

# Dispute Resolution Institutions and Strategic Militarization\*

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## Abstract

Engagement in a costly and destructive war can be understood as the ‘punishment’ for entering a dispute. So, institutions that reduce the chance that a dispute leads to war will lower the costs of entering into a dispute. This may incentivize militarization and make more disputes emerge. We provide a simple model in which the support for unmediated peace talks, while effective in improving the chance of peace for a given distribution of military strength, ultimately leads to the emergence of more disputes and to higher incidence of conflict outbreak. Happily, we find that not all conflict resolution institutions suffer from these, apparently paradoxical, but actually quite intuitive drawbacks. We identify a form of third-party mediation inspired by the celebrated work by Myerson, and show that it can effectively broker peace in disputes once they emerge and also avoid perverse militarization incentives.

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# 1 Introduction

The assessment of which institutions effectively resolve disputes that might otherwise lead to military conflict is of fundamental importance and has been addressed in several investigations.<sup>1</sup> These studies take the emergence of a dispute as the starting point of the analysis, and ask questions of the sort: given a dispute, how will different institutions such as mediated or un-mediated peace talks likely influence the outcome? This paper broadens the scope of analysis. Instead of taking disputes as given, we ask: how are disputes likely to emerge, given the disputants' expectations about the conflict resolution institutions employed by the international community? Intuitively, a bloody, costly and wasteful conflict can be understood as the eventual 'punishment' for militarizing and entering a dispute in the first place. Hence, institutions that minimize the chances that crises lead to conflict may breed perverse militarization incentives, and lead to the emergence of more disputes. Addressing this effect is an important part of forming an assessment of the overall value of conflict-resolution institutions. These institutions should not only be effective in resolving the disputes that emerge, but also in minimizing the chance that disputes emerge.<sup>2</sup>

The payoff of our theoretical model is that it clarifies these nuanced considerations. We show that the inclusion of the connection between dispute resolution institutions and militarization incentives into the analysis may significantly challenge established views. Specifically, we find that un-mediated peace talks, while effective in reducing the chance that an emergent dispute turns into open warfare, may provide perverse incentives for

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<sup>1</sup>Much recent theoretical work analyzes the effectiveness of peace talks and third-party mediation as conflict resolution institutions (e.g., Bester and Wärneryd 2006, Fey and Ramsay 2010, Hörner, Morelli, and Squintani 2015, Kydd 2003). Others considers how various forms of direct diplomacy can influence the probability of conflict (e.g., Baliga and Sjöström 2004, Ramsay 2011, Sartori 2002, Smith 1998). Bercovich and Jackson (2001) and Wall and Lynn (1993) review the vast empirical literature on the effectiveness of mediation as a conflict resolution institution.

<sup>2</sup>The possibility that well-meaning third party intervention may lead to perverse incentives for the emergence of disputes is a concrete concern for academics and practitioners. For example, Kuperman (2008) presents evidence that expectations of humanitarian military intervention have emboldened weaker groups to trigger conflict against dominant entities (see also De Waal, 2012). Kydd and Straus (2010) provide a theoretical model of this issue. Unlike us, they do not consider mediation and do not endogenize militarization choices.

militarization and precipitate the emergence of disputes. Indeed, the expectation that disputes will be handled by un-mediated peace talks may lead to such an increase in the likelihood of a dispute that the resulting total probability of warfare is higher than it would be in a world in which un-mediated peace talks are not employed by the international community.

The reasoning behind this unexpected result is actually quite simple. Informative communication in un-mediated peace talks reduces the uncertainty that each disputant has regarding their opponent's strength. When the starting point of the analysis is a fixed dispute or crises that has already emerged, this reduction of uncertainty decreases the chance that the dispute evolves into open warfare (as was first formally proved by Baliga and Sjöström, 2004). We may summarize this perspective as follows: when the risk of war is driven by uncertainty that arises from militarization decisions that are hidden actions, un-mediated peace talks are thought to reduce the likelihood of war.<sup>3</sup>

However, our contribution is to go one step back and think about how expectations of dispute resolution influence militarization incentives. This reduction of uncertainty also makes each disputant more willing to acquiesce to the opponent's demands when the latter is highly militarized. Hence, when expecting that information will be exchanged in peace talks, the benefit for militarization increases, and the potential cost of militarization (which consists in the eruption of war) decreases. As a result, potential disputants have a greater incentive to militarize and enter disputes, so that more crises emerge. Although each crisis is less likely to lead to open warfare, the increased emergence of disputes may well lead to more wars; this is one of the key results to emerge from the analysis here. In other words, the effects of un-mediated peace talks on strategic militarization trump the improved odds

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<sup>3</sup>Militarization cannot lead to deterrence if it is a hidden action, as there cannot ever be an equilibrium in which disputants militarize and war does not take place, in any reasonable model of conflict: In anticipation that war will not take place, each disputant would deviate at the militarization stage and secretly choose to devote the resources earmarked to militarization to welfare enhancing means (see the discussion in Meiorowitz and Sartori, 2008, and Jackson and Morelli, 2009). Indeed, it is intuitive that observability of militarization is crucial for deterrence. In the words of Dr. Strangelove: "Of course, the whole point of a Domsday Machine is lost, if you \*keep it a secret\*!"

that players of particular strengths will negotiate a peaceful settlement.

Given this apparently paradoxical insight, it is natural to ask whether all conflict resolution institutions suffer from these same drawbacks. Happily, we find that this is not the case. Further analysis shows that the pathology found in un-mediated cheap talk is not linked to its tendency to resolve emergent disputes peacefully, but rather which disputes it tends to resolve peacefully. We study a larger class of institutions to obtain a more nuanced appreciation for the connections between dispute resolution and militarization incentives. In particular we focus on third-party intermediation by actors who do not have access to privileged information and who do not have any military or financial capability to enforce peaceful settlements or make transfers. Hence, the role of the third-parties we study is only to facilitate negotiations by managing the flow of information among the disputants. In practice, this is achieved mainly by setting the agenda and modes of communication of the peace talks. In the taxonomy of Fisher (1995), the third-party intervention we study is a form of ‘pure mediation’, whereas it is closer to ‘procedural mediation’ in the terminology by Bercovich (1997). A review of the literature finds compelling evidence that this form of mediation is often employed.<sup>4</sup> As the specific form of mediation we study is inspired by the celebrated work by Roger Myerson (1979, 1982), we will call it ‘Myerson mediation’, here.

We find that this type of third-party intervention improves the chances of peace-brokering in emerged disputes more effectively than un-mediated peace talks, and also avoids the perverse militarization incentives described above. Importantly, this is despite the fact that the third party’s mandate cannot realistically include the objective of stifling

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<sup>4</sup> Scholars in international relations have identified two main types of mediation: communication facilitation mediation, and procedural mediation. The latter is descriptively the closest to this paper’s model, because disputants pre-commit to let the mediator set the procedure for the dispute resolution process. In practice, this seriously impedes their capability to negotiate, or renegotiate an agreement outside the mediation process. Procedural mediation is widely adopted as it is perceived to be the most effective form of mediation. Since World War I, over 30 territorial disputes have been brought to an international adjudication body (Huth and Allee 2006) which took the form of procedural mediation. Among all other cases in which mediation was involved (roughly fifty percent of cases according to Wilkenfeld et al. 2005), many can be coded as procedural mediation. Also, 427 disputes have been brought up for ‘arbitration’ within the World Trade Organization between 1995 and 2011 (WTO database). This form of arbitration is similar to procedural mediation, because the enforcement is based on the actions of individual WTO member States.

militarization and the prevention of crisis emergence. In other words, a key perspective of our analysis is that because the disputants' militarization decisions are sunk at the time a third party is called in to mediate on an ongoing dispute, the third party only concerns herself with managing the dispute taking as given the militarization decisions. Our deep and general result is that this narrow mandate is irrelevant for the third parties we study here. Their intermediation strategies, while optimally designed to only give the highest chance of peace in emerged disputes, also provide the best possible incentives against crisis emergence within the class of institutions that do not give intermediaries access to privileged information, nor possess the budget to impose peaceful settlements or make transfers.

The reasoning behind this result is more complex than the intuition behind the drawbacks of un-mediated peace talks. The first step in our argument is the application of the 'revelation principle' by Roger Myerson (1982). In our context, this general result implies that an optimal way to organize the third-party intermediation we consider here is as follows. First, disputants report their information independently to the mediator. Second, the mediator submits a settlement proposal to the disputants for their independent approval. The revelation principle tells us there is an equilibrium which maximizes the chance of peace, in which the settlement proposal strategies by the mediator are chosen so as to ensure that disputants will reveal all their private information to the mediator, in anticipation of the settlements that the mediator will propose.

In practice, the mediator sets the agenda to "collect and judiciously communicate select confidential material" (Raiffa, 1982, 108–109). Obviously, the role for mediation that we identify cannot be performed by holding joint, face-to-face sessions with both parties, but requires private and separate caucuses, a practice that is often followed by mediators. The practice of shuttle diplomacy has become popular since Henry Kissinger's efforts in the Middle East in the early 1970s and the Camp David negotiations mediated by Jimmy Carter, in which a third party conveys information back and forth between parties, providing suggestions for moving the conflict toward resolution (see, for example, Kydd, 2003).

As has become standard in other areas of applied theory, the revelation principle allows us to conveniently describe the outcomes from equilibrium play in these more complex caucuses.

The second step of our assessment of Myerson mediation consists of a precise characterization of what is obtained by optimal settlement proposal strategies. We find that a stronger, more militarized disputant must receive more favorable terms of settlement on average, than a weaker one. Otherwise, the stronger disputant will never accept the proposed settlements, preferring instead to wage war in the expectation that his eventual payoff will be larger. Importantly, the mediator faces the task of steering the parties in such a manner that weak disputants do not pretend to be stronger, when reporting their information in the first stage of the intermediation. Thus, the mediator proposal strategies are chosen to minimize the expected reward for a weak disputant to pretend that it is strong, when, in fact, it did not militarize. As an unintended consequence, they also minimize the incentives for a weak disputant to militarize and become strong. Hence, the mediators we consider here not only improve the chance that disputes are resolved peacefully relative to un-mediated peace talks. They also keep in check the potential disputants incentives to engage in disputes and to militarize.<sup>5</sup>

## 2 Literature Review

This paper pushes for a reformulation of the study of conflict and institutional design and draws a finer distinction between different ways of fostering peace for a given crisis; some are also beneficial at reducing militarization while others generate offsetting negative incentives.

Our results are related to the study of contests and appropriation (see Garfinkel and Skaperdas, 1996, for a survey). In such a conceptualization, strategic militarization is

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<sup>5</sup>As we explain in the conclusion, these results may be useful for the study of optimal taxation with mechanism design.

treated as an arms race to prepare for a sure conflict where the military capacities of each country influence the war-payoffs through a contest function. However, in our model militarization increases the expected payoff of fighting in a crisis. The goal is expected utility maximization in a game in which war is not a foregone conclusion. Players may either reach a settlement or fight, and the militarization choice has strategic effects on both settlements, the odds of fighting and the payoffs from fighting.

