Economic Diplomacy

CLARA PONSATÍ
Institut d'Anàlisi Econòmica - CSIC

Abstract

We study bilateral conflicts that affect the welfare of third parties, the stakeholders. The conflict takes the form of a war of attrition and intervention is modeled as the possibility that the stakeholder "aids" the agreement with transfers to the contenders. We characterize the optimal policy when the stakeholder limits its intervention to a unilateral commitment to compensate the contenders if the conflict is resolved, and show that if contenders must be treated equally after agreement, then the optimal policy cannot eliminate the delay in resolving the conflict, and intervention is only advisable when the stakes are high enough. Economic diplomacy is modeled as a three-player game where the stakeholder is actively involved in the negotiation where transfers are discussed simultaneously with a settlement for the conflict. We prove that, provided that none of the parties involved is too impatient, diplomacy benefits the third party in all conflicts.

1. Introduction

Bilateral conflicts very seldom are an isolated affair. Bystanders suffer in a stalemate and enjoy benefits when agreement is reached. There are *stakeholders*, third parties *interested* in the resolution of the conflict, yet they are unable to impose an agreement upon the *contenders*. In these circumstances, governments and other public institutions often find themselves under pressure to intervene to ease conflicts.

Clara Ponsatí, Institut d'Anàlisi Econòmica - CSIC, campus UAB, Bellaterra (Barcelona), 08190, Spain (clara.ponsati@uab.es).

I am indebted to Paola Manzini for many discussions related to this work and to two anonymous referees for their comments. The financial support of DGCYT (SEC03-01961) EC(CIT2-CT-04-506084), and DURSI (2000SGR-0054) and the hospitality of the Institute for Policy Analysis at the University of Toronto, where this research was conducted in part, are gratefully acknowledged.

Received October 2001; Accepted March 2003.

© 2004 Blackwell Publishing, Inc.

Journal of Public Economic Theory, 6 (5), 2004, pp. 675–691.

This paper proposes a game-theoretic model of bilateral conflict that explicitly accounts for the presence of stakeholders, and explores the scope and effects of positive[1] economic intervention by the stakeholder.

We consider conflicts, which in the absence of intervention, are resolved only after a substantial delay: the contenders are engaged in a war of attrition, a strategic situation in which players confront each other, both trying to obtain the concession of the opponent. In these circumstances, an impatient stakeholder may be ready to offer wealth transfers to promote agreement. The contenders, being impatient themselves, may react to the expectation of compensations and reach a quicker agreement. If transfers accelerate agreement they necessarily benefit the contenders (and increase efficiency when the welfare of contenders and stakeholder is equally valuable). Do transfers benefit the stakeholder as well? Answering this question is the main concern of the present work.

We first explore the possibilities offered by a passive mode of intervention: the stakeholder *promises* a transfer to the contenders once they agree. Transfers might be targeted only to the conceding party or, alternatively, they may benefit both contenders equally. We show that transfers restricted to the conceding contender are advisable only if the gains of the stakeholder from agreement, *the stakes*, are high enough. If they are, (binding) promises can be very effective: they often result in the immediate resolution of the conflict. Compensations targeted to conceders are not entirely uncommon. Examples range from enticing offers of asylum to fleeing dictators to offers of financial support to demobilized combatants (as recently provided by the World Bank in Uganda and Mozambique). However, they often are difficult to implement (even if the credibility of the stakeholder is not an issue), because they may be politically unacceptable or because, upon agreement, it is hard (or politically unwise) to discern who has conceded. Furthermore, post-conflict aid often materializes as subsidized public goods. Consequently, we inquire about the effects of balanced transfers—those benefiting both contenders equally. Even when the stakes are high enough to call for intervention (the threshold for intervention is now higher), promises of balanced transfers are not nearly as effective as promises addressed exclusively to the conceder, and it is unlikely that they prompt immediate resolution of the conflict.

Knowing the potential and limitations of policies based on unilateral transfer promises, we go on exploring a model of *diplomacy*, in which the stakeholder plays an active role in promoting agreement between the contenders. We characterize equilibrium outcomes finding that unless the stakeholder is exceedingly impatient, and provided that the contenders are reasonably patient themselves, she can always attain higher payoffs with diplomacy than with nonintervention or unilateralism. We thus conclude that to stakeholders facing a war of attrition, diplomacy is always advisable.

[1]Negative economic intervention, i.e., sanctions, are beyond the scope of the present analysis.

Perhaps most of the examples that fit our model are in the realm of international relations. In the eloquent words of Kant, because "the spirit of commerce cannot coexist with war . . . states find themselves impelled (though hardly by moral compulsion) to promote the noble peace and to try to avert war by mediation whenever it threatens to break out anywhere in the world."[2] Self-interested or genuinely generous, the efforts of neutral third parties to promote the end of armed confrontations, surely are motivated by the assessment that more is at stake than the direct welfare of the contenders; and post-conflict aid is an important means of intervention. Lancaster (2000)[3] claims that "a *promise* of half billion dollars of U.S. aid was a key element in efforts by the Clinton administration to negotiate an end to the Bosnian war." In other recent peace-making efforts in El Salvador, Mozambique, Cambodia, the West Bank/Gaza and South Africa, debt relief, aid for reconstruction and development, mediation with the World Bank or the IMF, have all been in the agenda and "the donor community has pledged more than $25 billion to assist emergence from conflict."[4] Collective bargaining in firms or institutions supplying public goods offers multitude of examples as well. To take only one, think of a labor dispute between a School Board and its employees. As superior instances of government representing affected citizens are interested in a quick resolution of the conflict, beliefs that the government might reevaluate the Board budget as a result of the strike definitely affect the negotiation.

