}) = \frac{p_i (p_i + 1)}{2} \quad (14)$$

For the case of two groups, $G = 2$, setting $n_1 = n$ and $p_1 = p$, the equilibrium values are easy to compute:

$p = n$ (15)

$R = \sqrt{n(1-n)}$ (16) and

$$u_1(\boldsymbol{r}) = \frac{n(n+1)}{2} \; and \; u_2(\boldsymbol{r}) = \frac{(1-n)(2-n)}{2} \quad (17)$$

Using (11), (12) and (14) one obtains the equilibrium conflict payoffs for any G groups. For two groups one can use the simpler expression (17). These conflict payoffs will be the benchmarks against which individuals will compare the peace payoff that the political system gives to them. In this way, they will decide whether to trigger conflict or not.

In what follows, the equilibrium payoffs to conflict for player *i* will be simply denoted u_i.

Peace

In a situation of peace individuals accept the payoff that the political system allocates to them. We define a *policy* to be a vector γ of shares, with γ_i denoting the share (and also, therefore, the payoff) of group *i*. Hence, we can interpret γ as a 'compromise policy' composed of a convex linear combination over the available alternative types of public goods.

Formally, we shall have *peace* whenever

$u_i \leq \gamma_i$ for all $i = 1,\ldots,G$ (18)

It is trivial but nevertheless useful to observe that whether we have conflict or peace critically depends on what the ruling political system delivers to the different contending groups.

We shall examine here various sharing rules and check for their ability to guarantee peace. Specifically, we shall study dictatorial rules, fixed shares, majoritarian rules and proportional rules.

We hasten to add that regimes such as dictatorship cannot be fully described by something as simple as a mere sharing rule. These are just names we use to brand particular sharing rules that are precisely described below, and capture *some* but not all of the features of the regimes they are meant to approximate. We focus on these four rules because they are simple and can be taken as benchmarks. But, obviously, they do not exhaust the set of possible sharing rules covered by this model.

Our first example of a political system is the dictatorial rule. This will be the case when the alternative preferred by some group i is brought into effect, irrespective of the number of individuals for whom this is the best choice. If group i is the dictator, then $\gamma_i = 1$ and $\gamma_j = 0$ for all $j \neq i$.

The second case is *fixed shares*, which generalizes the dictatorial rule. The policy consists of a vector γ assigning a share to each group independent of its population size. There are many instances of such a political system. Various political bodies have fixed proportional representations of the different opposing interests (often rural vs. urban). There are also cases where the chairs of the two chambers have to alternate between the different ethnic or religious groups in the country.[9]

The *majoritarian rule* generates the policies that earn the support of a majority of citizens. For the case of $G = 2$ this is very easy to define: $\gamma_i = 1$ if and only if $n_i > 1/2$. For $G > 2$ the characterization of the policies resulting from a majoritarian rule is more intricate as it involves the formation of a majoritarian coalition. In some special environments there is a well-defined pivotal group (the *median* voter) who can impose its preferred policy to the rest of the majoritarian

[9] This was the first constitutional arrangement for the Lebanon after independence. The constitution established that the president had to be a Christian. The faster population growth rate among the Muslim population made this provision untenable and possibly contributed to the outbreak of the civil war. Another example is the EU 'rotating presidency' across the member countries with a frequency that is independent of their population.

coalition. This is not the case here and hence most of what we can say will be restricted to the two-group case.

This is an extremely stylized representation of the majoritarian rule. Real world majoritarian democracies do not work like this. A number of written and/or unwritten rules protect minorities from the tyranny of the majority.[10]

Finally, the *proportional rule* produces the policy that assigns to each group a share equal to its population size: $\gamma_i = n_i$. Parliamentary representations satisfy this rule for most countries (not in the UK where each seat corresponds to one constituency). Although most decisions simply require a majority vote in the chamber, the resulting policies tend to give some weight to the minoritarian opposition. Decentralization of government also contributes to give to the different groups an overall weight that brings them closer to their population share.

In the next section we study the relationship between polarization, fractionalization and conflict under the different political systems for the case of two groups. We later generalize to the case of more than two groups.

Polarization, fractionalization, conflict and the political system (*G=2)*

We are interested here in two quite different aspects of conflict. In the first place, we want to characterize the relationship between the intensity of conflict and polarization *when conflict actually takes place*. This relationship is independent of the political system. Secondly, we wish to identify the relationship between polarization and the occurrence of conflict.

Intensity of conflict

We start by noting that for $G = 2$ the measures F and P are proportional to each other. Furthermore, they all attain their maximum at $n = 1/2$. It follows that any

[10] Cox (1997) provides a careful attempt at categorizing the different existing democratic systems.

comparative test of the performance of P relative to F as a predictor of conflict should focus on cases with $G \geq 3$.

Using (5), we can obtain that for $G=2$, $P=n(1-n)$. Hence, in view of (16), the level of conflict R is just the square root of P and conflict intensity is an increasing function of polarization and of fractionalization.[11]

Figure 1 in here

Figure 1, left panel, plots the intensity of conflict as a function of the population shares n. The right panel does the same as a function of the level of polarization. Conflict intensity is maximal for $n = ½$. Polarization is also maximal at that value of n, with $P = 1/4$.