There is also a recent body of formal theory on endogenous militarization in the shadow of bargaining and war fighting. Meirowitz and Sartori (2008) connect militarization with bargaining behavior but provide only results on the impossibility of avoiding conflict. They do not study optimal mechanisms or make comparisons across different institutions. Jackson and Morelli (2009) consider militarization and war but in their analysis states observe each other's investment decisions prior to bargaining and thus there is no room for communication of any kind to solve information problems. Akcay, Meirowitz and Ramsay (2012) study investment that influences the value of agreement for one player and disagreement for the other prior to the play of a mechanism and provide a characterization of the equilibrium relationship between the probability of bargaining failure and investment levels. In that paper, however, the investments are over a private value component whereas here investment by either player influences the payoffs of both players.

Our study of Myerson mediation falls within the large literature of mechanism design that dates back at least to Hurwicz (1960). But unlike mechanisms used in economics applications, the mediators studied here do not have the power to enforce their settlement decisions. The key distinguishing feature of international disputes is that the players involved are sovereign entities, and hence there is no legitimate or recognized third party to which they can credibly delegate decision and enforcement power (see e.g. Waltz, 1959). For this reason, any mechanism design model well-suited to the study of international relations has to dispense with the assumption that the mediator can enforce her decisions and,

instead, focus on self-enforcing mechanisms.<sup>6</sup>

In a more distantly connected literature, militarization is assumed to be observable, and is viewed as a deterrent or a signal. Garfinkel (1990) focuses on a simple repeated armament setting that illustrates this role, and Powell (1993) provides an example of the conditions under which endogenous observable armament can lead to effective deterrence. Similarly, Fearon (1997) argues that observed military expenditures can be a form of costly signaling. Collier and Hoeffler (2006) consider the signaling and deterrent effects of armament as competing mechanisms explaining levels of post-conflict military expenditures in countries which have recently experienced a civil war. Chassang and Padro (2010) show that while weapons have deterrence effects under complete information in a repeated game, when adding strategic uncertainty it is no longer true that there is a monotonic relationship between the size of an arsenal and the degree of deterrence in equilibrium. For very different reasons, even in our model the effects of endogenous militarization incentives on peace are non-monotonic. Taken together with the point made in footnote 3, this work highlights the importance of whether militarization is observable or not, for the study of deterrence. It is then natural to ask whether mechanisms that improve observability, such as espionage, or military inspections would lead to more or less militarization, deterrence, or conflict. We leave these questions for future research.

### **3 Un-mediated Peace Talks and Militarization**

In this section we develop the baseline model of militarization and conflict and augment it to allow for un-mediated communication, so as to show that un-mediated peace talks may breed perverse incentives for militarization. Un-mediated peace talks help resolve disputes by allowing for settlements that would not otherwise be possible when the disputants are

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<sup>6</sup>Among the few papers studying self-enforcing mechanisms in contexts different from international relations, see Matthews and Postlewaite (1989), Banks and Calvert (1992), Cramton and Palfrey (1995), Forges (1999), Skreta (2006), Compte and Jehiel (2009), and Goltsman, Hörner, Pavlov and Squintani (2009).



strong. But the expectation that war is less likely if a dispute emerges leads to an increased incentive for the actors to militarize. As a result, we show that for some model parameters, un-mediated peace talks can increase the overall war probability when militarization decisions are taken into account.

**The Model of Militarization and Conflict** The analysis starts with the description of a model of militarization and conflict without mediated or un-mediated peace talks. Ideally, this model represents a world in which there is no support for the organization of these initiatives by the international community. The model introduced is deliberately minimal so that its augmentation to include communication and mediation can lead to results that can be described simply.

Two players,  $A$  and  $B$ , dispute a prize or pie normalized to unit size. If no peaceful settlement is reached, the disputants fight. Conflict is treated as a lottery that shrinks the expected value of the pie to  $\theta < 1$ , the odds of winning a war depend on the configuration of arming decisions.<sup>7</sup> Each player can possess one of two possible arming levels,  $H$  or  $L$ , and arming is private information. We will often refer to player with arm level  $H$  as a “hawk” and to one with arm level  $L$  as a “dove.” When the two players are of the same type, each wins the war with probability  $1/2$ . When a hawk fights against a dove, her probability of winning is  $p > 1/2$ , and hence her expected payoff is  $p\theta$ . We assume that  $p\theta > 1/2$ , otherwise the dispute can be trivially resolved by agreeing to split the pie in half. The dove’s payoff is  $(1 - p)\theta$ . Note that whether country  $A$  is a hawk or a dove influences country  $B$ ’s payoff from fighting, hence we are in a context of private information of “interdependent value.”

In the initial militarization stage,  $A$  and  $B$  each decide whether to remain doves or to arm and become hawks at a cost  $k > 0$ . We characterize a mixed arming strategy by  $q \in [0, 1]$ , the probability of arming and becoming a hawk.<sup>8</sup> The militarization decisions

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<sup>7</sup>Conflict destruction need not only consist of physical war damages, but may also include foregone gains from trade, and increased military flow costs.

<sup>8</sup>The consideration of mixed strategies should not be taken as literally claiming that players are indifferent and randomize when making their choices. As is known since Harsanyi (1973), mixed strategy

are treated as hidden actions, so neither player observes the choice of the other nation. But in equilibrium the disputants hold correct conjectures of the equilibrium strategy —and thus they know the probability that their opponent has armed. For expositional purposes, we assume that military strength is entirely private information. Our results hold also if the disputants have some information on each other’s military, as long as there is also some residual private information.<sup>9</sup> For simplicity, given the symmetry of the game, we restrict attention to equilibria that are symmetric in the militarization strategies  $q$ .

After militarization decisions are sunk, players bargain over the pie in the attempt to reach a peaceful agreement and avoid a destructive war. Several bargaining game forms may be adopted, but none would succeed in avoiding militarization or conflict. Because militarization is a hidden action, the emergence of militarized disputes and the development of some of these disputes in open warfare is unavoidable.<sup>10</sup> As the specific game form is not important here, we represent bargaining as a simple Nash demand game (see Nash, 1953, and Matthews and Postlewaite, 1989, for the private information case). Players simultaneously make demands  $x_A$  and  $x_B$  both in  $[0, 1]$ , analogously to giving their diplomats a set of instructions to “...bring back at least a share  $x_i$  of the pie.” If one player’s demands are sufficiently generous to accommodate the minimal demands of the other, i.e., if the sum of the demands is less than 1, then the split that emerges from bargaining gives each disputant her demand and half the surplus. If the demands  $x_A$  and  $x_B$  are incompatible,

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equilibria can be explained as the limit of pure strategy equilibria of a game in which players are not precisely sure about the payoffs of opponents. Further, an alternative interpretation of this simple model is that  $q$  is the level of investment in uncertain military technologies that lead to high military strength with probability  $q$ , and low strength otherwise, and that bears the linear cost  $qk$ .

<sup>9</sup>The latter is hardly disputable, given the extent to which States engage in espionage and counter-espionage, as well as manipulating beliefs about their actual military strength. Among some famous episodes of manipulations, Soviets flew jets with fake missiles in parades, and Serbians put cardboard tanks in their towns during NATO-led air strikes. Likewise, the prospect of the Star Wars program sponsored by the Reagan administration were grossly exaggerated.

<sup>10</sup>There cannot exist any militarization and bargaining game in which arming is a hidden action, and in which players arm with positive probability but do not fight in equilibrium (peace by deterrence). Very simply, because arming is a hidden action, if players anticipate that they will not fight, they will deviate from this hypothesized equilibrium and choose not to arm. Likewise there cannot exist an equilibrium in which players do not ever militarize, as each one of them will have the unilateral incentive to secretly militarize and subjugate the opponent.

meaning they sum to more than the whole prize, then no split is feasible and the outcome is war.<sup>11</sup>

To make the exposition of results more parsimonious, we introduce the parameter  $\gamma \equiv [p\theta - 1/2]/[1/2 - \theta/2]$ , which subsumes the two parameters  $\theta$  and  $p$ . The numerator of  $\gamma$  is the gain from waging war against a dove instead of accepting the equal split, and the denominator is the loss from waging war against a hawk rather than accepting the equal split; so  $\gamma$  representing the ratio of benefits over cost of war for a hawk. For simplicity, we henceforth assume that  $\gamma \geq 1$  (or equivalently, that  $(2p + 1)\theta \geq 2$ ), i.e., that war is not too destructive and the hawk's military advantage is significant. But one of our main results (Theorem 1) also holds for  $\gamma < 1$ , as explained in the Appendix. Our welfare analysis is based on three measures: the equilibrium militarization probability of a country,  $q$ , the probability of peaceful conflict resolution, defined as  $V$ , and the total utilitarian ex-ante welfare,  $W \equiv \theta(1 - V) + V - 2kq$ .

We calculate the optimal equilibrium of the Nash demand game in the next part of this section. It is important that the Nash demand game possess 'conflict equilibria' in which the players coordinate on war with probability one, because their demands are incompatible.<sup>12</sup> This equilibrium outcome represents instances in which conflicts erupt because of failure to coordinate on a peaceful dispute resolution.<sup>13</sup> As a consequence, our model of militarization

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<sup>11</sup>Wittman (2009) and Ramsay (2011) use the Nash demand game in their studies of crisis bargaining. Baliga and Sjöström (2015) adopt a slightly more elaborated version of Nash demand game as a workhorse model of conflict. Jarque et al. (2003) develop a repeated version of the Nash demand game. Our results on unmediated peace talks and mediation are robust. They hold if representing bargaining with these models, and with many more others, including a 'smoothed' Nash demand game, in which incompatible demands lead to a peaceful settlement with probability decreasing in the demands' distance. Indeed, they hold with any bargaining model that do not constrain the effectiveness of unmediated communication and mediation, once arming decisions are sunk. Modelling bargaining with constraining game forms seems difficult to justify in this context, as one would like to derive results that are as general and 'game-free' as possible.

<sup>12</sup>Indeed, any demand strictly larger than  $1 - (1 - p)\theta$  leads to war with probability one, because it is so excessive that even a dove who knows that the opponent is stronger would prefer to fight than to acquiesce to this demand.

<sup>13</sup>Failure of coordination on a peaceful solution of disputes can take place for a number of reasons. For example, conflicts may erupt because of successful derailment by fringe extremists (e.g., the assassination of Yitzhak Rabin in 1995 contributed to the failure of the Oslo peace process, and WWI started because of the assassination of Archduke Franz Ferdinand of Austria in 1914). Likewise, miscalculation of negotiation tactics by overconfident negotiating delegates may lead to the failure of coordination on peaceful conflict

and conflict has a grim equilibrium outcome in the militarization-bargaining game, in which both players arm with probability  $q = 1$ , in the expectation that they will later fight. Unfortunately, history abounds with cases in which arms escalations eventually led to open warfare. According to some historical assessments, for example, one of these cases are the events that led to World War I (see also footnote 13). Even a ‘rationalistic’ theory of war should not exclude the possibility of coordination on grim ‘arm-and-fight equilibria’ as a cause of conflict (see the discussion in Fey and Ramsay, 2007, for example).

**Solution of the Baseline Model** The collective interest is to devise institutions that minimize the chance that disputes emerge and led to open warfare, i.e., that disputants mis-coordinate on the ‘state of nature’ described by arm-and-fight equilibria. Unfortunately, as already pointed out, it is impossible to fully avoid militarization and warfare. We begin our analysis on the effectiveness of different institutions by solving the baseline bargaining model without mediated or un-mediated peace talks presented above.