The recent game-theoretic literature exploring the role of third parties in the resolution of bilateral conflicts focuses on the (differentiated) effects of arbitration and mediation on bargaining games. Compte and Jehiel (1995) and Manzini and Mariotti (2001) emphasize the role of arbitrators as the outside option of a bilateral bargaining game. Jarque, Ponsatí, and Sákovics (2003) and Čopič and Ponsatí (2003) consider a model where the mediator is an information filter in a context of bilateral bargaining under two-sided asymmetric information. In all these models, third parties are only part of the environment in which bargaining takes place, they do not receive payoffs nor do they take any strategic decision. As we have argued, bilateral agreements/disagreements may yield payoffs to third parties, that is, they generate externalities. The crucial effect of externalities over third parties has been pointed out by Jehiel and Moldovanu (1995a, 1995b) and Jehiel, Moldovanu, and Stacchetti (1996) in the context of bargaining games and auctions where the third parties are competing buyers or sellers. In the present paper, related ideas are explored in a framework of conflict resolution.

The rest of the paper is organized as follows. In Section 2 we describe the bilateral conflict and characterize the outcomes when the stakeholder

---

[2]Kant (1795).

[3]A high-ranking officer under Secretary of State M. Albright.

[4]Forman and Patrick (2000), p. 10.

abstains from intervention. Section 3 explores the effects of passive policies promising a transfer after agreement, and the optimal transfers are characterized. A model of diplomacy, a multilateral negotiation with the active participation of the stakeholder, is proposed and analyzed in Section 4. Section 5 concludes.

2. Nonintervention

There are three agents, the *contenders* $i = 1, 2$ and the *stakeholder, s*. For expositional clarity the first two are male and the latter is female. The contenders disagree on how to share one unit of surplus and the stakeholder has a stake $S > 0$ in the resolution of the conflict. That is, a total surplus of $1 + S$ is available and an agreement between 1 and 2 on how to share their unit of bilateral surplus is necessary to realize it.

Three important assumptions are implicit in the previous paragraph. First, *the stakeholder is neutral*, her payoff S, is independent of how the conflict between the contenders is resolved. Second, *the stakeholder and a potential intermediary are identified*. And third, the *stakes take the form of transferable resources*. These assumptions are useful to render our model tractable, yet they all can be relaxed leaving unaltered the qualitative nature of our results.

The bilateral conflict is polarized between two agreements only, one favored by each party. That is, for a given value a, $0 < a < \frac{1}{2}$, one of the contenders, say i, must obtain share a while j gets $(1 - a)$. For obvious reasons, when a decreases we say that the *level of confrontation* in the bilateral conflict increases.

In the absence of s's involvement, the strategic interaction between the contenders takes the form of a *war of attrition*: at each date $t = 0, 1, 2, \ldots$, one contender is selected, each with probability $\frac{1}{2}$, and he must take one of two possible actions, *concede* or *pass*. If the action is pass, one period is lost and the process is repeated in the following period. At the first concession the game ends. A conflict that ends at t with i's concession yields payoffs $a\delta^t$ to i and $(1 - a)\delta^t$ to j, while s obtains $S\gamma^t$, with $0 < \delta, \gamma < 1$. Strategies, and (subgame-perfect) equilibria are defined in the usual way.

It is well known[5] that a war of attrition admits two types of equilibrium outcomes: nondegenerate profiles in which both contenders use both actions[6] with positive probability, and degenerate profiles in which one of the players gives in immediately. A degenerate profile in which one player always

[5]Wars of attrition, also known with the name of chicken games, were first discussed by Maynard Smith (1974). Hendricks, Weiss, and Wilson (1988) and Ponsatí and Sákovics (1995) present characterizations of equilibria under complete and incomplete information, respectively. For a textbook discussion see, for example, Fudenberg and Tirole (1993).

[6]Here, and in what follows we say that a player takes the action *pass* (*concede) at t*, meaning *passes* (*concedes) if selected to move at t.*

concedes and the opponent always passes can be equilibria because when a player never concedes his opponent must concede as soon as possible; confirming that never conceding can be a best response. When such a degenerate equilibrium prevails, bilateral confrontations do not occur, the conflict is not felt by the stakeholder and her intervention is surely unnecessary.

We are interested in exploring the costs and benefits of intervention in conflicts that, in the absence of third party intervention, do take time to resolve. Therefore, our attention is naturally focused on situations where the equilibrium prediction is nondegenerate: A bilateral conflict equilibrium (BCE) is a subgame-perfect equilibrium profile of strategies in which, either one player uses a dominant action or both agents use both with positive probability.

There are two additional reasons to focus on nondegenerate equilibria. One is symmetry; if we expect similar agents to behave similarly, equilibria in which one player yields because his counterpart always passes do not seem reasonable. The second is robustness: degenerate equilibria disappear under a slight uncertainty about the agents' capability to concede. Games where there is a small but positive probability ϵ that players are *obstinate types* (play as automata programmed to pass for sure at all t) yield (Bayesian) equilibrium outcomes where both players pass; in the limit as $\epsilon \to 0$ these equilibria never approach a degenerate equilibrium.