Figure 2 in here

It will also be useful to keep track of the equilibrium utility payoffs as given by (17). We do so in Figure 2. These payoffs depend on the population distribution parameter n. The equilibrium utility for each player is the win probability $p = n$ minus the cost of the resources expended in conflict, which are equal for each type of players when $G = 2$. The win probabilities are points on the straight line between (0,1) and (1,0), the utility possibility frontier. Given n, from the corresponding point on the frontier we move inwards along a 45º line for a length equivalent to the utility loss caused by the expended resources. This gives us a utility equilibrium pair. As we vary n we generate all the points of the equilibrium payoff curve. The maximum distance between the payoff curve and the frontier is at $n = ½$ where the conflict loss is maximal.

We now turn to the occurrence of conflict. This depends on the payoffs obtained in peace. The latter depend, in turn, on the political system.

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[11] If we drop the restriction that $\sigma = 1$ but retain $b = 1$, $P(\sigma,1)$ ceases to be proportional to F, but continues to behave like it. Indeed, $P(\sigma,1)$ is concave and attains its maximum at $n = 1/2$. Therefore, it will still be the case that increases in $P(\sigma,1)$ go with increases in the level of conflict R. Things are different when we allow for asymmetric inter-group distances. It can be readily verified that if b < (>) 1 both polarization and conflict are maximized at (two different) values $n^P, n^R > (<)$ 1/2. Therefore, except for values of n within this interval, the level of conflict will be strictly increasing with polarization. The non-monotonicity with respect to F and P will be for n in the interval $(1/2, n^R)$.

Dictatorial Rule

The first rule we examine is the dictatorial one. Will there ever be peace? The answer is no. In equilibrium conflict, all players receive a strictly positive payoff because they could have opted for contributing nothing to conflict, thus guaranteeing for themselves a payoff of zero. Hence, for a non-dictator, a peace payoff of zero is always dominated by the conflict payoff. Of course, this is a trivial case and a more complete analysis is provided in what follows.

Fixed shares

We next examine the case of fixed shares γ.

The necessary and sufficient condition for conflict is that either

$$\frac{n(1+n)}{2} > \gamma \;\; or \;\; \frac{(1-n)(2-n)}{2} > 1-\gamma \quad (19)$$

Figure 3 in here

The situation is captured in Figure 3. Consider the peace share γ and the corresponding utility payoff. For a population parameter like *n'* the payoffs to conflict are dominated by the peace payoff for the two players. However, if we decrease sufficiently the population share of the first group—all the way down to *n"* --- the second group would have a strong advantage over the first in conflict and would therefore prefer conflict to the peace payoff.

To be more specific, let us rewrite the inequalities in (19) as

$$n - \frac{n(1-n)}{2} > \gamma \quad or \quad n + \frac{n(1-n)}{2} < \gamma \quad (20)$$

The LHS of the two inequalities is strictly increasing in *n* (one convex and the other concave). Therefore, there exist *n'* and *n"* such that if $n \in [n', n'']$ there is peace, while if *n* falls outside this interval, there is conflict.

In Figure 4 we depict the values of *n* for which we have peace (given a fixed vector of shares). These are the values of *n* bounded by the points on the equilibrium utility curve at which one of the two players is indifferent to the peace payoff.

Figure 4 in here

Clearly, the interval of values of *n* for which there will be peace depends on the bias exhibited by the fixed-shares policy γ. Let us take as a benchmark the case of equal treatment of the two groups of players with γ = ½. From our previous analysis it follows that for very low polarization (i.e. for very low or very large *n*) there will be conflict, but its intensity will be low. As polarization increases the intensity of conflict will increase too. But, further increases in polarization will produce peace and bring the level of conflict down to zero. *The overall relationship between polarization or fractionalization and conflict is therefore non-monotonic*.

We can address the complementary question of the range of policies γ that would guarantee peace for given *n*. This range is given by the gap between the two bounds: *n(1-n)*. Hence the widest range for peaceful policies corresponds to *n = 1/2*. *High polarization allows for a wider choice of peaceful fixed-share policies*. The intuition for this result is straightforward. If there is conflict, higher polarization produces larger losses. Hence, it is only when the policy is very biased against one group that that group will decide to incur the heavy cost of conflict. With low polarization the costs are smaller and hence a lower bias in γ might be enough to trigger conflict.

Majority rule

The case of majority rule is equivalent to letting the largest group be a dictator. By the same argument as before, we shall never have peace as the minoritarian group will always obtain a higher payoff under conflict than under peace. Hence, *with majority rule we shall always have conflict and the level of conflict will positively depend on the degree of polarization*.

We remind the reader that this statement has to be interpreted with due caution, and will only apply to the extent that an existing majoritarian democracy actually permits the tyranny of the majority.

Proportional rule

We start by noting that in the previous case of fixed shares, in view of (20), when γ is sufficiently close to the win probability of a group, peace will not be challenged by that group. Under our assumptions, $p = n$ and hence making $\gamma = n$ would guarantee peace. This precisely is the proportional rule that gives each group a share equal to its population size, that is, $\gamma_i = n_i$.

Therefore, for *symmetric valuations we should never observe conflict under the proportionality rule*.[12]

The intuition for this result is that the proportionality rule gives to each group a weight that is close to their win probability under conflict. Hence, it never pays to challenge the peace allocation. As we will see, this result is specific to the two-group case and does not extend to the case of a larger number of groups.

Diagrammatically, we can see in Figure 2 that the point *(n,1-n)* always dominates the conflict equilibrium payoffs.

Summing up

[12] This is no longer true for asymmetric valuations. The equilibrium *p* can be made arbitrarily close to unity by choosing *b* for one group sufficiently close to zero.

In this section we have obtained two main results. The first one is that it does matter for conflict which political system is in place. Dictatorial and majoritarian systems never yield peace. Fixed shares may give peaceful outcomes for some parameter values. The proportional system always yields peace, at least whenever there are just two groups.