Suppose first that militarization decisions are sunk; i.e., let us solve the Nash demand game holding the militarization probability  $q$  fixed. Proposition 1 reports the optimal equilibrium of the Nash demand game as a function of  $q$ . It demonstrates that even a bargaining scheme as simple as the Nash Demand game has an equilibrium less grim than the conflict equilibria described above, when holding the militarization probability  $q$  fixed. Later, Proposition 2 will show that this result is partially reversed when the militarization choices are endogenized.

**Proposition 1** *As a function of the arming probability  $q$ , the equilibrium of the Nash demand game that maximizes the peace probability  $V$  is as follows. For  $q \geq \gamma/(\gamma + 1)$ , the players always achieve peace, by playing  $x_A = x_B = 1/2$ . For  $\gamma/(\gamma + 1) > q \geq \gamma/(\gamma + 2)$ , peace is achieved unless both disputants are hawks; hawk players demand  $x_H \in [p\theta, 1 - (1 - p)\theta]$  and dove players demand  $x_L = 1 - x_H$ . For  $q < \gamma/(\gamma + 2)$ , peace is resolution. The historical record seems full of examples of failure to coordinate on a peaceful outcome.*

achieved only if both disputants are doves, the demand of doves is  $x_L = 1/2$ , whereas hawks trigger war by demanding  $x_H > 1/2$ .

The arguments leading to this result may be summarized as follows. When  $q$  is sufficiently large,  $q \geq \gamma/(\gamma + 1)$ , each player  $i$  anticipates that the opponent is likely a hawk, and prefers not to trigger the fight. Both players demand a fair share  $x_i = 1/2$  and peace is achieved. Conversely, when  $q < \gamma/(\gamma + 1)$ , hawks are not afraid to make prevaricating demands  $x_H > 1/2$ . When  $q \geq \gamma/(\gamma + 2)$ , the risk of facing a hawk is still sufficiently high that doves want to avoid war and make demands compatible with the hawk's (i.e.,  $x_L = 1 - x_H$ ). So, war occurs only in hawk dyads. Instead, when  $q$  is sufficiently small,  $q < \gamma/(\gamma + 2)$ , doves prefer to make demands that trigger war with hawks, and peace is achieved only by dove dyads.

Having established that the Nash Demand game has an equilibrium less grim than the arm-and-fight equilibria, for any militarization probability  $q$ , we now move one step back and ask the same question for the whole game, which includes also the militarization stage. Proposition 2 reports for which values of the cost of arming  $k$  the game of militarization and conflict has equilibria that improve welfare,  $W$ , upon 'arm-and-fight', and isolates the equilibrium that maximizes the players' welfare  $W$ . We focus on equilibria of the game of conflict and militarization in which the play at the bargaining stage, given  $q$ , is consistent with Proposition 1. We justify this selection after the equilibrium characterization (below). We also focus on the case where  $k$  is smaller than  $\bar{k} \equiv [(1 - \theta) \gamma (\gamma + 1)]/[2(\gamma + 2)]$  as this greatly simplifies the exposition without affecting the insights of the analysis.<sup>14</sup> In the notation below, we introduce the notation  $k^* \equiv [(1 - \theta) \gamma^2]/[2(\gamma + 1)]$ , and note that  $k^* < \bar{k}$ .

**Proposition 2** *Assume that the cost of arming  $k$  is smaller than  $\bar{k}$ .*

1. For  $k \in [0, k^*)$ , there does not exist any equilibrium of the game of militarization

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<sup>14</sup>The full characterization of equilibrium for the remaining range of high costs of militarization is available upon request.

and conflict in which the play at the Nash demand game stage is consistent with Proposition 1 and so both  $q = 1$  and  $V = 0$  in equilibrium.

2. For  $k \in [k^*, \bar{k}]$ , the equilibrium consistent with Proposition 1 which maximizes the players welfare  $W$  is such that each disputant militarizes with probability  $q(k) = \gamma - 2k/(1 - \theta)$ , and only hawk dyads fight.

This result is intuitive. For small costs of militarization, i.e. when  $k < k^*$ , the players cannot improve on the arm-and-fight equilibrium, because they are unable to commit to remaining unarmed, or even to randomize. Because the cost of arming is so small, each disputant has an incentive to deviate, arm and wage war whenever there is a significant chance that the opponent remains weak or randomizes. Instead, for  $k \in [k^*, \bar{k}]$ , there are equilibria in which the disputants neither strictly prefer to remain peaceful, nor to militarize. Indeed, they randomize at the militarization stage, and then fight if and only if they both armed. Not surprisingly, the arming probability decreases as the cost of militarization increases, to reach  $q = \gamma/(\gamma + 2)$  for  $k = \bar{k}$ .<sup>15</sup>

As anticipated earlier, we conclude this section by motivating our choice to focus on equilibria of the game of militarization and conflict in which the play at the Nash demand game stage is consistent with Proposition 1. First, note that, because militarization is a hidden action, the players cannot coordinate on different equilibria of the Nash demand game for different militarization choices. This excludes the possibility of using ‘punishment’ strategies in which players make high demand if the opponent militarizes. Second, the equilibria of Proposition 1 satisfy a ‘credibility’ criterion that is often appealed in game-theoretical analyses, as they maximize the probability of peace (and hence welfare) in the Nash demand game, at the stage in which militarization choices are sunk. Third, and most

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<sup>15</sup>The equilibrium characterization changes discontinuously for  $k > \bar{k}$ , because, once the dispute has arisen, players fight unless they are both doves. Also, as already pointed out, the result that a mixed strategy equilibrium is played for  $[k^*, \bar{k}]$  should not be taken as a literal prediction that players are indifferent between arming or not and play randomly. As is well known since Harsanyi (1973), equivalent and more plausible interpretations of mixed strategy equilibria are routinely invoked by applied game theorists to understand mixed strategy equilibria (see footnote 8).

importantly, the equilibria of Proposition 1 also yield the highest possible payoffs to dove players, and the lowest ex-ante incentives to militarize. For  $k$  low this focus highlights the cause of the failure to improve upon the ‘arm-and-fight’ equilibrium; players cannot escape the temptation to militarize.

**Un-mediated Peace Talks** The previous section has described the game of conflict and militarization. We now augment this game by adding an extra intermediate stage. We assume that after the militarization stage, but before the bargaining game is played, direct bilateral peace talks take place. Talks are modeled as a meeting in which the disputants conduct un-mediated talks, share information, and attempt to find an agreement and coordinate their future play. In the meeting, both players  $i = A, B$  simultaneously send unverifiable messages  $m_i \in \{l, h\}$  to each other, so as to represent their arming type  $L$  or  $H$ .<sup>16</sup> Then, the meeting continues with the disputants trying to find an agreement. Any equilibrium has the following form: with some probability, the peace conference is successful, and the disputants agree on a peaceful resolution. With complementary probability, the peace talks fail, and lead to conflict escalation. In any equilibrium in which information is meaningfully revealed, the probability that the peace conference results in a peaceful resolution depends on the players’ types, as we detail below in Proposition 3.

In more formal terms, we allow players to make use of a joint randomization device, whose realization is observed by both disputants. So, disputants can possibly coordinate on different equilibria of the crisis bargaining game, as a function of both their messages and the realization of the public randomization device.<sup>17</sup> It is important that we can exploit the equilibrium multiplicity of the Nash bargaining game to model the possibility of the failure of the players’ attempts to coordinate on a peaceful outcome. This is not only a realistic

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<sup>16</sup>For simplicity, we assume that only one round of unmediated communication takes place.

<sup>17</sup>The same communication model is used by Krishna and Morgan (2004) and Aumann and Hart (2003) in different contexts. The latter also prove that joint randomization can also be reconstructed as simultaneous cheap talk. Hence, by allowing for public randomization devices we are ensuring that the logic of our result holds for a large class of models of communication (albeit in a reduced form representation).

assumption (one needs only to browse history books and contemporary press to appreciate that, often, peace talks fail despite everyone's best intentions). It is also the only reason why un-mediated peace talks succeed in improving the chance of peaceful resolution once militarization investments are sunk. Indeed, it can be proved that absent this possibility of miscoordination, the players would never reveal any information in the peace talks (and hence peace talks would not be organized in the first place).

The description of our results for un-mediated peace talks is divided in two parts. First, we show that, for any fixed probability of militarization  $q$ , un-mediated peace talks strictly improve the probability of peace and welfare (except for the trivial case in which  $q \geq \gamma/(\gamma+1)$  where peace is always achieved). Hence, a-fortiori, un-mediated peace talks also improve on the conflict equilibria described earlier. As we later explain in detail, this improvement is due to the fact that participation in peace talks increases the probability that players coordinate on peaceful dispute resolution. This insight is novel in the literature, and complements the findings of Baliga and Sjöström (2004) who did not include the possibility of coordination with a public randomization device in their model of un-mediated peace talks. This result is formally stated in Proposition 3. As in the statement of Proposition 1, we focus on the equilibrium that maximizes the peace probability  $V$ , for any given arming strategy  $q$ . For expositional reasons, we focus our attention on equilibria with pure communication strategies.

**Proposition 3** *For any given militarization strategy  $q$ , the optimal equilibrium of the bargaining game with un-mediated peace talks is characterized by two parameters,  $p_H$ , and  $p_M$ , and has the following form. Each type truthfully reveals her type during peace talks. Then, hawk dyads  $(H, H)$  coordinate on the peaceful demands  $x_A = 1/2$ ,  $x_B = 1/2$  with probability  $p_H$ , and fight with probability  $1 - p_H$ ; asymmetric dyads  $(H, L)$  coordinate on the peaceful demands  $(p\theta, 1 - p\theta)$  with probability  $p_M$ , and fight with probability  $1 - p_M$ . The case for  $(L, H)$  is symmetric; and dove dyads  $(L, L)$  achieve peace with probability one, making demands  $x_A = 1/2$ ,  $x_B = 1/2$ .*



*Specifically, when  $q < \gamma/(\gamma + 2)$ ,  $p_H = 0$  and  $p_M \in (0, 1)$ ; whereas when  $\gamma/(\gamma + 2) \leq q < \gamma/(\gamma + 1)$ ,  $p_M = 1$  and  $p_H \in (0, 1)$ ; finally, when  $q \geq \gamma/(\gamma + 1)$ ,  $p_M = 1$  and  $p_H = 1$ .*

*For any given militarization strategy  $q$ , un-mediated peace talks improve the peace chance  $V$ , and they improve it strictly whenever  $q < \gamma/(\gamma + 1)$ .*

The equilibrium in Proposition 3 is best illustrated by comparing it to the optimal equilibrium of the bargaining game without communication, reported in Proposition 1. In both cases disputants play a separating equilibrium (except for the trivial case in which  $q \geq \gamma/(\gamma + 1)$  where peace is always achieved). In both equilibria, players reveal their types by means of their choices. But in the crisis bargaining game without peace talks, this information is revealed only after demands are made, whereas with un-mediated communication, the information is shared before the demands are made. Intuitively, sharing information before demands are made allows the players to use this information more efficiently in the crisis bargaining game, thereby improving the chance that the disputants coordinate on a peaceful outcome.

In fact, un-mediated communication induces a strict improvement in the probability of peace for  $q < \gamma/(\gamma + 1)$ . Specifically, when  $\gamma/(\gamma + 2) \leq q < \gamma/(\gamma + 1)$ , and both players are hawks, the introduction of a peace conference turns the sure event of war (which occurs in the game without talks) into one in which peace occurs with positive probability. Similarly, when  $q < \gamma/(\gamma + 2)$ , the equilibrium of Proposition 1 is such that war takes place with probability one in asymmetric hawk-dove dyads, but with probability smaller than one when a peace conference is introduced to coordinate future play.