In what follows, in order to assure that we are modeling a genuine bilateral conflict we assume that

$$a < \frac{\delta}{2}. \tag{1}$$

This condition implies that there is no dominant action in the bilateral conflict. Note that if $a \geq \frac{\delta}{2}$, then pass would be a dominated action: when the opponent concedes for sure, delaying concession one period pays $\frac{\delta}{2}(1-a) + \frac{\delta}{2}a = \frac{\delta}{2}$, since each player is selected to move with probability $\frac{1}{2}$.

Consequently, in a BCE both agents must use strictly mixed strategies: they concede with probability less than 1, leaving the opponent indifferent between concession and delay at all times.

Since the present environment is stationary and symmetric the probability of concession at a BCE must be a constant over time and equal for both contenders: At each t each player is selected to take action with probability $\frac{1}{2}$, hence the *ex ante* (before the mover is selected) expected payoff of both players, denoted v, and the probability of concession, denoted π, must solve

$$v = \frac{1}{2}(\pi(1-a) + (1-\pi)\delta v) + \frac{1}{2}\delta v. \tag{2}$$

The indifference condition $a = \delta v$ implies that $v = \pi \frac{1-a}{2(1-\delta)+\delta\pi}$ and substitution (uniquely) yields

$$\pi = \frac{(1-\delta)2a}{\delta(1-2a)}. \tag{3}$$

Our first result is now immediate.

PROPOSITION 1: *There is a unique BCE, along this equilibrium at each t, contenders concede with probability π that satisfies equation (3) and the stakeholder obtains an expected payoff*

$$V^{ni} \equiv S\frac{\pi}{1-\gamma+\gamma\pi}. \tag{4}$$

Consequently, V^{ni} is the benchmark to evaluate the stakeholder's benefits from intervention. This payoff is a (strict) fraction of S that decreases in the level of confrontation (increases in a) and in the patience of the contenders, and increases in her own patience. That is, the following holds:

COROLLARY 1: *In the BCE the payoffs to the (non-participating) stakeholder satisfy*

$$\frac{\partial V^{ni}}{\partial \pi}\frac{\partial \pi}{\partial a} > 0, \qquad \frac{\partial V^{ni}}{\partial \pi}\frac{\partial \pi}{\partial \delta} < 0, \qquad \frac{\partial V^{ni}}{\partial \gamma} > 0,$$

$$\lim_{\delta\to 1} V^{ni} = 0, \qquad \lim_{\gamma\to 1} V^{ni} \to S, \qquad \text{and} \lim_{2a\to\delta} V^{ni} \to S.$$

Transfers from the stakeholder to the contenders may be an effective way to accelerate agreement: a contender's anticipation of a transfer in addition to the agreed share will entice him toward a quicker resolution of the disagreement. In the following section we explore whether this is also in the interest of stakeholders.

3. Unilateral Promises

Consider situations in which the stakeholder does not actively participate in the negotiation process, but she can unilaterally commit[7] to transfer a positive amount d to the contenders after their differences are resolved. We consider two possibilities. An *unbalanced promise* of value d, is a commitment to transfer d to the conceding contender. A *balanced promise* of value d, is a commitment to transfer $\frac{d}{2}$ to each contender upon agreement. Under an unbalanced promise the payoffs from concession at t are $(a+d)\delta^t$ while the opponent gets $(1-a)\delta$. Payoffs under a balanced promise are, respectively, $(a+\frac{d}{2})\delta^t$ and $(1-a+\frac{d}{2})\delta^t$. The stakeholder obtains $(S-d)\gamma^t$ either way.

[7]This is a strong assumption in the absence of binding contracts or alternative enforcement mechanisms. Although one is inclined to believe the aid pledged by legitimate democratic states should be credible, Forman and Patrick (2000) survery aid pledged in recent peace agreements and show a disturbing pattern of noncompliance.

A sufficiently large d surely triggers the immediate resolution of the conflict: When $d \geq \frac{\delta - 2a}{2 - \delta}$, then $a + d \geq \delta(\frac{1-a}{2} + \frac{a+d}{2})$, that is, under such an unbalanced promise pass is a dominated move even if the opponent is expected to concede with probability 1 when he is selected to move. On the other hand, $d \geq \frac{\delta - 2a}{1 - \delta}$ is equivalent to $a + \frac{d}{2} \geq \frac{\delta}{2}((1 - a) + \frac{d}{2} + a + \frac{d}{2})$, similarly implying that under such a balanced promise contenders concede at their first opportunity.

When d remains below these thresholds, the bilateral conflict is still a war of attrition, and the analog of Proposition 1 prevails for the modified payoffs. The probability of concession in the BCE of the war of attrition with modified payoffs under a promise of value d, denoted, respectively, $\pi^{up}(d)$ and $\pi^{bp}(d)$ are readily computed as

$$\pi^{up}(d) = 2\frac{(a+d)(1-\delta)}{\delta(1-2a-d)}, \quad \pi^{bp}(d) = \frac{(2a+d)(1-\delta)}{\delta(1-2a)}. \tag{5}$$

Hence, the stakeholder's expected payoffs from a promise d are, respectively,

$$V^{up}(d) \equiv \begin{cases} (S-d)f(d), & d < \dfrac{2a-\delta}{2-\delta}, \\ S-d, & d \geq \dfrac{2a-\delta}{2-\delta}, \end{cases}$$
$$V^{bp}(d) \equiv \begin{cases} (S-d)g(d), & d < \dfrac{2a-\delta}{1-\delta}, \\ S-d, & d \geq \dfrac{2a-\delta}{1-\delta}, \end{cases} \tag{6}$$

where $f(d) \equiv \frac{\pi^{up}(d)}{1-\gamma+\gamma\pi^{up}(d)}$ and $g(d) \equiv \frac{\pi^{bp}(d)}{1-\gamma+\gamma\pi^{bp}(d)}$.