The second result is that while the *intensity* of conflict is positively related to the degree of polarization, the *incidence* of conflict is not. Only in the fixed shares system does the incidence of conflict depend on the distribution of the population across the two groups. For the other three political systems the incidence of conflict is independent of the distribution (and hence of the degree of polarization). For the fixed shares system conflict is more likely at low levels of polarization and peace more likely at high levels. Therefore, if there is any relation between conflict and polarization this is non-monotonic.

Polarization, conflict and political rules with several groups

We shall examine now whether our previous conclusions can be extended to the general case of several groups. As we shall see, there are some important differences.

Intensity of conflict

The relationship between the intensity of conflict and polarization has been extensively studied in Esteban & Ray (1999, section 6). Adding up (10) over all *i* and multiplying both sides by R^2 we have

$$R^2 = \sum_i \frac{1-p_i}{1-n_i} n_i^{\,2}(1-n_i)b_i \quad (21)$$

Comparing (21) with the measure of polarization *P* in (4) we can observe that, if $p_i = n_i$, the level of conflict *R* would be equal to the index of polarization $P(1,\mathbf{b})$.

The *n/p* ratio is determined in equilibrium and will generally be different from unity. Therefore, how closely related *P* is to *R* critically depends on how much *n/p* varies across the different groups in equilibrium. It can be shown that the case in which $n_i/p_i = 1$ for all i is specific to the symmetric case for $G = 2$ or for uniform distributions over $G > 2$ groups. Therefore, on these grounds alone, we should *a priori* expect a positive but incomplete association between polarization $P(1,\mathbf{b})$ and the level of conflict R.

Drawing on the results in Esteban & Ray (1999) we can restate the following properties of R, implicitly determined in (12), to be contrasted with the properties of F and P presented in the previous section.

(i) A transfer of population from a group to a smaller one increases R if both groups are larger than 1/3. If the two groups are small enough the equalization of populations will bring R down;

(ii) For any given G, R is maximized when the population is split into two equally sized groups only;

(iii) Over the set of uniform distributions R decreases with the number of groups G; and

(iv) The split of a group with population n into two groups with n' and n'', $n' + n'' = n$, increases R if and only if the group size is sufficiently large. If n is small, the split will decrease R.

Do the properties of our theoretical model align with our intuition on the intensity of conflict? Consider conflict among three groups of varying size. Property (i) says that equalizing the size of the two largest groups will increase conflict while reducing the size of the second largest group at the benefit of the smallest will reduce conflict. Property (ii) appears to conform to the common intuition that conflict is worst when society is split into two equally sized groups. In the case considered by Property (iii) each group becomes progressively smaller, while its collective opponent (the rest of the groups) becomes larger. In this case the smaller groups will commit less resources to conflict. As for Property (iv), consider first the case of a monolithic society that gets split into two distinct groups. This must increase the intensity of conflict. The same has to be true even if the initial society was not monolithic, but had a small 'dissident' group. But suppose now that after the first split the second sized group splits into two smaller groups. Then we would expect that conflict would come down because now the untouched group has become relatively larger than the others. The smaller groups may not be willing to contribute much to conflict.

In sum, the properties displayed by our conflict model do not seem to contradict our intuitions about conflict intensity.

Let us now compare the properties of *R* and *P*. It is immediate that the two sets of properties describe movements in the same direction for the type of population changes considered. Hence, we should expect a strong positive relation between polarization and conflict intensity (see below for a parametric illustration).

How does the index of fractionalization *F* behave relative to *R*? Property (i) of *R* is not satisfied by *F*. Property (a) of *F* says that any equalization of sizes will increase *F*. In contrast, *R* may go either up or down depending on the size of the groups involved. Properties (ii) and (b) are aligned as long as there are two groups in conflict to start with. With more groups *F* is maximized at the uniform distribution while *R* continues to be maximal when the population is concentrated on two equally sized groups. Properties (iii) and (c) are exactly the opposite of each other. Finally, when we compare Properties (iv) and (d) we observe that any split always increases *F*, while *R* may either decrease or increase depending on the size of the broken group.

We can thus conclude that we can expect a strong positive relationship between polarization and conflict, and a weak and (if anything) negative relationship between fractionalization and conflict, at least insofar as intensity is concerned.

We now turn to an analysis of the incidence of conflict when there are more than two groups.

Dictatorial and majoritarian rule

Notice that our arguments on the impossibility of peace under dictatorial or the majoritarian rule did not depend on the number of groups. In both cases, the excluded groups obtain a lower payoff than what they get under conflict.

Fixed shares

From (14) we have that there will be conflict whenever

$$\frac{p_i(1+p_i)}{2} > \gamma_i \text{ for some } i = 1,\dots,G \quad (22)$$

Using (11) in (22) we obtain that the condition for conflict is

$$u_i = \frac{1}{2}\frac{n_i^2}{n_i^2+R^2}\left(1+\frac{n_i^2}{n_i^2+R^2}\right) > \gamma_i \quad (23)$$