The second part of this subsection studies un-mediated peace in the whole game of conflict and militarization. We find that, paradoxically, un-mediated peace talks may not improve the chance of peace and the players' welfare. Instead, they may broaden the negative results identified in Proposition 2 to the whole parameter set  $k < \bar{k}$ . Un-mediated peace talks may give such perverse incentives to militarize that they fully impede improvement upon the state of nature described by the arm-and-fight equilibrium. As in

Proposition 2, we focus on equilibria of the whole game of conflict and militarization, in which the play at the bargaining stage maximizes the chance of a peaceful resolution for any given militarization probability  $q$ , as outlined in Proposition 3.<sup>18,19</sup>

**Proposition 4** *For any militarization cost  $k \in [0, \bar{k})$ , there does not exist any equilibrium of the game of militarization and conflict with un-mediated bilateral peace talks in which the bargaining game play is consistent with Proposition 3.*

For any militarization cost  $k \in (k^*, \bar{k})$ , Proposition 2 established that it is possible to improve upon the state of nature arm-and-fight equilibrium in the benchmark case without communication. Proposition 4 shows that un-mediated peace talks may unravel this possibility. Hence, for any  $k \in (k^*, \bar{k})$ , un-mediated peace talks may induce negative incentives for militarization and reduce the peace chance as well as overall welfare. For  $k \leq k^*$ , the equilibrium incentives are the same with and without un-mediated peace talks.

The intuition for this seemingly perverse result is simple: in some sense, un-mediated peace talks are victims of their own success. Taking as given the probability that each disputant is strong, peace talks improve the chance of a peaceful crisis resolutions by reducing the probability of war when both disputants are hawks (without any change in the hawks payoffs when they meet doves). This is because the disputants are more likely to coordinate on peaceful resolution of the crisis when they meet at peace talks. This increases the expected payoff of becoming strong, and thus disputants arm with higher probability, in equilibrium. As a result, more disputes emerge and while un-mediated peace talks reduce the probability that each one of them erupts in open conflict, it may be the case that the

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<sup>18</sup>Of course, the game of militarization and conflict with unmediated peace talks admits uninformative communication equilibria that induce the same outcomes as in the game of militarization and conflict described in Proposition 2.

<sup>19</sup>Our focus on the optimal and most informative equilibrium of the Nash demand game with unmediated communication in the statement of Proposition 4 is motivated by two reasons. First, equilibrium selection is appropriate, because ours is only a possibility result (we argue that unmediated peace talks *can* induce perverse militarization incentives. Second, focusing on the most informative communication is justified by simple ‘forward-induction’ arguments. There are significant political and financial costs to organize peace talks. Why would the belligerent parties go through all this trouble to meet and only babble?

overall level of conflict is higher than in a world where the international community does not provide support for un-mediated peace talks.

Below we will contrast the best equilibrium to the game of militarization and conflict with un-mediated peace talks and the best equilibrium with mediated peace talks, but for now key take away from proposition 4 is that if potential disputants anticipate that when disputes involving strategic uncertainty emerge they will be resolved by un-mediated talks aimed at maximizing the peace chance then equilibrium requires that disputes militarize and strategic uncertainty does not arise.

## 4 Mediation

We have shown that bilateral un-mediated communication, exactly because they can reduce the risk of conflict in ongoing disputes, may lead to more militarization, more emergence of disputes, and ultimately to a higher level of conflict. We now show that there exist forms of third party interventions that do not suffer from these drawbacks. In fact, it is possible to avoid the perverse militarization incentives of un-mediated peace talks, if effective mediators are appointed to deal with the crises that emerge, even though they have no enforcement power and have no special access to the private information of either disputant.

**Optimal Mediation, Given Militarization** The specific form of mediation we consider is inspired by the celebrated work of Roger Myerson (1979, 1982) and hence we call it ‘Myerson mediation’. A Myerson mediator is a neutral or “honest broker” mediator who does not favor either of the disputants.<sup>20</sup> The mediator has a mandate to set the agenda, or procedure, of the peace talks so as to minimize the probability of war when the international dispute emerges, after the militarization stage. That is, we assume our mediators

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<sup>20</sup>Examples of such mediators might be Nobel Peace Prize winners like Martti Ahtisaari and Jimmy Carter, or Nongovernmental Organizations like the International Crisis Group.

have a narrow mandate to resolve the current conflict and do not take into account the incentives of disputants who, in turn, anticipate the mediation strategies and techniques when they choose whether to militarize before negotiations. Indeed, it would not be realistic to presume that the mediator’s mandate included deterring strategic choices that took place before their intervention in the crisis. Rather, our mediator takes the (symmetric) equilibrium militarization probability  $q$  as given, and tries to minimize the chance that this dispute ends in war. This assumption mirrors our selection in the benchmark bargaining game and its un-mediated communication extension. There we focus on the best equilibria, treating militarization decisions as fixed. Our mediator has the same characteristics.

A Myerson mediator’s objective is the minimization of the ex ante probability of war. Hence, she must be able to commit to her proposal during the crisis and will not renegotiate if one or both disputants reject her recommendation. This means that we assume the mediator can quit the peace talks and credibly refuse to broker any subsequent deals. If she quits, the disputants escalate to open conflict. Thus, employing a mediator does not guarantee a peaceful agreement in all contingencies.<sup>21</sup> Such commitments make information disclosure by the contestants possible, and ultimately improve the ex ante chances of peaceful conflict resolution. On the basis of all the evidence available, these assumptions seem realistic to us.<sup>22,23</sup> Further, we rule out the possibility of negotiation outside the mediation process. Realistically, disputants are not likely to go back to the negotiation table in

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<sup>21</sup>The optimal Myerson mediation mechanism has, among its properties, that quitting (or not making a proposal after receiving the private communication) needs to be interpreted as an implicit suggestion to go to war, which is a continuation equilibrium.

<sup>22</sup>The online appendix of Hörner, Morelli and Squintani (2015) provide empirical evidence that mediators as well as disputants recognize the value of a (Myerson) mediator’s commitment to quit. They also show that if mediators cannot commit to quit, and seek a peaceful agreement in all contingencies, then they are entirely ineffective at brokering peace in the bargaining game that takes place once militarization decisions are sunk.

<sup>23</sup>We have also interviewed a real-life experienced mediator, Mr. Gianluca Esposito, Principal Administrator at the Council of Europe (currently Consulting Counsel at the International Monetary Fund), who participated in a number of international mediations including the ones associated with the Bosnian war. He confirmed that mediators understand very much the importance of being able to credibly set the rules of the mediation process, and credibly threaten to quit if disputants persist with excessive demands (i.e., in the context of our paper, both report to be hawks). The views expressed by Gianluca Esposito do not necessarily reflect the views of the Council of Europe, of the IMF or of any of their respective bodies.

the attempt to broker a deal without the help of the mediator, once the mediation process has failed.<sup>24</sup>

We begin our analysis by applying a celebrated result, the ‘revelation principle’ by Myerson (1982) to our crisis bargaining game (in which militarization probability  $q$  is taken as given). This general result implies in our context that an optimal way for the mediator to set the mediation agenda is as follows. First, disputants report their information independently to the mediator. Second, the mediator submits a settlement proposal to the disputants. After these proposals are made, the players bargain according to the Nash demand game, as in the benchmark model of the previous section.<sup>25</sup> Further, there is an equilibrium that maximizes the chance of peace, in which the mediator’s proposal strategies lead the disputants to reveal all their private information to the mediator, in anticipation of the proposals that she will make and the disputants are willing to adhere to the mediator’s proposals.

This intermediation procedure is often adopted by third-party negotiators in the form of ‘shuttle diplomacy’, as we discussed in the introduction. Disputants do not report information directly to each other, but through the intermediation of a mediator whose actions are inspired by a principle of confidentiality. As we explain later in more detail, players have better incentives to disclose their type confidentially to the Myerson mediator than they have when communicating directly. As a result, the mediator improves the chance of peace for any given arming probability  $q$ , upon un-mediated peace talks.

**Proposition 5** *For any given militarization strategy  $q$ , the optimal equilibrium of the bargaining game with a Myerson mediator can be characterized by three parameters,  $q_H$ ,  $q_M$ ,  $p_M$ , and can be described as follows. Each player truthfully reveals her arms level to the mediator. Then, hawk dyads  $(H, H)$  coordinate on the peaceful demands  $(1/2, 1/2)$  with*

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<sup>24</sup>There are many reasons for this. For example, audience costs are recognized to provide an important channel that makes war threats credible in case of failed negotiations (e.g., Tomz, 2007).

<sup>25</sup>Alternatively, we could assume that the proposals are submitted for independent approval to the two disputants, and are implemented if both the players approve them, as in Hörner, Morelli and Squintani (2015). As we prove in the Appendix, our results are exactly the same with these two game forms.

probability  $q_H$ , and fight with probability  $1 - q_H$ ; asymmetric dyads  $(H, L)$  coordinate on the peaceful demands  $(p\theta, 1 - p\theta)$  with probability  $p_M$ , on the demands  $(1/2, 1/2)$  with probability  $q_M$  and fight with probability  $1 - p_M - q_M$  — the case for  $(L, H)$  is symmetric; and dove dyads  $(L, L)$  achieve peace with demands  $(1/2, 1/2)$  with probability one.

Specifically, when  $q \leq \gamma/(\gamma + 2)$ ,  $q_H = q_M = 0$ , and  $p_M \in (0, 1)$ ; when  $\gamma/(\gamma + 2) \leq q < \gamma/(\gamma + 1)$ ,  $p_M + q_M = 1$ ,  $q_H \in (0, 1)$  and  $q_M \in (0, 1)$ ; and finally, when  $q \geq \gamma/(\gamma + 1)$ ,  $q_M = 1$ , and  $q_H = 1$ .

Whenever  $\gamma/(\gamma + 2) \leq q < \gamma/(\gamma + 1)$ , mediation strictly improves the peace chance relative to un-mediated peace talks. For all values of  $q$ , mediation yields at least as large a chance of peace as un-mediated peace talks.

The above characterization of optimal mediation strategies is based on the following insights. To begin, note that a strong, militarized disputant must receive more favorable terms of settlement on average than a weak one. Otherwise, the strong player would reject the settlement, in the expectation that the war payoff will be larger. But favorable settlements to self-reported hawks provide an incentive for doves to pretend to be strong, when reporting her information to the mediator. Settlement strategies must be chosen so as to avoid that doves lie. When  $\gamma/(\gamma + 2) \leq q < \gamma/(\gamma + 1)$ , mediation strictly improves the peace chance relative to un-mediated peace talks, given any fixed arming probability  $q$ , as it makes a dove more willing to reveal its type to the mediator, than if communicating directly with its opponent. If revealing its type to a hawk opponent, the dove is in a weak bargaining position and surely needs to accept a low payoff,  $1 - p\theta$ , to secure peace. If instead communicating through a mediator, the dove is proposed  $1/2$  of the pie with probability  $q_M$ , and the lower payoff  $1 - p\theta$  only with probability  $p_M = 1 - q_M$ . To ensure that the hawk is willing to accept these mediator's proposal, the proposal strategy cannot be fully revealing. When receiving proposal  $(1/2, 1/2)$ , the hawk does not know if the opponent is strong or weak. The randomization value  $q_M$  is chosen so as to make the hawk

indifferent between accepting the proposal  $(1/2, 1/2)$  and fighting.<sup>26</sup> As a result, this optimal mediation strategy minimizes the difference between the hawk’s and the dove’s expected payoff, among all mediation strategies that make the players’ truthfully reveal their types, and accept the mediator settlement proposals.