Characterizing the optimal transfer in each regime is now a straightforward optimization problem (details are in the Appendix). The following notation simplifies the exposition. Let $\underline{S} \equiv \frac{a}{\delta}\frac{2a(\gamma-\delta)+\delta(1-\gamma)}{(1-a)(1-\gamma)}$, $\underline{\underline{S}} \equiv \frac{2(1-a)}{1-2a}$, note that $\underline{\underline{S}} > \underline{S} > 0$, and let d^f and d^g solve, respectively, $S - d = \frac{f(d)}{f'(d)}$, and $S - d = \frac{g(d)}{g'(d)}$.

PROPOSITION 2: *The optimal unilateral transfers are*

$$d^{up} = \begin{cases} 0 & S \leq \underline{S} \\ d^f, & \underline{S} \leq S \leq \dfrac{\delta-2a}{2-\delta}, \\ \dfrac{\delta-2a}{2-\delta}, & S > \dfrac{\delta-2a}{2-\delta}; \end{cases}$$
$$d^{bp} = \begin{cases} 0 & S \leq \underline{\underline{S}} \\ d^g, & \underline{\underline{S}} \leq S \leq \dfrac{\delta-2a}{1-\delta}, \\ \dfrac{\delta-2a}{1-\delta}, & S > \dfrac{\delta-2a}{1-\delta}. \end{cases} \tag{7}$$

Promising an optimal transfer prompts the immediate resolution of the conflict if and only if $S > \frac{\delta-2a}{2-\delta}$ *under unbalanced promises, and* $S > \frac{\delta-2a}{1-\delta}(> \frac{\delta-2a}{2-\delta})$ *under balanced promises.*

The notable differences between balanced and unbalanced promises are easily visualized by looking at the optimal transfers as contenders approach infinite patience.

Remark 1: As $\delta \to 1$, $\underline{S} \to a\frac{1-2a}{1-a}$ and $\underline{\underline{S}} \to 2a$. If a positive transfer is advisable, the optimal promises approach

$$
\begin{aligned}
d^{up} &= \begin{cases} (1-2a) - \sqrt{(1-2a-S)(1-a)}, & S \leq 1-2a, \\ 1-2a, & \text{otherwise,} \end{cases} \\
d^{bp} &= \frac{S}{2} - a.
\end{aligned}
\tag{8}
$$

If S is greater than the threshold for intervention ($S > a\frac{1-2a}{1-a}$), the immediate resolution of the conflict is guaranteed under unbalanced promises while it is impossible if promises must be balanced.

We thus conclude that a promise to transfer wealth upon agreement, is advisable only if the stakes are high enough. Moreover, a promise to compensate the conceding contender is always more effective than promises to split compensations. As agents approach infinite patience, only the first policies are effective.

In the absence of mechanisms for commitment promises have no effect. And the assumption that promises are binding is strong. Moreover, even when the stakeholder's credibility is not an issue, some promises may simply be unfeasible. Perhaps the stakeholder acts on behalf of a constituency that disapproves "donations" without a previous diplomatic effort to persuade the contenders to end their differences. Or, maybe it is required that she treats both contenders equally, ruling out unbalanced promises. Interventions where the stakeholder actively participates in multilateral negotiations are considered next.

4. Diplomacy

Let us now assume that the stakeholder actively tries to persuade the contenders to end their differences. To be effective her *diplomatic* effort must still contemplate transfers. Rather than committed *ex ante*, however, transfers will be discussed while bargaining over a settlement for the (bilateral) conflict.

We will assume that the potential transfer from the stakeholder is exogenously set at a fixed level b, $0 < b < S$, and that contenders must split it equally. The stakeholder's decisions are then limited to whether or not to contribute b.[8] Even under this simplification the game protocol, detailing the timing of moves and what terminates an agent's participation, is important.

---

[8]See Manzini and Ponsati (2004) for an analysis in which b is bargained over.

Think first of protocols in which a contender's concessions on the bilateral agreement are final while the stakeholders's concession is continued with the war of attrition with payoffs $a + \frac{b}{2}$, $1 - a + \frac{b}{2}$, and therefore the stakeholder's concession yields the outcome of a unilateral balanced promise. Of course, when that unilateral policy is not advisable, playing under this protocol cannot benefit her either. To explore a model in which diplomacy is a policy substantially different from unilateral promises, we must consider protocols where a contender's concession on the bilateral conflict does not imply that he gives up claims on b. There are many possible specifications: For example contenders may concede on the bilateral conflict or on their claim to $\frac{b}{2}$, or both, and a great variety of continuation subgames follow—each with specific continuation protocols.