Consider G≥3 groups, any given vector of shares γ and a particular group of size n_i. Observe that the conflict payoff u_i can take values in *(0,1)* depending on *R*. Therefore, the condition for conflict is most likely to be satisfied when *R* is small and hence polarization is small too. To be precise, suppose that all the remaining groups have the same size, $n_j = \frac{1-n_i}{G-1}, j \neq i$. It can be readily verified from (12) that *R* is strictly decreasing in *G*. To see this, start by noting that (12) now becomes $\frac{n^2}{n^2+R^2} + (G-1)\frac{\left(\frac{1-n}{G-1}\right)^2}{\left(\frac{1-n}{G-1}\right)^2 + R^2} = 1$, that is $\frac{n^2}{n^2+R^2} + \frac{(1-n)^2}{\frac{(1-n)^2}{G-1} + (G-1)R^2} = 1$. Totally differentiating with respect to *G* and *R* we can see that $\frac{dR}{dG}$>0 if and only if $\frac{dD}{dG}$≥0, where *D* is the denominator of the second fraction. Performing the differentiation we obtain $\frac{dD}{dG}=\frac{1}{G-1}\left(-\frac{(1-n)^2}{G-1}+(G-1)R^2\right)$. Notice now that $\frac{(1-n)^2}{\frac{(1-n)^2}{G-1}+(G-1)R^2}<1$.

Using this inequality we obtain that $\frac{dD}{dG}>\left(1-\frac{2}{G-1}\right)(1-n)^2>0$. So, *R* is strictly decreasing in *G*. Therefore, it follows that there is a *G* sufficiently large so that a uniform distribution over the *G-1* remaining groups would induce group *i* to prefer conflict. Note that as *G* becomes large polarization comes down and fractionalization goes up. Therefore we shall see conflict with low levels of polarization and high levels of fractionalization, but the intensity of conflict will be low.

In the discussion above, observe that the untouched group, the group that has become larger relative to the others, is the one that prefers conflict to peace. Hence, even in this case, one might argue that it is not high fractionalization as such that precipitates conflict but the *coexistence* of one large group with numerous small groups. In fact, if we now equalize the size of all the groups, thus increasing *F* and decreasing *P*, no group would have an incentive to challenge the peace share and we would have peace with higher fractionalization.

To sum up, for the egalitarian fixed shares policy, *conflict will not occur in societies with high polarization/low fractionalization*. For distributions displaying low polarization/high fractionalization, the relation between conflict and *F* or *P* will be non-linear. *Conflict will be most likely for distributions with one large group and many small ones* (and hence with relatively high fractionalization and low polarization).

As the rule of fixed shares departs from egalitarianism, the occurrence of conflict will critically depend upon the bias introduced by the rule.

Proportional rule

Once again, from (14) we have that under the proportional rule there will be conflict whenever

$$\frac{p_i + 1}{2} > \frac{n_i}{p_i} \text{ for some } i = 1,\ldots,G \quad (24)$$

In the previous section we have seen that for *G = 2* the proportional rule always guarantees peace. Does this property extend to *G > 2*?

A first observation is that for the distributions under which the equilibrium win probabilities are very close to the population shares condition (24) will not be satisfied and we shall observe peace. We shall only have conflict when p_i is sufficiently larger than n_i for some group *i*.

Using (10) in (14), we can rewrite condition (24) as

$$\frac{1}{2}\frac{n_i}{n_i^2 + R^2}\left(1 + \frac{n_i^2}{n_i^2 + R^2}\right) > 1 \quad (25)$$

The LHS of (25) can take values in $(0, \frac{1}{2n_i})$, depending on *R*. Provided $2n_i < 1$, we have already seen that there is a distribution of the population (for *G* sufficiently large) so that group *i* will prefer conflict over peace. Esteban & Ray (2001) demonstrate that under these assumptions there always are distributions for which (25) is satisfied for one group. Here are two numerical examples: G=5 with one group being 1/3 of the population and the other four of size 1/6; and *G=4* with one group of size 1/2 and the other three of size 1/6.[13]

As in the case of fixed coefficients conflict occurs in very skewed distributions by size. One large group together with a number of small sized groups is the type of distribution that would be more likely to generate open conflict. Because of the returns to scale in conflict, the win probability of the large group may amply exceed its population share. Furthermore, precisely because of the

[13] The case of India has been taken as a critical test for Lijphart's claim that 'consociational' systems –hence proportional—are guarantors of ethnic peace. Most of the debate, Lijphart (1996) and Wilkinson (2000), has focused on whether India was more 'consociational' under Nerhu or more recently. Our analysis suggests that the change in population sizes of Hindus, Muslims and others that has actually taken place in India in 1961-2001 might also have a role in explaining the evolution of ethnic conflict.

returns to scale the small groups will be deterred from expending much resources in such an uneven conflict and hence we shall observe a low conflict loss R.

Therefore, we conclude that with *G > 2 under the proportional rule we may have conflict*. This will be associated with distributions with low polarization and high fractionalization. However, the relationship will be non-monotonic: additional increases in fractionalization may bring peace rather than further conflict.

In order to illustrate this relationship consider the following parametric example. There are three groups with $n_1 = ½$, $n_2 = \lambda ½$, and $n_3 = (1-\lambda) ½$, $0 \leq \lambda \leq ½$. When $\lambda = 0$ we have two groups with the same population and thus maximal polarization. When $\lambda = ½$ we shall have the same first group facing two groups of half the size. F and P can be computed to be

$$F(\lambda) = \frac{1+\lambda-\lambda^2}{2} \quad (26)$$

and

$$P(\lambda) = \frac{3-\lambda+\lambda^2}{8} = \frac{1}{2} - \frac{F}{4} \quad (27)$$

From (27) it is plain that when λ changes fractionalization and polarization move in opposite directions: as we move away from the perfect bipolar distribution P comes down but F goes up.