We will next see how this optimal mediation strategy also leads to optimal incentives for militarization.

**Mediation and Militarization** We now build on the above result to solve for the militarization equilibrium probability  $q$  given that the ensuing dispute is solved via Myerson mediation. The following result characterizes the equilibrium militarization and conflict probability. Importantly, it shows that Myerson mediation does not suffer from the drawbacks presented by un-mediated bilateral peace talks. Not only can a Myerson mediator improve the peace chance given militarization strategies  $q$  but such a mediator can also improve welfare in the whole game, which captures the “upstream” militarization decisions.

**Proposition 6** *In the crisis bargaining game with a Myerson mediator, the best equilibrium can be characterized as follows: For any militarization cost  $k$ , there is a unique symmetric equilibrium militarization probability  $q(k)$ , which strictly decreases in  $k$  for  $k \in [0, \bar{k}]$ , with  $q(0) = \gamma / (\gamma + 1)$ , and  $q(\bar{k}) = \gamma / (\gamma + 2)$ .<sup>27</sup>*

*Myerson mediators improve the chance of peace  $V$ , and the welfare  $W$  with respect to any equilibrium of the benchmark Nash demand game with un-mediated peace talks, or without communication.*

This Proposition finds that the optimal strategies of Myerson mediators, who are only given a mandate to minimize the chance that conflict erupts in the dispute that they mediate, do not breed perverse incentives for dispute emergence and militarization. Refreshingly, the reason for this powerful result is intuitive. As we explained in the discussion

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<sup>26</sup>In the complementary parameter region, optimal mediation strategies are fully revealing and coincide with the unmediated peace talks game equilibrium of Proposition 2.

<sup>27</sup>The explicit formula for the mixing probability is cumbersome, and is relegated to the appendix.

after Proposition 5, the optimal mediation strategies minimizes the difference between the hawk's and the dove's expected payoff, among all mediation strategies that make the players' truthfully reveal their types, and accept the mediator settlement proposals. So, they minimize the expected reward for a dove to pretend that it is a hawk, when, in fact, it did not militarize. As an unintended consequence, they also minimize the incentives for a weak disputant to militarize and become strong. Hence, Myerson mediators not only improve the chance that the disputes that emerge are more often resolved peacefully than with un-mediated peace talks. They also keep in check the disputants' incentives to let the dispute emerge, and militarize.

A more formal intuition can be grasped by noting that, given any dispute resolution institution, the equilibrium mixed strategy  $q$  of the arming strategy is given by

$$q = \frac{U(H, L) - U(L, L)}{U(H, L) - U(L, L) + U(L, H) - U(H, H)}, \quad (1)$$

where  $U(t_A, t_B)$  is player  $A$ 's expected payoff in the dispute when the players' types are  $t_A$  and  $t_B$ . Hence, the equilibrium militarization strategy  $q$  increases in  $U(H, L) - U(L, L)$ , the gain for being a hawk instead of a dove, when facing a dove. Similarly,  $q$  decreases in  $U(L, H) - U(H, H)$ , the loss for being a hawk instead of a dove, when facing a hawk. Myerson mediation penalizes choosing to be a hawk more than bilateral and direct cheap talk, i.e., it makes  $U(H, L) - U(L, L)$  smaller and  $U(L, H) - U(H, H)$  larger. Hence, it makes the militarization strategy  $q$  smaller in equilibrium.

The key relevance of Proposition 6 lies in the comparison with Proposition 4. The latter shows that, because un-mediated peace talks reduce the risk of war in the disputes that emerge, it may paradoxically incentivize arming, and thus ultimately raise the risk of war. Instead, Proposition 6 shows that Myerson mediation does not suffer from this drawback: it improves the chances of peaceful dispute resolution without creating negative militarization distortions. So, while the exact nature of the bargaining or mediation protocol will likely



have effects on exact settlements, the probability of war, and the chance of peace, in general there should be a difference in militarization strategies across crises conditional on observed dispute settlement techniques. In fact, empirically, this is sometimes the case. For example, looking at the data from Svensson's (2007) study on the effects of direct negotiations and mediation on agreements in all intrastate armed conflicts between 1989 and 2003, one finds that if you compare the size of government armies in crises with just bilateral negotiations to those with a mediator, the first category averages 273,901 troops whereas when a mediator is used the average army size is only 124,277. A simple t-test rejects the hypothesis of no difference in these case at better than a .001 level.

**The Institutional Optimality of Mediation** The previous sub-section proved that Myerson mediation not only improves the chance that disputes that emerge are resolved peacefully more effectively than with un-mediated peace talks, but also keeps the potential disputants incentives to let the dispute emerge and militarize in check. We will now show a much stronger result. Myerson mediation achieves the same welfare as a hypothetical optimal third party intervention mechanism in which the third party has the broader mandate to commit to 'punish' nations for militarizing and entering a dispute in the first place.<sup>28</sup> That is, a hypothetical mediator with the mandate to consider total welfare and minimize the militarization incentives that lead to dispute emergence can do no better than the Myerson mediator with a 'narrow' and more realistic mandate to foster peaceful resolution of the disputes that emerge, .<sup>29</sup>

**Theorem 1** *Although Myerson mediators may not take into account the incentives they create for strategic militarization, they are an optimal institution among all budget-balanced*

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<sup>28</sup>Such an optimal hypothetical mediator is not likely available in the real world, and serves only as benchmark to assess how much is lost by the narrow mandate. We maintain the assumption that the optimal institution does not have access to privileged information beyond what it gathers from communication with the disputants and that it is budget balanced. That is, the optimal institution cannot bribe or punish the players to force them to settle.

<sup>29</sup>The mandate of this hypothetical mediator is defined precisely in the appendix.

*institutions with no direct access to disputants information, for the aim of both arms reduction and peace chance maximization in the militarization and bargaining game.*

The improvement in peace chance from Myerson mediators over all possible equilibria with un-mediated peace talks is strict for important parts of the parameter space. For example, whenever  $k$  induces an equilibrium to the game with militarization and Myerson mediation that involves a lower probability of war given  $q$  than the equilibrium characterized in proposition 3 for that value of  $q$  the gains from mediated peace talks over every possible equilibrium with un-mediated peace talks are real.

An intuitive description of the proof of Theorem 1 may be obtained by considering equation (1) again. Recall from Proposition 5 that, under optimal Myerson mediation, (i) dove pairs never fight, (ii) the settlement  $(p\theta, 1 - p\theta)$  is chosen so as to keep the payoff of hawks meeting doves as low as possible, and (iii) hawk pairs are more likely to fight than any other type pair. Hence, the mediator minimizes the incentives of a weak nation to pretend that it is strong. As an unintended consequence, it also minimizes the incentives for a weak nation to become strong. That is, Myerson mediation minimizes  $U(H, L) - U(L, L)$  and maximizes  $U(L, H) - U(H, H)$ , among all budget-balanced institutions. Hence, it keeps the upstream incentives to arm in check, and minimizes strategic militarization  $q$  in equilibrium. In other words, such a mediator induces the same militarization incentives as the hypothetical institution whose mandate includes deterring militarization which took place before the eruption of the crisis.

Because, by construction, the mediator's strategy in Proposition 5 maximizes the chance of peace given any militarization strategy  $q$ , the fact that it also minimizes the equilibrium militarization probability implies that it maximizes the overall disputants' welfare, among all budget-balanced institutions.

## 5 Conclusion

This paper pushes scholars of conflict to broaden their field of vision in thinking about institutions. How nations negotiate can affect more than whether the crises that emerge are resolved peacefully; conflict resolution institutions can have pronounced effects on the types of crises that are likely to emerge by shaping militarization incentives. Because engagement in a costly and destructive war can be seen as the ‘punishment’ for entering a dispute, institutions that reduce the chances that a dispute lead to open conflict may make more disputes emerge and incentivize militarization.

We show that consideration of militarization incentives is important when assessing the overall effectiveness of conflict resolution institutions. Our formal analysis finds that the support for un-mediated peace talks, while effective in improving the chance of peace for a given distribution of military strength, ultimately may lead to the emergence of more disputes and to higher conflict outbreak. Happily, we find that not all conflict resolution institutions suffer from these, apparently paradoxical, but actually quite intuitive drawbacks. We identify a form of third-party intervention inspired by the celebrated work by Myerson, and show that it can broker peace in emerged disputes effectively and also avoid perverse militarization incentives.

Beyond broadening the focus of theoretical work on conflict resolution institutions to consider the effects we describe above, this paper contributes to our understanding of communication and bargaining. A series of paper going back to at least Kydd (2003) focus on the question of whether mediation can improve on direct communication. At the heart of this debate is whether there is value in a mediator with no independent private information and no ability to create external incentives. In the case of private values the answer is no (Fey and Ramsay, 2010), but in the context of interdependent values the answer is yes (Hörner, Morelli and Squintani, 2015).

In this paper we have focused on how the effectiveness of mediated and un-mediated communication can differ as the former does not breed perverse militarization incentives,

whereas the latter does. The difference hinges on the confidentiality of communication through a mediator. Because of the mediator's confidentiality, players have better incentives to disclose their information than when communicating directly. By adopting a non-fully revealing recommendation strategy, the mediator can optimally shape the equilibrium beliefs players assign to their opponent being a hawk at the time that they must accept or reject an offer. In settings with interdependent values this belief is important as it influences what a hawk will accept. But in settings with private values the type of the other nation is not payoff relevant and thus the ability to influence this belief buys a mediator nothing.

To be sure, mediators improve upon direct communication only if they are able to commit to quit negotiations in which disputants report that they are highly militarized (and as argued earlier, this supposition seems realistic on the basis of existing evidence). This capability, while seemingly counterproductive, is necessary both to minimize the chance that disputes that emerge erupt in open warfare, and to provide optimal incentives for arming and dispute emergence. Hence, one take away of this paper is a better understanding of what makes a mediator effective—the confidentiality of communication, the commitment capability, and when such attributes can have the most value—when the uncertainty is about common value components.

We conclude by relating our findings with the study of optimal taxation with mechanism design, a large literature that dates back at least to the celebrated work by Mirrlees (1971). The issue of tax evasion is of course a main concern of policy-makers. Tax auditing is an imperfect system to tackle tax evasion, and one may want to complement it with direct mechanisms that discourage income under-reporting, especially by high income earners. And at the same time, a classical concern of the optimal taxation literature is that the tax system does not reduce the incentives to work and increase income for low income persons. Our results may be related to these matters. We have found that the optimal mediation mechanism simultaneously discourages weak players from (falsely) reporting that they are

strong, and minimizes the incentive that they militarize and become strong in the first place. This suggests that classical results on the construction of taxation schemes to avoid dis-incentives to income generation may also facilitate truthful reporting and help avoid tax evasion.

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# Appendix

## Proofs of Results on Un-mediated Peace Talks

Throughout the Appendices, we will use the notation  $\lambda = q/(1 - q)$ , which denotes the odds ratio associates with the probability  $q$  that players are militarized, as this will simplify calculations.