To keep matters tractable we assume that negotiations take place as follows. At each period one player is (randomly) selected to move and chooses one of two possible actions, *concede* (accept to take the smaller share, accept to contribute b), or *pass* (insist on the larger share, insist that the contenders reach agreement without a contribution). If the mover decides to pass, one period of delay elapses and a new mover is selected in the following period. Initially, all players $\{1, 2, s\}$ are active and each is selected to move with probability $\frac{1}{3}$ as long as all three remain active. If a player concedes first at t', she/he ceases to be active, and only the remaining players are active in the continuation subgame. From then on, at each t the two active players are selected to move with probability $\frac{1}{2}$ each. The game ends when a second concession occurs at $t \geq t'$. Payoffs from outcome (x, d, t), where $x \in \{a, 1 - a\}$ and $d \in \{0, b\}$, are $(x + \frac{b}{2})\delta^t$, $(1 - x + \frac{b}{2})\delta^t$, and $(S - b)\gamma^t$, respectively, for 1, 2, and s. Perpetual disagreement pays zero to all players.

In the present multilateral negotiation the first contender to concede, say i, gives up his claims both to the large portion of the surplus *and* to s's transfer. This, however, does not immediately imply an agreement between the contenders: now since s is involved, agreement between 1 and 2 requires agrement between j and s, either by s concession to donate b (which i enjoys in spite of his concession) or because j gives up his claim to a transfer.

Strategies and (subgame-perfect) equilibria are defined in the usual way. The complete set of equilibria is vast and its characterization is extremely cumbersome as profiles combining complex (nonstationary) patterns of degenerate behavior can be mutually self-enforcing. We concentrate attention to nondegenerate equilibrium profiles: A *diplomacy equilibrium* (DE) is a subgame-perfect equilibrium in which either one player uses a dominant action or all players use both actions with positive probability.

The arguments to support our equilibrium notion are again threefold. First, since we want to focus attention on outcomes in which the stakeholder's transfer is not offered unilaterally, we must rule out (potential) equilibria in which she unilaterally concedes and the contenders play best response with strategies in which they surely pass. On the other hand, if we expect that contenders will behave similarly we cannot expect equilibria in which one concedes for sure in the bilateral conflict while his opponent remains firm. Finally, the arguments of robustness discussed in Section 2—that are valid here too—are perhaps even more relevant because the ability of the stakeholders to concede is more frequently subject to uncertainty.

Subgames that follow each first concession are two-player wars of attrition between the remaining pair of active players, $(1, 2)$ or (i, s). By an immediate extension of Proposition 1 to nonsymmetric settings, these (possibly asymmetric) wars of attrition admit two types of equilibria: degenerate outcomes where a given player always concedes, and the other always passes and profiles where players randomize. In a DE play at two-player subgames is fully characterized by the probabilities that agents concede. They are given in the following lemma. The proof is tedious but straightforward and it is relegated to the Appendix.

LEMMA 1: *In a DE play at two-player subgames is as follows:*

(i) When one contender faces the stakeholder both agents randomize, conceding with probabilities q and q_s,

$$q = 2\frac{(S-b)(1-\gamma)}{\gamma b}, \quad q_s = \frac{4(1-\delta)(1-a)}{\delta b}, \tag{9}$$

provided that b is large $(b \geq 2S\frac{1-\gamma}{2-\gamma})$; otherwise, if b is small $(b < 2S\frac{1-\gamma}{2-\gamma})$ the stakeholder surely concedes while the contender passes, that is, $q_s = 1$ and $q = 0$.

(ii) When contenders face each other after the stakeholder concedes b both randomize, conceding with probability

$$p = \frac{(1-\delta)(\delta+2)(b+2a)}{\delta(b(1-\delta)+2(1-a(1+\delta)))} \tag{10}$$

provided that b is small $(b < \frac{\delta-2a}{1-\delta})$; otherwise, for large b, $(b \geq \frac{\delta-2a}{1-\delta})$ both concede immediately.

Remark 2: Under a small $b < 2S\frac{1-\gamma}{2-\gamma}$ the stakeholder's payoff from concession in two-player subgames is high enough that pass is a dominated action for her. Similarly, pass is a dominated action for both contenders after the stakeholder commits to a large $b \geq \frac{\delta-2a}{1-\delta}$. In these two cases, the two-player subgames after the first concession, formally a war of attrition, lack genuine conflict.

Lemma 1 uniquely determines the DE continuation payoffs after each first concession. Denote by u^a the gains of concession of agent a, and let w^s and w^i_o, $o = j, s$, denote the gains of agents when an opponent concedes. These continuation values are easily computed. Note that they must solve

$$
\begin{aligned}
u^i &\equiv \frac{q\left(a+\dfrac{b}{2}\right)+q_s a}{2} \sum_{i=0}^{\infty} \delta^i \left(1-\frac{q+q_s}{2}\right)^i, \\
u^s &\equiv (S-b)p \sum_{i=0}^{\infty} \gamma^i (1-p)^i, \\
w_s^i &\equiv \frac{1}{2}\left(a+\frac{b}{2}\right)+\frac{p}{2}\left(1-a+\frac{b}{2}\right)+\frac{1-p}{2}\delta w_s^i, \\
w_j^i &\equiv \frac{1-a}{2}+\frac{q}{2}\left(1-a+\frac{b}{2}\right)+\frac{1-q}{2}\delta w_j^i, \\
w^s &\equiv \frac{S-b}{2}+\frac{q_s S}{2}+\frac{(1-q_s)\gamma w^s}{2},
\end{aligned} \tag{11}
$$