Using this parameterization for the distribution of the population in expression (12) we implicitly obtain the equilibrium intensity of conflict R as a function of λ. Totally differentiating, we obtain that R decreases as λ increases, i.e. as P decreases and as F increases. Conflict intensity goes from $R(0) = 0.5$ to $R(1/2) = 0.211$. This is depicted in Figure 5.

Whether there will be conflict or peace under the proportional rule depends on whether the untouched group –always with population ½-- obtains a conflict equilibrium utility higher or lower than ½. In Figure 5 we also depict u_1 as a function of λ. Not surprisingly, as λ increases group 1 is facing smaller and smaller enemies. Hence, u_1 increases with λ. The large group obtains a higher utility from conflict the less polarized the distribution is. The equilibrium utility goes from $u_1(0) = 0.375$ to $u_1(1/2) = 0.837$. It follows that for low λ the equilibrium utility of group 1 will be below the peace payoff and there will be peace. This corresponds to the highest levels of polarization and lowest of fractionalization. For $\lambda > \lambda^o$ [see Figure 5] there will be conflict. Therefore, open conflict will be associated with low polarization and high fractionalization.

Figure 5 in here

We finally combine the intensity with the occurrence of conflict and derive the relationship between observable intensity of conflict and both fractionalization and polarization. This is depicted in Figure 6. As we can see, in both cases the relation is non-monotonic. For the case of fractionalization, there is peace until the threshold level F^o is reached. At this point, there is conflict and it attains its maximum intensity. For higher values of F we continue to have conflict but its intensity monotonically comes down. The relationship between P and the observable intensity of conflict is the other side of the coin. Open conflict occurs at low levels of polarization. As polarization goes up, the intensity of conflict raises until the threshold P^o is attained. For higher levels of polarization the costs of conflict are so high that we will observe peace. The two functions are depicted in Figure 6.

Figure 6 in here

Summing up

When we consider distributions with more than two groups it is still true that the occurrence of conflict critically depends on the particular political system in place. The dictatorial and the majoritarian rule can never bring peace, as we already observed for $G = 2$. But in general, both fixed shares and proportional rule fail to universally guarantee peaceful outcomes. We shall not see conflict either for very low or for very high levels of fractionalization.[14] A mirror-image, inverted pattern would be followed by the conflict-polarization relationship.

Concerning the general relationship between polarization, fractionalization and conflict our results suggest that they will be significantly nonlinear.[15] Under some political systems the occurrence of conflict is independent of the shape of the distribution while in other systems it does depend on the shape. Under the first class of political systems the intensity of conflict will be closely (positively) related to the degree of polarization (and negatively to fractionalization). Under the second class (fixed and proportional shares) we shall observe zero intensity at high and very low levels of polarization (and fractionalization). For the range of levels of polarization for which we shall have conflict, higher polarization will be positively related to higher intensity of conflict. As far as fractionalization is concerned there seems to be no regular relationship between its level and the intensity of conflict.

All these results suggest that there may be more to be learned from empirical exercises that put all the evidence together and also attempt to control for the political system of each country. Political scientists have been aware for long of the critical role played by the political institutions in preventing domestic conflict. The work of Lijphart (1977) is fundamental here as well as the recent controversy between Horowitz (2006) and Fraenkel & Grofman (2006) on the effectiveness of constitutional *engineering*. Our point is that in spite of this important line of literature, empirical tests on the determinants of conflict have very seldom controlled for the different specific forms of democracy. Recent exceptions are Reynal-Querol (2002b, 2005) and Schneider & Wiesehomeier (2008), who do study the relationship between political systems and domestic conflict.

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[14] This seems to contradict the result obtained by our parametric example above. This is due to the very special change in the distribution that our parameterization allows for. Consider for instance our limit case with $l = ½$ ($n_1 = ½, n_2 = ¼, n_3 = ¼$). Fractionalization is maximal and we still have conflict. However, if we now move to $n_1 = n_2 = n_3 = 1/3$—not allowed by our parameterization—fractionalization would be even higher but there would be no conflict.

[15] These results are in line with the empirical findings of Schneider & Wiesehomeier (2008).

Conclusions

We provide an analytical framework that permits an interpretation of recent empirical exercises that study the relationship between population distributions over opposing groups, and the emergence or intensity of conflict. We argue that conflict typically breaks out when the payoffs delivered by the political system fall short of what one group can obtain by precipitating noncooperation. While the intensity of conflict clearly depends on the shape of the distribution, the occurrence of conflict also depends on the responsiveness of each political system to the popular support for each of the competing alternatives. When we combine occurrence with intensity, the relationship between conflict and polarization/fractionalization becomes significantly non-linear and contingent on the ruling political system.

The rationale behind our result is straightforward. Conflict is costly and hence payoffs are less than what are achievable under peace. The costlier is such conflict, the easier it becomes to assign payoffs to groups that Pareto dominate conflict payoffs. Therefore, the political systems with highly unequal outcomes (such as dictatorial or majoritarian rule) will always be challenged even when the cost is high. Under 'fairer' systems no group would be willing to pay too high a cost to obtain a different payoff. Therefore, it is only when conflict is nearly costless to one group (such as the case of one large group and a number of small opponents) that the outcome of the political system will be challenged, by precisely that large group.[16]

Highly polarized situations may be fairly peaceful. This is what happened during the Cold War period. The cost of challenging the international status quo was so immense that even if one of the two sides considered the division of international power disproportionate it could not—or would not--trigger a world conflict. At the same time, when polarization is extremely low, there is little to

[16] Note the similarity of this point with the findings of Collier (2001) on the dominant ethnicity provoking civil war. One should qualify these points, however, by observing that small groups can provoke conflict when private goods are at stake. For more on this issue, see Esteban & Ray (2006).

fight about. Consequently, we would expect the overall degree of conflict to be maximal in societies with intermediate levels of polarization.