**Proof of Proposition 1.** First, note that for  $q\theta/2 + (1 - q)p\theta \leq 1/2$ , or  $q \geq \gamma/(\gamma + 1)$ , both doves and hawks can achieve peace by coordinating on the claims  $x_A = x_B = 1/2$ . When  $q < \gamma/(\gamma + 1)$ , it is impossible that hawk dyads achieve peace. But it is possible to achieve peace for all other type dyads, as long as the hawk's claim is compatible with an opponent dove's demand. This is achieved by setting  $x_L + x_H = 1$ , so that peace can be achieved in equilibrium. Also, a hawk must prefer to demand  $x_H$  rather than triggering war against a dove by making a higher demand (if meeting a hawk, the demand will result in war anyway). Hence, we need that  $x_H \geq p\theta$ . Further, a dove must prefer to post her demand  $x_L$  rather than triggering war with a hawk, but collecting a higher share of the pie with a dove, by making the demand  $1 - x_L$ . This requirement translates into the following inequality:  $(1 - q)/2 + qx_L \geq (1 - q)(1 - x_L) + q(1 - p)\theta$ . Bringing together these conditions, we obtain the condition that  $q \geq \gamma/(\gamma + 2)$ . When this condition fails, it is impossible to achieve peace for mixed hawk-dove dyads. As a result, only dove dyads will achieve peace, by making compatible claims  $x_L = 1/2$ . ■

**Proof of Proposition 2.** We calculate the equilibrium militarization strategy  $q$  given the solution of the crisis bargaining game in Proposition 1.

We first search for completely mixed strategies, i.e., we impose the indifference condition

$$I_L(q) = I_H(q) - k;$$

where  $I_L(q)$  and  $I_H(q)$  are the interim payoffs of doves and hawks respectively.

On the basis of Proposition 1, there are two cases to consider.

Case 1:  $q \leq \gamma/(\gamma + 2)$ . Here, peace is only achieved by dove dyads, and so:

$$I_L(q) = q(1 - p)\theta + (1 - q)/2$$

$$I_H(q) = q\theta/2 + (1 - q)p\theta.$$

Solving the indifference condition, we obtain

$$k(q) = \frac{1}{2}q(1 - \theta) + p\theta - \frac{1}{2},$$

which is an increasing expression in  $q$ , such that  $k(0) = p\theta - 1/2$ .

Case 2.  $\gamma/(\gamma + 2) < q \leq \gamma/(\gamma + 1)$ . Here, only hawk dyads result in war. Because  $x_H = p\theta$  and  $x_L = 1 - p\theta$ , we obtain:

$$I_L(q) = q(1 - p\theta) + (1 - q)/2$$

$$I_H(q) = q\theta/2 + (1 - q)p\theta.$$

Solving the indifference condition yields:

$$k(\lambda) = (1 - \theta) \frac{\gamma - \lambda(1 - \gamma)}{2(\lambda + 1)},$$

which is a decreasing function in  $\lambda$  such that  $k^+(\gamma/2) = (1 - \theta) \frac{(\gamma+1)\gamma}{2(\gamma+2)} < k^-(\gamma/2) = \frac{(\gamma+3)\gamma}{2(\gamma+2)}(1 - \theta)$  and  $k(\gamma) = (1 - \theta) \frac{\gamma^2}{2(\gamma+1)}$ . Inverting the expression  $k(\lambda)$ , and changing variable to  $q$ , we obtain:

$$q(k) = \gamma - \frac{2k}{1 - \theta}$$

Hence, we obtain that for  $k \in [0, (1 - \theta) \frac{\gamma^2}{2(\gamma+1)})$ , there is no completely mixed strategy equilibrium  $q$ .

For  $k \in [(1 - \theta) \frac{\gamma^2}{2(\gamma+1)}, (1 - \theta) \frac{(\gamma+1)\gamma}{2(\gamma+2)}]$ , the unique completely mixed strategy equilibrium  $q(k) = \gamma - \frac{2k}{1 - \theta}$  is decreasing in  $k$ , such that  $\lambda \left( (1 - \theta) \frac{\gamma^2}{2(\gamma+1)} \right) = \gamma$  and  $\lambda \left( (1 - \theta) \frac{(\gamma+1)\gamma}{2(\gamma+2)} \right) = \gamma/2$ .

For  $k \in ((1 - \theta) \frac{(\gamma+1)\gamma}{2(\gamma+2)}, (1 - \theta) \frac{\gamma}{2})$ , there is no completely mixed strategy equilibrium  $q$ .

Considering that, for  $k \geq (1 - \theta) \frac{\gamma}{2}$ , there is a pure strategy equilibrium, in which  $q = 0$ , we can disregard case 1, which yields higher militarization probability and lower welfare.

Now consider pure-strategies. Suppose that  $q = 0$ , then  $I_L(q) = 1/2$  and  $I_H(q) = p\theta$ . Hence,  $q = 0$  is an equilibrium if and only if  $k \geq p\theta - 1/2 = (1 - \theta) \frac{\gamma}{2}$ . In the remaining region,  $k < (1 - \theta) \frac{(\gamma+1)\gamma}{2(\gamma+2)}$ , the ‘grim’ equilibrium, in which disputants arm and then fight is the unique equilibrium. ■

**Proof of Proposition 3.** In order to prove this result, we first reformulate the problem by substituting the last stage of the game, the double auction game, with the following, simpler, model. Given messages  $m = (m_A, m_B)$ , and the outcome of the public randomization

device, nature selects a split proposal  $x$ , and the players simultaneously choose whether to agree to the pie division  $(x, 1 - x)$ .

It is evident that any outcome of this simpler model is also an equilibrium of our model. Suppose, in fact, that the players agree to the split division  $(x, 1 - x)$  in the simpler model. Then, they can achieve the outcome  $(x, 1 - x)$  in the double auction game, by making demands  $x_A = x$  and  $x_B = 1 - x$ .

Focusing on fully-separating equilibria, one can also establish the converse result, that any equilibrium of our model (with the double auction game) is also an outcome of this simpler model. In fact, when types fully separate at the cheap talk stage, each player's type is common knowledge in the double auction stage. Hence, in equilibrium, the players know each other's demands. Suppose that, in equilibrium, player  $A$  demands  $x$ . Player  $B$ 's best response is either to demand  $1 - x$ , or to trigger war with a higher demand. Hence, either peace takes place with the split  $(x, 1 - x)$ , or war occurs. Player  $B$ 's choice of whether to trigger war or make the demand  $1 - x$  follows exactly the same calculation that it would make in the simpler model we introduced above, if nature selected the split proposal  $(x, 1 - x)$ . Because the same argument applies to player  $A$ , we have shown that any fully-separating equilibrium of our model (with the double auction game) is also an outcome of this simpler model.

Note, now, that pure-strategy equilibria of our model belong to two different categories: pooling equilibria and fully-separating equilibria. Of course, the pooling equilibria coincide with the equilibria of the game of conflict without peace talks. Hence, the solution of our problem can be achieved by comparing the equilibria described in Proposition 1, with the optimal (fully-separating) outcomes of the simpler game introduced in this proof, which are fully characterized in Lemma 1 in Hörner, Morelli, and Squintani (2015), henceforth shortened as HMS. These outcomes are the one reported in the statement of Proposition 3. They induce a higher peace chance than the equilibria described in Proposition 1, because it is the case that  $p_H > 0$ , when  $\gamma/2 \leq \lambda < \gamma$ , and that  $p_M > 0$ , when  $\lambda < \gamma/2$ . ■

**Proof of Proposition 4 .** In the notation of the separating equilibrium, for any given militarization probability, the interim payoffs are:

$$I_L(q) = q(p_M(1 - b) + (1 - p_M)(1 - p)\theta) + (1 - q)/2$$

$$I_H(q) = q(p_H/2 + (1 - p_H)\theta/2) + (1 - q)(p_M b + (1 - p_M)p\theta).$$

We search for completely mixed strategies, i.e., we impose that  $I_L(q) = I_H(q) - k$ . There are two cases.

Case 1:  $\lambda \leq \gamma/2$ . Substituting the solution described in Proposition 3 into the above

expressions, we obtain:

$$I_L(q) = q \left[ \frac{1}{1 + \gamma - 2\lambda} (1 - p\theta) + \left( 1 - \frac{1}{1 + \gamma - 2\lambda} \right) (1 - p)\theta \right] + (1 - q)/2$$

$$I_H(q) = q\theta/2 + (1 - q)p\theta.$$

Solving the indifference condition, and reparametrizing to get rid of  $p$  and  $q$ , we obtain the  $k$  which makes the players indifferent for  $\lambda$  and  $\gamma$  and  $\theta$  fixed:

$$k(\lambda) = (1 - \theta) \frac{(\gamma - \lambda + \lambda\gamma - 2\lambda^2)(\gamma + 1)}{2(\gamma - 2\lambda + 1)(\lambda + 1)}$$

Because  $2\lambda \leq \gamma$ , this is always positive.

We first differentiate  $k(\lambda)$ ,

$$\begin{aligned} \frac{\partial k(\lambda)}{\partial \lambda} &= \frac{1}{2} (\gamma - 2\lambda + 1)^{-2} (\lambda + 1)^{-2} (\gamma - 4\lambda - 1) (\gamma + 1) (1 - \theta) \\ &\propto \gamma - 4\lambda - 1 \end{aligned}$$

The expression is positive for  $\lambda < (\gamma - 1)/4$  and negative for  $\lambda > (\gamma - 1)/4$ , on the range  $\lambda \in [0, \gamma/2]$ . Then, we calculate the extremes of the range:  $k(0) = (1 - \theta) \frac{\gamma}{2}$  and  $k(\gamma/2) = (1 - \theta) \frac{(\gamma+1)\gamma}{2(\gamma+2)}$ . This concludes that the function  $k(\lambda)$  equals  $(1 - \theta) \frac{\gamma}{2}$  at  $\lambda = 0$  to then increase until  $\lambda = (\gamma - 1)/4$  and then decrease until  $\lambda = \gamma/2$  reaching  $(1 - \theta) \frac{(\gamma+1)\gamma}{2(\gamma+2)}$ . Noting that  $(1 - \theta) \frac{\gamma}{2} > (1 - \theta) \frac{(\gamma+1)\gamma}{2(\gamma+2)} > 0$ , we determine the following conclusions:

For  $[k \in (1 - \theta) \frac{(\gamma+1)\gamma}{2(\gamma+2)}, (1 - \theta) \frac{\gamma}{2})$ , there exists a unique equilibrium  $\lambda(k)$ , the function  $\lambda$  is strictly decreasing in  $k$ . It starts at  $\lambda = \gamma/2$  for  $k = (1 - \theta) \frac{(\gamma+1)\gamma}{2(\gamma+2)}$  and reaches  $\lambda(q) = 0$  for  $k = (1 - \theta) \frac{\gamma}{2}$ . The explicit equilibrium solution is cumbersome, and its omission inconsequential.

For  $k \in [0, (1 - \theta) \frac{(\gamma+1)\gamma}{2(\gamma+2)})$ , there does not exist any equilibrium such that  $\lambda \leq \gamma/2$ .