which yield

$$
\begin{aligned}
u^i &= \frac{(q+q_s)a+q\dfrac{b}{2}}{2(1-\delta)+\delta(q+q_s)}, & u^s &= \frac{(S-b)p}{1-\gamma+\gamma p}, \\
w_s^i &= \frac{a+\dfrac{b}{2}+p\left(1+\dfrac{b}{2}\right)-pa}{2-\delta(1-p)}, & w_j^i &= \frac{1-a+q\left(1+\dfrac{b}{2}\right)-qa}{2-\delta(1-q)}, \\
w^s &= \frac{S-b+q_s S}{2-(1-q_s)\gamma}.
\end{aligned} \tag{12}
$$

Since each first concession yields a unique continuation payoff, DE behavior at three-player subgames must be *stationary*, that is, agents' choices of actions are time-independent. Hence, at a DE the probability by which each action is selected remains constant (and symmetric for the contenders) at all subgames with the same set of active players. Consequently, DE profiles at subgames with three active players are characterized by a pair (α, β), $0 \leq \alpha$, $\beta \leq 1$, where α and β denote, respectively, for $i = 1, 2$ and s, the probabilities of concession at three-player subgames.

The following proposition, proved in the Appendix, fully characterizes DE.

PROPOSITION 3: *For large δ the unique DE is such that in subgames with three active players all pass with positive probability: both contenders concede with probability* $\alpha = \frac{u^s}{w^s}\frac{3-\delta}{2\delta}$, $0 < \alpha < 1$, *and the stakeholder concedes with probability* $\beta = \frac{2u^i w^s - u^s w_s^i}{w^s w_s^i}\frac{3-\delta}{2\delta}$, $0 < \beta < 1$.

We are now ready to compare DE outcomes with outcomes under nonintervention. Our main result is that when contenders are patient enough, there is an interval of values for b such that stakeholder's payoff under diplomacy dominates V^{ni}.

PROPOSITION 4: *Let $\gamma > \frac{1}{3}$. For each a and S, there is a $\hat{\delta} < 1$ such that for all $\delta > \hat{\delta}$ the stakeholder payoff at the DE dominates her payoff under nonintervention for all $b \in (0, S\frac{3\gamma-1}{2})$.*

Proof: It suffices to check that $V^{DE}(b) > V^{ni}$.

Note that $V^{DE}(b) = \frac{2\alpha}{(1-\gamma)3+\gamma 2\alpha} w_s$ and recall that $V^{ni} = S\frac{\pi}{1-\gamma+\gamma\pi}$ and $u^s = \frac{(S-b)p}{1-\gamma+\gamma p}$. Substituting $\alpha = \frac{u^s}{w_s}\frac{3-\delta}{2\delta}$ in the denominator of $V^{DE}(b)$ the required inequality is

$$\frac{\frac{3-\delta}{\delta}\frac{p}{1-\gamma+\gamma p}}{3(1-\gamma)+2\gamma\alpha} > \frac{S}{S-b}\frac{\pi}{1-\gamma+\gamma\pi}. \tag{13}$$

Since $p > \pi$ for all $b > 0$ and $\frac{x}{1-\gamma+\gamma x}$ is increasing for all $0 \leq x \leq 1$, it is sufficient that

$$\frac{\frac{3-\delta}{\delta}}{3(1-\gamma)+2\gamma\alpha} > \frac{S}{S-b}. \tag{14}$$

As $\delta \to 1$, $\frac{\frac{3-\delta}{\delta}}{3(1-\gamma)+2\gamma\alpha} \to \frac{2}{3(1-\gamma)}$, and consequently the strict inequality holds in the limit provided that $b < S\frac{3\gamma-1}{2}$. The result follows by continuity. ∎

Remark 3: Note that as the stakeholder becomes patient diplomacy pays even if a large portion of the stake is to be transferred.

Remark 4: Recall that for $S < 2a$ and δ close to 1 the stakeholder is better off under nonintervention than under a unilateral balanced promise. Hence, if transfers must be split equally between both contenders and diplomacy dominates nonintervention, then diplomacy is also better than at any outcome attainable via unilateral promises.

5. Conclusions

We proposed a simple model to explore the effects of positive economic intervention by stakeholders in the resolution of bilateral conflicts. We have proved that while unilateral promises offering transfers after the contenders agree may sometimes help, they are not always advisable. On the other hand, active participation in a multilateral negotiation may easily yield outcomes that benefit the stakeholder.

Our results fundamentally rely on the very crude nature of the bilateral conflict that we have postulated, a war of attrition, and on the constraints imposed by the game protocol. Manzini and Ponsatí (2004) explore the role of stakeholders in bargaining games where a bilateral agreement can be any division of the surplus. There the willingness of stakeholders to make contributions to promote agreement may backfire: instead of accelerating agreement the stakeholder's intervention might be the source of additional inefficiency.

Relaxing the assumption that stakeholders gain only from agreement, allowing stakeholders that suffer negative externalities upon agreement (think, for example, of weapon suppliers) is an extension for future research.

Appendix

Proof of Proposition 3:

Step 1: Optimal transfers under unbalanced promises.