Two recommendations appear to emerge for future empirical exercises. First, there should be a serious attempt to account for the nonlinearity, for instance, by entering both polarization and its square on the right-hand-side of a regression.[17] But the prescription is simply this: the empirical specification needs to be more firmly grounded in theory, even if that theory is simple.

Second, the incidence of conflict depends not only on the shape of the distribution but also critically on the ruling political system. Alternative political systems perform quite differently in guaranteeing peace. For the countries with political systems that always yield conflict we shall observe that the intensity of conflict is (roughly) positively related to polarization (and negatively) to fractionalization. However, in countries with political systems that may yield peace, the occurrence and intensity of conflict will typically have a highly non-linear relationship with polarization and/or fractionalization. It follows that the exercise critically demands that political systems be controlled for.

[17] On a similar issue arising in the empirical debate on inequality and growth (though for very different reasons), see Banerjee & Duflo (2003).

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Figure 1: Intensity of conflict, group size, and polarization

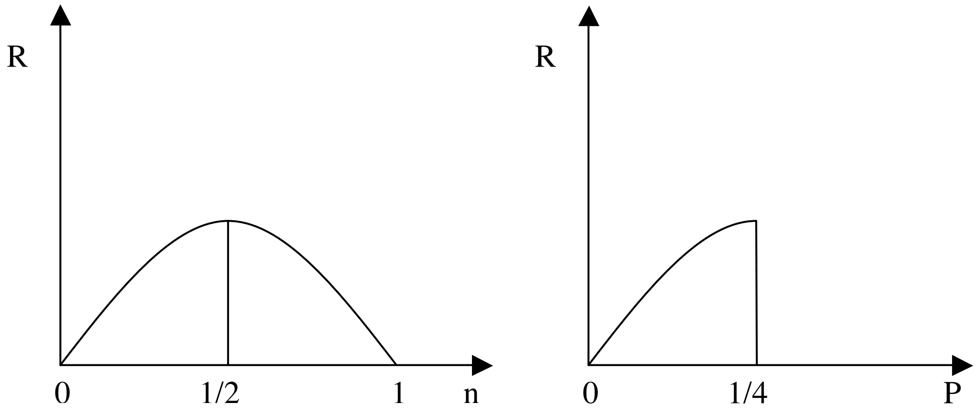


Figure 2: Equilibrium conflict payoffs and group size