Case 2.  $\lambda \in [\gamma/2, \gamma)$ . The interim payoffs are:

$$I_L(q) = q(1 - p\theta) + (1 - q)/2$$

$$I_H(q) = q \left[ \frac{2\lambda - \gamma}{\lambda(\gamma + 2)} (1/2) + \left( 1 - \frac{2\lambda - \gamma}{\lambda(\gamma + 2)} \right) \theta/2 \right] + (1 - q)p\theta.$$

Hence, the indifference condition yields:

$$k = (1 - \theta) \frac{(\gamma + 1) \gamma}{2(\gamma + 2)},$$

which is constant in  $\lambda$ . So, for  $k = (1 - \theta) \frac{(\gamma+1)\gamma}{2(\gamma+2)}$ , all  $\lambda \in [\gamma/2, \gamma)$  are an equilibrium, and there is no completely mixed equilibrium for  $k < (1 - \theta) \frac{(\gamma+1)\gamma}{2(\gamma+2)}$ .

Now consider pure-strategies. Suppose that  $q = 0$ , then  $I_L(q) = 1/2$  and  $I_H(q) = p\theta$ . Hence,  $q = 0$  is an equilibrium if and only if  $k \geq p\theta - 1/2 = (1 - \theta) \frac{\gamma}{2}$ . In the remaining region,  $k < (1 - \theta) \frac{(\gamma+1)\gamma}{2(\gamma+2)}$ , the ‘grim’ equilibrium, in which disputants arm and then fight is the unique equilibrium. ■

## Proofs of the Results on Mediation

**Proof of Proposition 5.** The proof of this result consists of showing that the optimal strategies of a Myerson mediator coincide with the optimal strategies of a mediator characterized in HMS, Lemma 4.

The basic set up is the same in the two papers: There are two players, whose strength can be high with probability  $q$  and of low with probability  $1 - q$ ; if fighting, the payoffs are  $(\theta/2, \theta/2)$  when players have the same strength, and  $p\theta, (1 - p)\theta$  if the first player is stronger. Unlike here, when modeling mediation in HMS, we directly appeal to the revelation principle (Myerson, 1982) and restrict attention, without loss of generality, to direct revelation mechanisms. In a direct revelation mechanism the players privately report their “types”, in this case their realized level of militarization, to the mediator. Then, the mediator makes a recommendation to the players, possibly randomizing across recommendations. In this context, such a recommendation may also be to go to “war”. Furthermore, without loss of generality, we restricted attention to truthful equilibria of the direct and obedient revelation mechanism, in which the mediators strategies are such that players reveal their types truthfully to the mediator, and the mediator’s recommendation is obeyed by the players. By the revelation principle we know that the ex-ante peace probability induced by *any* mediation scheme, within the class of games described above, can also be achieved as the truthful equilibrium of the game induced by the direct and obedient revelation mechanism. For future reference, we here report the mediation program derived in HMS.

$$\min_{b, p_H, p_M, q_M, p_L, q_L} (1 - 2p_L - q_L) (1 - q)^2 + (1 - p_M - q_M) 2q (1 - q) + (1 - q_H) q^2$$

subject to the high-type *ex post* Individual Rationality (IR) constraint

$$bp_M \geq p_M p \theta, \quad (qq_H + (1 - q)q_M) \cdot 1/2 \geq qq_H \theta/2 + (1 - q)q_M p \theta,$$

to the low type *ex post* IR constraint

$$p_L b \geq p_L \theta/2, \quad (qp_M + (1 - q)p_L)(1 - b) \geq qp_M(1 - p)\theta + (1 - q)p_L \theta/2, \\ (qq_M + (1 - q)q_L) \cdot 1/2 \geq qq_M(1 - p)\theta + (1 - q)q_L \theta/2,$$

to the high-type *ex interim* incentive compatibility (IC\*) constraint

$$q(q_H/2 + (1 - q_H)\theta/2) + (1 - q)(p_M b + q_M/2 + (1 - p_M - q_M)p\theta) \geq \\ \max\{(qp_M + (1 - q)p_L)(1 - b), qp_M \theta/2 + (1 - q)p_L p \theta\} + \max\{(1 - q)p_L b, (1 - q)p_L p \theta\} \\ + \max\{(qq_M + (1 - q)q_L) \cdot 1/2, qq_M \theta/2 + (1 - q)q_L p \theta\} \\ + q(1 - p_M - q_M)\theta/2 + (1 - q)(1 - 2p_L - q_L)p\theta,$$

and to the low-type *ex interim* IC\* constraint

$$q(p_M(1 - b) + q_M/2 + (1 - p_M - q_M)(1 - p)\theta) \\ + (1 - q)(p_L b + p_L(1 - b) + q_L/2 + (1 - 2p_L - q_L)\frac{\theta}{2}) \geq \\ \max\{(1 - q)p_M b, (1 - q)p_M \frac{\theta}{2}\} + \max\{(qq_H + (1 - q)q_M) \cdot 1/2, qq_H(1 - p)\theta + (1 - q)q_M \frac{\theta}{2}\} \\ + q(1 - q_H)(1 - p)\theta + q(1 - p_M - q_M)\theta/2,$$

To see that such an upper bound can be reached by Myerson mediation in our model, it is sufficient to note that any truthful equilibrium achieved by the direct and obedient revelation mechanism is also an equilibrium of our Nash demand game augmented with a Myerson mediator.

Suppose in fact that the mediator's recommendation is for a peaceful split  $(x, 1 - x)$  of the pie, accepted by the players in the equilibrium of the game induced by the direct revelation mechanism. Then, there is also an equilibrium of the Nash demand game in which the players demand precisely  $x_A = x$  and  $x_B = 1 - x$ , thus resolving the dispute peacefully. And we have seen before that the crisis bargaining game always has war equilibria, to reproduce the outcome of a "war recommendation" in the game induced by the direct revelation mechanism. Hence, the direct revelation mechanism yields an upper bound for the peace probability that mediation can achieve in the Nash demand game augmented

with a Myerson mediator.

This concludes that the optimal strategies of a Myerson mediator coincide with the optimal strategies of a mediator characterized in HMS, Lemma 4 which states that, for any fixed  $q$ , the specific values of the control variables are:

- For  $q \leq \gamma/(\gamma + 2)$ ,  $b = p\theta$ ,  $q_L = 1$ ,  $q_H = q_M = 0$ ,  $p_M = \frac{1-q}{(\gamma+1)(1-q)-2q}$ .
- For  $\frac{\gamma}{\gamma+2} \leq q < \frac{\gamma}{\gamma+1}$ ,  $b = p\theta$ ,  $q_L = 1$ ,  $p_M + q_M = 1$ ,  $q_H = \frac{1-q}{q} \frac{2q-\gamma(1-q)}{(\gamma+1)(1-q)-q}$ ,  $q_M = \frac{1}{\gamma} \frac{2q-\gamma(1-q)}{(\gamma+1)(1-q)-q}$ .
- For  $q \geq \frac{\gamma}{\gamma+1}$ ,  $b = p\theta$ ,  $q_L = 1$ ,  $q_M = 1$ , and  $q_H = 1$ .

■

**Proof of Proposition 6.** Consider the Myerson mediation game. The expected equilibrium payoffs of a hawk and dove before they report their type to the mediator are, respectively:

$$I_L(q) = q(p_M(1 - p\theta) + q_M/2 + (1 - p_M - q_M)(1 - p)\theta) + (1 - q)/2; \quad (2)$$

$$I_H(q) = q(q_H/2 + (1 - q_H)\theta/2) + (1 - q)(p_M p\theta + q_M/2 + (1 - p_M - q_M)p\theta). \quad (3)$$

Hence, at the beginning of the game, the payoff for militarizing is  $I_H(q) - k$ , whereas the payoff of remaining a dove is  $I_L(q)$ . An equilibrium with full militarization,  $q = 1$ , exists when  $I_H(1) - k \geq I_L(1)$ ; likewise, an equilibrium with no militarization,  $q = 0$ , exists when  $I_L(0) \geq I_H(0) - k$ ; whereas an equilibrium with mixed militarization strategy  $q$  exists when  $I_L(q) = I_H(q) - k$ .

When  $k > p\theta - 1/2$ , the unique symmetric equilibrium is  $q = 0$ . In fact, for all  $q$ ,

$$\begin{aligned} & I_L(q) - I_H(q) + k \\ = & q(p_M(1 - p\theta) + q_M/2 + (1 - p_M - q_M)(1 - p)\theta) + (1 - q)/2 \\ & - (q(q_H/2 + (1 - q_H)\theta/2) + (1 - q)(p_M p\theta + q_M/2 + (1 - p_M - q_M)p\theta)) + k \\ > & q(p_M(1 - p\theta) + q_M/2 + (1 - p_M - q_M)(1 - p)\theta) + (1 - q)/2 \\ & - (q(q_H/2 + (1 - q_H)\theta/2) + (1 - q)(p_M p\theta + q_M/2 + (1 - p_M - q_M)p\theta)) + p\theta - 1/2 \\ = & \frac{1 - \theta}{2(1 + \lambda)} (2\lambda p_M - \lambda q_H - \lambda + 2\lambda q_M + \gamma q_M + \lambda \gamma q_M) \end{aligned}$$

$$\begin{aligned}
&= \begin{cases} \frac{1-\theta}{2(1+\lambda)} \left( 2\lambda \frac{1}{1+\gamma-2\lambda} - \lambda \right) & \text{if } \lambda < \gamma/2 \\ \frac{1-\theta}{2(1+\lambda)} \left( 2\lambda - \lambda \frac{2\lambda-\gamma}{\lambda(\gamma+1-\lambda)} - \lambda + \gamma \frac{2\lambda-\gamma}{\gamma(\gamma+1-\lambda)} + \lambda \gamma \frac{2\lambda-\gamma}{\gamma(\gamma+1-\lambda)} \right) & \text{if } \gamma/2 \leq \lambda < \gamma \\ \frac{1-\theta}{2} \gamma & \text{if } \lambda \geq \gamma. \end{cases} \\
&= \begin{cases} \frac{1-\theta}{2(1+\lambda)} \frac{(2\lambda-\gamma+1)}{(\gamma-2\lambda+1)} \lambda & \text{if } \lambda < \gamma/2 \\ \frac{1-\theta}{2(1+\lambda)} \frac{\lambda+1}{\gamma-\lambda+1} \lambda & \text{if } \gamma/2 \leq \lambda < \gamma \\ \frac{1-\theta}{2} \gamma & \text{if } \lambda \geq \gamma. \end{cases}
\end{aligned}$$

These quantities are all positive.

So, suppose that  $k \leq p\theta - 1/2 = (1-\theta)\gamma/2$ . We now search for mixed strategy equilibria. The indifference condition is:

$$I_L(q) + k = I_H(q)$$

Case 1:  $\lambda \leq \gamma/2$ . Substituting the mediator's solution into the expressions (2) and (3), we obtain:

$$I_L(q) = q \left[ \frac{1}{1+\gamma-2\lambda} (1-p\theta) + \left( 1 - \frac{1}{1+\gamma-2\lambda} \right) (1-p)\theta \right] + (1-q)/2$$

$$I_H(q) = q\theta/2 + (1-q)p\theta.$$

Solving the indifference condition, and reparametrizing to get rid of  $p$  and  $q$ , we obtain the  $k$  which makes the players indifferent for  $\lambda$  and  $\gamma$  and  $\theta$  fixed:

$$k(\lambda) = (1-\theta) \frac{(\gamma - \lambda + \lambda\gamma - 2\lambda^2)(\gamma + 1)}{2(\gamma - 2\lambda + 1)(\lambda + 1)}$$

Because  $2\lambda \leq \gamma$ , this is always positive.