If the transfer is $d \geq \frac{\delta - 2a}{2-\delta}$, the bilateral conflict results in immediate concession after s commits to a transfer. Hence, the optimal d must be $d \leq \frac{\delta - 2a}{2-\delta}$.

Observe that for $0 \leq d < \min\{\frac{\delta - 2a}{2-\delta}, S\}$, the expected gains to s will be $V(d) \equiv (S-d)\, f(d)$. A positive transfer is optimal only if this is strictly increasing at $d = 0$, that is, if and only if

$$S > \underset{\sim}{S} = \frac{f(0)}{f'(0)} = \frac{a}{\delta} \frac{2a(\gamma - \delta) + \delta(1-\gamma)}{(1-a)(1-\gamma)} > 0. \tag{A1}$$

Observe that $f'(d) = \frac{2\delta(1-\delta)(1-\gamma)(1-a)}{(-2\gamma a - 2\gamma d - \delta + \delta\gamma + 2a\delta + \delta d + \delta\gamma d)^2} > 0$. An optimal transfer $0 < d < \min\{\frac{\delta - 2a}{2-\delta}, S\}$ must solve the first-order condition

$$\begin{aligned} S - d &= \frac{f(d)}{f'(d)} \\ &= \frac{(a+d)}{\delta} \frac{2a(\gamma - \delta) + \delta(1-\gamma) + d((2-\delta)\gamma - \delta)}{(1-a)(1-\gamma)}. \end{aligned} \tag{A2}$$

If $\underset{\sim}{S} < S \leq \frac{\delta - 2a}{2-\delta}$, then $(S-d)\ f(d)$ must have a maximum at some $0 < d < S < \frac{\delta - 2a}{2-\delta}$, and after s optimally commits to $d^{up} < \frac{\delta - 2a}{2-\delta}$ the conflict is never resolved immediately. If $S > \frac{\delta - 2a}{2-\delta}$, the expected payoff from a transfer d is $(S-d)\, f(d)$, which is strictly increasing at all $d < \frac{\delta - 2a}{2-\delta}$ and $S - d$ for $d \geq \frac{\delta - 2a}{2-\delta}$, hence the optimal transfer is $\frac{\delta - 2a}{2-\delta}$.

Step 2: Optimal transfer under balanced promises.

If the committed transfer is $d \geq \frac{\delta - 2a}{1-\delta}$, concession in the bilateral conflict will be immediate after s commits to a transfer. Hence, the optimal d must be $d \leq \frac{\delta - 2a}{1-\delta}$.

Observe that for $0 \leq d < \min\{\frac{\delta - 2a}{1-\delta}, S\}$ the expected gains to s will be $V(b) \equiv (S-d)\frac{p^{bpi}(d)}{1-\gamma+\gamma p^{bpi}(d)} = (S-d)\, g(b)$, which is strictly increasing at $d = 0$ provided that

$$S > \underset{=}{S} = \frac{g(0)}{g'(0)} = \frac{2a}{\delta}\frac{2a(\gamma-\delta)+\delta(1-\gamma)}{(1-\gamma)(1-2a)}, \tag{A3}$$

observe that $g'(d) = \frac{\delta(1-2a)(1-\delta)(1-\gamma)}{(2a\delta-\delta+\delta\gamma-2\gamma a+\delta\gamma d-\gamma d)^2} > 0$ and note that

$$\underset{=}{S} = \frac{g(0)}{g'(0)} = \frac{2(1-a)}{1-2a}\underset{-}{S} > \underset{-}{S}. \tag{A4}$$

An optimal transfer $0 < d < \min\{\frac{\delta-2a}{1-\delta}, S\}$ must solve the first-order condition

$$S - d = \frac{g(d)}{g'(d)}. \tag{A5}$$

An argument analogous to that ending the first step completes the proof. ■

Proof of Lemma 1:

Since players randomize, concession must leave opponents indifferent between concede and pass; their unique values are immediate from the indifference conditions.

(1) When a contender faces the stakeholder he must concede with probability q solving

$$S - b = \gamma\left(\frac{q}{2}S + \frac{1-q}{2}(S-b) + \frac{1}{2}(S-b)\right); \tag{A6}$$

that is, at any t after j conceded, s must be indifferent between concede and pass, given that, at $t+1$, i will be selected to take action with probability $\frac{1}{2}$ and will concede with probability q. This yields

$$q = 2\frac{(S-b)(1-\gamma)}{\gamma b}. \tag{A7}$$

For the stakeholder that faces a contender the probability of concession, q_s, must solve

$$1 - a = \delta\left(\frac{q_s}{2}\left(\frac{b}{2} + (1-a)\right) + \frac{1-q_s}{2}(1-a) + \frac{1}{2}(1-a)\right); \tag{A8}$$

that is, at t after the j has conceded, i must be indifferent between concede and pass, given that, at $t+1$, s will be selected to take action with probability $\frac{1}{2}$ and will concede with probability q_s. This yields $q_s = \frac{4(1-\delta)(1-a)}{\delta b}$.