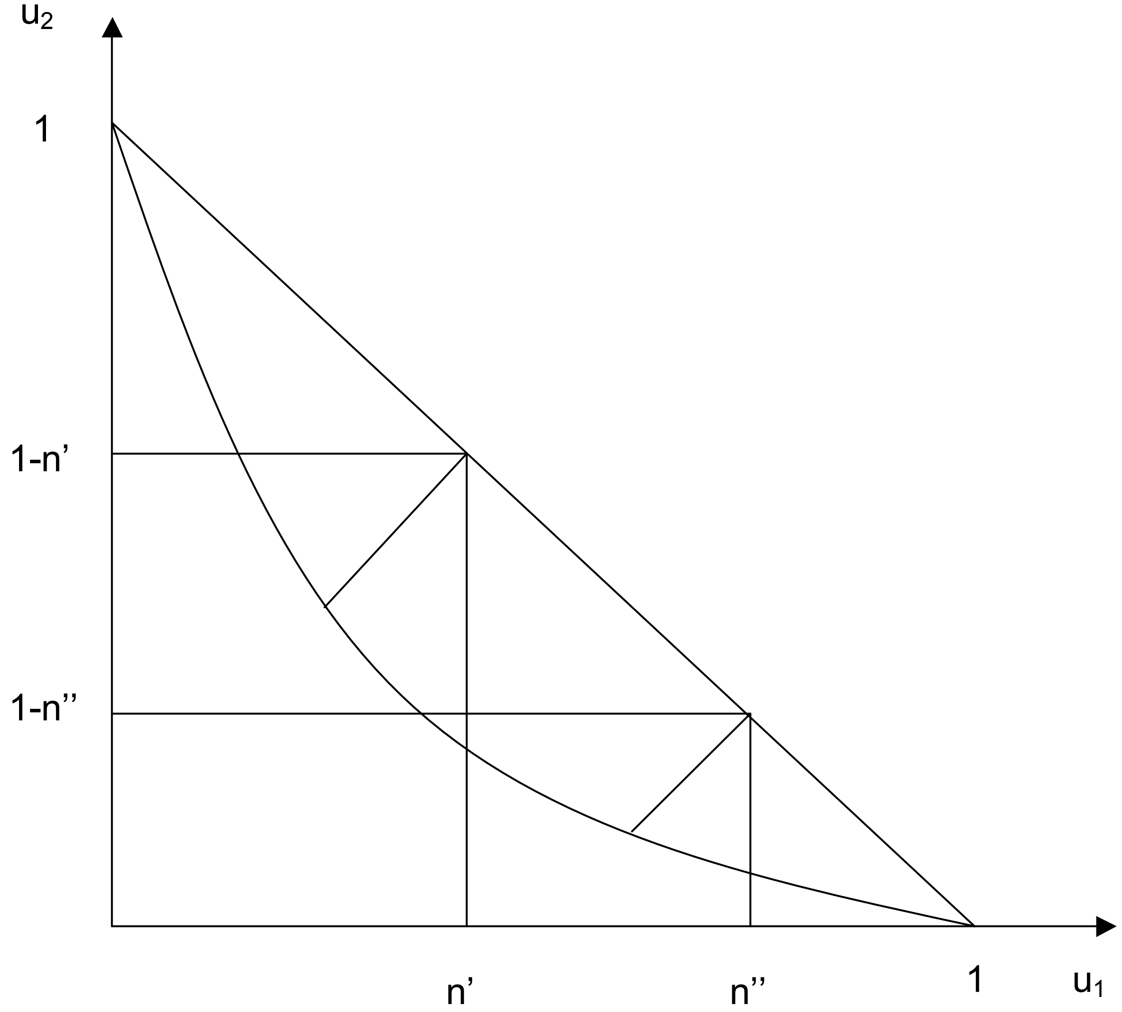


Figure 3: Conflict vs. peace payoffs under fixed shares

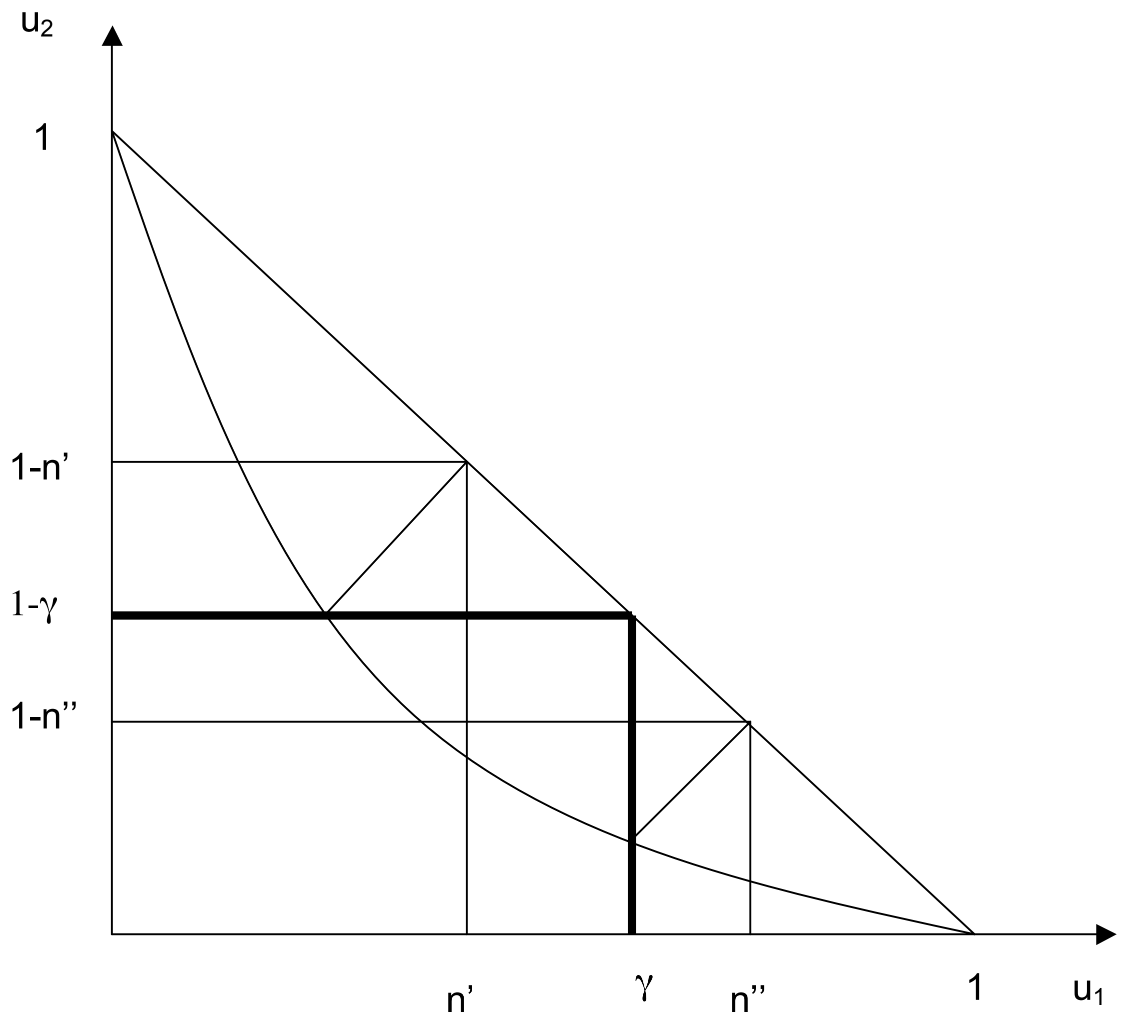


Figure 4: Range of peaceful group sizes with fixed shares

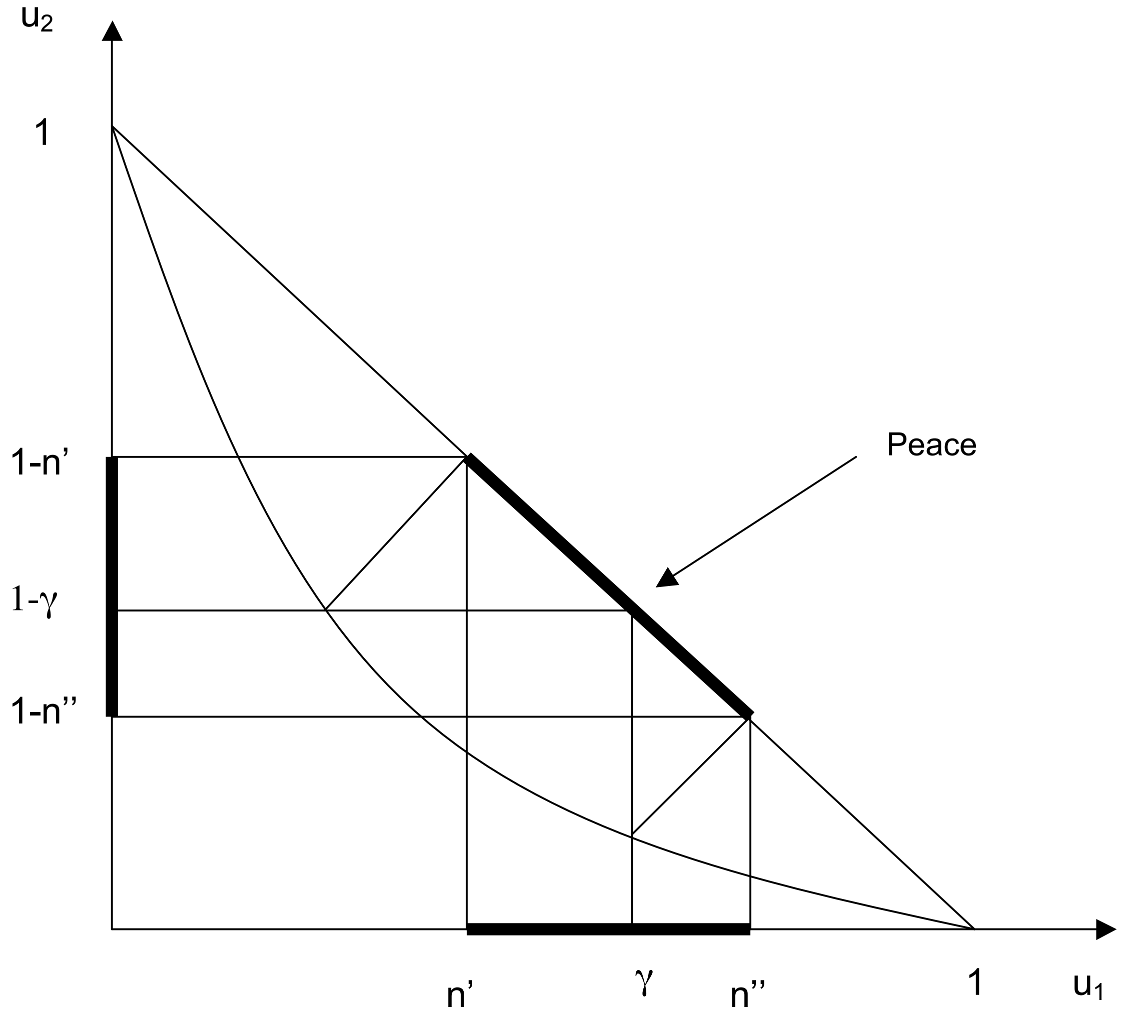
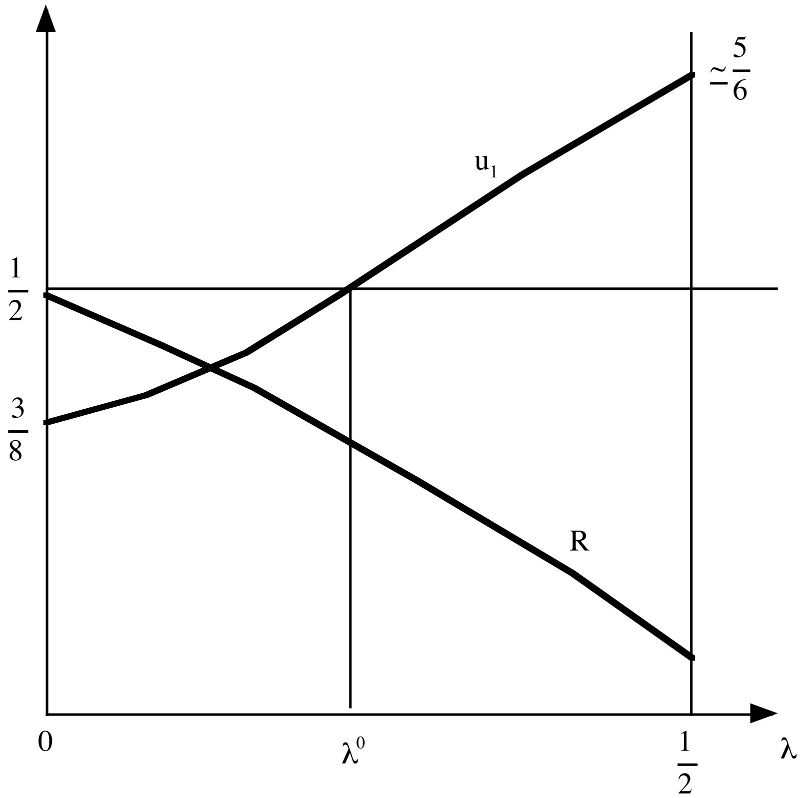


Figure 5: Conflict intensity, individual payoff and group size



Biographical statement

JOAN ESTEBAN, b. 1945, D.Phil. Oxon 1988, Research Professor, Instituto de Análisis Económico-CSIC, Bellaterra-Barcelona, and President of the Society for the Study of Economic Inequality (2007-2009).

DEBRAJ RAY, b.1957, Ph.D. Cornell University 1983, Julius Silver Professor of Economics and Director of Graduate Studies, New York University, 1999- .