Note that $2\frac{(S-b)(1-\gamma)}{\gamma b} \leq 1$ if and only if $b \geq 2S\frac{1-\gamma}{2-\gamma}$: when $b < 2S\frac{1-\gamma}{2-\gamma}$, for any probability of concession by the contenders η the payoff concession is greater than the continuation payoff upon delay

$$S - b > \gamma\left(\frac{\eta}{2}S + \frac{1-\eta}{2}(S-b) + \frac{1}{2}(S-b)\right), \qquad \text{(A9)}$$

that is, pass is a dominated action. Therefore, s must surely concede. The best response of the contender is to pass for sure.

(2) When two contenders face each other, if they randomize in a DE they concede with a probability p that must solve

$$a + \frac{b}{2} = \delta\Bigg(\frac{p}{2}\left(\frac{b}{2} + (1-a)\right) + \frac{1-p}{2}\left(a + \frac{b}{2}\right) + \frac{1}{2}\left(a + \frac{b}{2}\right)\Bigg); \qquad \text{(A10)}$$

that is, at t after s's concession, a contender is indifferent between concede and pass, given that the other contender is selected with probability $\frac{1}{2}$ at $t+1$ and in this case concedes with probability p. This yields

$$p = \frac{(2a+b)(1-\delta)}{\delta(1-2a)}, \qquad \text{(A11)}$$

which is smaller than 1 only if $b < \frac{\delta - 2a}{1-\delta}$. For $b \geq \frac{\delta - 2a}{1-\delta}$ pass is a dominated action for both contenders and therefore they both surely concede at their first opportunity. ■

Proof of Proposition 4:

Proof: We first show that for δ large pass cannot be a dominated move. Observe that pass is a dominated move for the contenders provided that

$$\frac{u^i}{w_s^i + w_j^i} \geq \frac{\delta}{3-\delta}. \qquad \text{(A12)}$$

Similarly, pass is a dominated move for the stakeholder only if

$$\frac{u^s}{2w_i^s} \geq \frac{\gamma}{3-\gamma}. \qquad \text{(A13)}$$

Substituting the continuation values (that depend on the probabilities given in Lemma 1) it is easily checked that for large δ neither of these conditions can hold. In the limit as $\delta \to 1$ condition (A12) becomes $\frac{a}{1+\frac{1}{2}b} \geq \frac{1}{2}$ while (A13) demands that $0 \geq \frac{\gamma}{3-\gamma}$, hence both conditions fail strictly for $\delta < 1$ large enough.

Consequently, at a DE all players pass with positive probability, implying that the probability of their opponents' concession must keep them all indifferent. That is, α and β solve

$$u^s = \delta\left(\left(\frac{2\alpha w^s}{3} + \frac{u^s}{3}\right)\right), \tag{A14}$$

and

$$u^i = \delta\left(\frac{\beta\left(w_c^i\right)}{3} + \frac{\alpha\left(w_s^i\right)}{3} + \frac{u^i}{3}\right). \tag{A15}$$

That yields

$$\alpha = \frac{u^s}{w^s}\frac{3-\delta}{2\delta}, \tag{A16}$$

and

$$\beta = \frac{2u^i w^s - u^s w_s^i}{w^s w_s^i}\frac{3-\delta}{2\delta}. \tag{A17}$$

It is straightforward to check that α and β lie in $(0, 1)$. ■

References

COMPTE, O., and P. JEHIEL (1995) On the role of arbitration in negotiations, mimeo.

ČOPIČ, J., and C. PONSATÍ (2002) Implementation by decent mechanisms, mimeo. available at http://www.iae.Csic.es/ponsati.

FORMAN, S., and S. PATRICK (2000) *Good Intentions: Pledges of Aid for Postconflict Recovery*. Boulder, CO: Lynne Reinner Publishers.

FUDENBERG, D., and J. TIROLE (1993) *Game Theory*. Cambridge, MA: MIT Press.

HENDRICKS, K., A. WEISS, and C. WILSON (1988) The war of attrition in continuous time with complete information, *International Economic Review* **29**, 663–680.

JARQUE, X., C. PONSATÍ, and J. SÁKOVICS (2003) Mediation: Incomplete information bargaining with filtered communication, mimeo, *Journal of Mathematical Economics* **39**, 803–830.

JEHIEL, P., and B. MOLDOVANU (1995a) Cyclical delay in bargainig with externalities, *Review of Economic Studies* **62**, 619–637.

JEHIEL, P., and B. MOLDOVANU (1995b) Negative externalities may cause delay in negotiation, *Econometrica* **63**, 1321–1335.

JEHIEL, P., B. MOLDOVANU, and E. STACCHETTI (1996) How (not) to sell nuclear weapons, *American Economic Review* **86**, 814–829.

KANT, I. (1795) *Essay on Perpetual Peace*, in *Kant's Political Writings*, H. Reiss, ed. Cambridge, U.K.: Cambridge Universty Press.

LANCASTER, C. (2000) Redesigning foreign aid, *Foreign Affairs* **79**, 74–90.

MANZINI, P., and M. MARIOTTI (2001) Perfect equilibria in a model of bargaining with arbitration, *Games and Economic Behavior* **37**, 170–195.

MANZINI, P., and C. PONSATI (2002) Stakeholder bargaining games, mimeo. available at http://www.iae.Csic.es/ponsati.

MAYNARD SMITH, J. (1974) The theory of games and evolution in animal conflicts, *Journal of Theoretical Biology* **47**, 209–221.

PONSATÍ, C., and J. SÁKOVICS (1995) The war of attrition with incomplete information, *Mathematical Social Sciences* **29**, 239–254.