We first differentiate  $k(\lambda)$ ,

$$\begin{aligned}
\frac{\partial k(\lambda)}{\partial \lambda} &= \frac{1}{2} (\gamma - 2\lambda + 1)^{-2} (\lambda + 1)^{-2} (\gamma - 4\lambda - 1)(\gamma + 1)(1 - \theta) \\
&\propto \gamma - 4\lambda - 1
\end{aligned}$$

The expression is positive for  $\lambda < (\gamma - 1)/4$  and negative for  $\lambda > (\gamma - 1)/4$ , on the range



$\lambda \in [0, \gamma/2]$ . Then, we calculate the extremes of the range:

$$k(0) = (1 - \theta) \frac{\gamma}{2} \text{ and } k(\gamma/2) = (1 - \theta) \frac{(\gamma + 1)\gamma}{2(\gamma + 2)}.$$

This concludes that the function  $k(\lambda)$  equals  $(1 - \theta) \frac{\gamma}{2}$  at  $\lambda = 0$  to then increase until  $\lambda = (\gamma - 1)/4$  and then decrease until  $\lambda = \gamma/2$  reaching  $(1 - \theta) \frac{(\gamma+1)\gamma}{2(\gamma+2)}$ . Noting that  $(1 - \theta) \frac{\gamma}{2} > (1 - \theta) \frac{(\gamma+1)\gamma}{2(\gamma+2)} > 0$ , we determine the following conclusions:

- For  $[k \in (1 - \theta) \frac{(\gamma+1)\gamma}{2(\gamma+2)}, (1 - \theta) \frac{\gamma}{2})$ , there exists a unique equilibrium  $\lambda(k)$ . The function  $\lambda$  is strictly decreasing in  $k$ , it starts at  $\lambda = \gamma/2$  for  $k = (1 - \theta) \frac{(\gamma+1)\gamma}{2(\gamma+2)}$  and reaches  $\lambda(q) = 0$  for  $k = (1 - \theta) \frac{\gamma}{2}$ .
- For  $k \in [0, (1 - \theta) \frac{(\gamma+1)\gamma}{2(\gamma+2)})$ , there does not exist any equilibrium such that  $\lambda \leq \gamma/2$ .

The explicit equilibrium solution is cumbersome, and its omission inconsequential.

Case 2. For  $\gamma \geq \lambda \geq \gamma/2$ , substituting the mediator's solution into the expressions

$$I_L(q) = q \left[ \left( 1 - \frac{2\lambda - \gamma}{\gamma(\gamma + 1 - \lambda)} \right) (1 - p\theta) + \frac{2\lambda - \gamma}{2\gamma(\gamma + 1 - \lambda)} \right] + (1 - q)/2$$

$$I_H(q) = q \left[ \frac{2\lambda - \gamma}{2\lambda(\gamma + 1 - \lambda)} + \left( 1 - \frac{2\lambda - \gamma}{\lambda(\gamma + 1 - \lambda)} \right) \theta/2 \right] + (1 - q) \left[ \left( 1 - \frac{2\lambda - \gamma}{\gamma(\gamma + 1 - \lambda)} \right) p\theta + \frac{2\lambda - \gamma}{2\gamma(\gamma + 1 - \lambda)} \right].$$

Again, solving for the indifference condition and reparametrizing, we obtain

$$k(\lambda) = (1 - \theta) \frac{(\gamma - \lambda)(\gamma + 1)}{2(\gamma - \lambda + 1)},$$

or

$$q = (1 + \gamma) \frac{2k - \gamma(1 - \theta)}{2k(2 + \gamma) - (1 + \gamma)^2(1 - \theta)}$$

this is again always positive.

Differentiating it, we obtain:

$$\frac{\partial k(\lambda)}{\partial \lambda} = -\frac{1}{2} (\lambda - \gamma - 1)^{-2} (\gamma + 1) (1 - \theta) < 0.$$

Calculating it at the two extremes  $\lambda = \gamma/2$  and  $\lambda = \gamma$ , we obtain:

$$k(\gamma/2) = (1 - \theta) \frac{(\gamma + 1)\gamma}{(\gamma + 2)2}, \text{ and } k(\gamma) = 0.$$

This concludes that, for  $k \in \left[0, (1 - \theta) \frac{(\gamma+1)\gamma}{(\gamma+2)2}\right]$ , there is a unique mixed strategy equilibrium  $\lambda(k)$ , with  $\gamma/2 \leq \lambda \leq \gamma$ , the function  $\lambda(k)$  is strictly decreasing, it starts at  $\lambda = \gamma$  for  $k = 0$ , and reaches  $\lambda = \gamma/2$  for  $k = (1 - \theta) \frac{(\gamma+1)\gamma}{(\gamma+2)2}$ .

Wrapping up the two cases, we conclude that there is a unique mixed strategy equilibrium  $\lambda^*(k)$ . It is strictly decreasing in  $k$  for  $k \in \left[0, (1 - \theta) \frac{\gamma}{2}\right]$ , with  $\lambda(0) = \gamma$  and  $\lambda\left((1 - \theta) \frac{\gamma}{2}\right) = 0$ , for  $k > (1 - \theta) \frac{\gamma}{2}$ ,  $\lambda(k) = 0$ .

Turning to check for pure-strategy equilibria, we first suppose that  $q = \lambda = 0$ , then  $I_L(q) = 1/2$  and  $I_H(q) = p\theta$ . Hence, for  $k \leq p\theta - 1/2$ ,  $\lambda = 0$  is not an equilibrium. Then, suppose that  $q = 1$ . The mediator's solution is to assign  $q_L = q_M = q_H = 1$ , so that the split  $1/2$  is always assigned regardless of the reports. Hence, the interim payoffs are  $I_L(q) = 1/2 = I_H(q)$ . So, becoming a hawk with probability one is never an equilibrium. This result completes the proof of Proposition 6. ■

**Proof of Theorem 1.** To prove this result, we first show a useful Lemma that compares the symmetric equilibrium militarization probability in the *arbitration* dispute resolution solution of HMS, with the *mediation* HMS dispute resolution solution. The arbitration dispute resolution in HMS is formulated as mediation, with the only difference that players must commit to agree to the third party recommendation before such recommendations are made. In other terms, the arbitrator is capable of enforcing its recommendation, whereas the mediator's recommendations need to be self enforcing.

Formally, the HMS arbitration program is formalized as follows:

$$\min_{b, p_L, p_M, p_H} (1 - q)^2 (1 - p_L) + 2q(1 - q)(1 - p_M) + q^2(1 - p_H)$$

subject to *ex interim* individual rationality (for the hawk and dove, respectively)

$$\begin{aligned} (1 - q)(p_M b + (1 - p_M)p\theta) + q(p_H/2 + (1 - p_H)\theta/2) &\geq (1 - q)p\theta + q\theta/2, \\ (1 - q)(p_L/2 + (1 - p_L)\theta/2) + q(p_M(1 - b) + (1 - p_M)(1 - p)\theta) &\geq (1 - q)\theta/2 + q(1 - p)\theta, \end{aligned}$$

and to the *ex interim* incentive compatibility constraints (for the hawk and dove, respec-

tively)

$$(1 - q) ((1 - p_M)p\theta + p_M b) + q ((1 - p_H)\theta/2 + p_H/2) \geq \\ (1 - q) ((1 - p_L)p\theta + p_L/2) + q ((1 - p_M)\theta/2 + p_M(1 - b)),$$

$$(1 - q) ((1 - p_L)\theta/2 + p_L/2) + q ((1 - p_M)(1 - p)\theta + p_M(1 - b)) \geq \\ (1 - q) ((1 - p_M)\theta/2 + p_M b) + q ((1 - p_H)(1 - p)\theta + p_H/2).$$

**Lemma.** The *arbitration* dispute resolution solution of HMS yields the same symmetric equilibrium militarization probability as the *mediation* HMS dispute resolution solution.

**Proof of Lemma.** For any  $\gamma$  (including  $\gamma < 1$ ), HMS show that the arbitration solution is:

- For  $\lambda \leq \gamma/2$ ,  $b = \frac{1}{2}(\gamma(1 - \theta) + 1)$ ,  $p_L = 1$ ,  $p_M = \frac{1}{\gamma - 2\lambda + 1}$ ,  $p_H = 0$ ;
- For  $\gamma/2 < \lambda \leq \gamma$ ,  $b = -\frac{3\lambda - 3\gamma - 2\theta\lambda + 2\theta\gamma + \lambda\gamma - \theta\lambda\gamma - \gamma^2 + \theta\gamma^2 - 1}{-2\lambda + 2\gamma + 2}$ ,  $p_L = 1$ ,  $p_M = 1$ ,  $p_H = \frac{2\lambda - \gamma}{(\gamma - \lambda + 1)\lambda}$ .

The militarization strategy  $q$  in the arbitration game is given by the indifference condition:

$$I_L(q) = (1 - q) ((1 - p_M)p\theta + p_M b) + q ((1 - p_H)\theta/2 + p_H/2) \\ = (1 - q) ((1 - p_L)\theta/2 + p_L/2) + q ((1 - p_M)(1 - p)\theta + p_M(1 - b)) - k = I_H(q) - k \quad (4)$$

Substituting the above solutions in the indifference condition, we find the expressions:

$$k(\lambda) = (1 - \theta) \frac{(\gamma - \lambda + \lambda\gamma - 2\lambda^2)(\gamma + 1)}{2(\gamma - 2\lambda + 1)(\lambda + 1)}, \text{ for } \lambda \leq \gamma/2, \quad (5)$$

$$k(\lambda) = (1 - \theta) \frac{(\gamma - \lambda)(\gamma + 1)}{2(\gamma - \lambda + 1)}, \text{ for } \gamma/2 < \lambda \leq \gamma, \quad (6)$$

which correspond to the solutions for the militarization game with the HMS optimal mediation solution (for any  $\gamma$ , including  $\gamma < 1$ ). ■

As a consequence of the above Lemma, we can prove the Theorem simply by showing that the HMS arbitration solution achieves the same outcome as our hypothetical institution that includes militarization deterrence in its objectives. In fact, we prove a stronger result.

We show that the HMS arbitration solution achieves the same welfare as a hypothetical institution that not only aims to keep militarization in check, but is also capable of enforcing its recommendations. Such an institution is represented by the following program. Let the dove and hawk interim expected utilities be, respectively,

$$I_L = q(p_M(1 - p\theta) + q_M/2 + (1 - p_M - q_M)(1 - p)\theta) + (1 - q)/2$$

$$I_H = q(q_H/2 + (1 - q_H)\theta/2) + (1 - q)(p_M p\theta + q_M/2 + (1 - p_M - q_M)p\theta).$$

The optimal institution chooses  $q, b, p_L, p_M$  and  $p_H$  so as to solve the program

$$\min_{q, b, p_L, p_M, p_H} (1 - q)^2 (1 - p_L + p_L\theta) + 2q(1 - q)(1 - p_M + p_M\theta - k) + q^2(1 - p_H + p_H\theta - 2k)$$

subject to the ex-ante obedience constraints:

$$q(1 - q)[I_H - k - I_L] = 0, q[I_H - k - I_L] \geq 0, (1 - q)[I_H - k - I_L] \leq 0$$

to the *ex interim* individual rationality (for the hawk and dove, respectively)

$$\begin{aligned} I_H &\geq (1 - q)p\theta + q\theta/2, \\ I_L &\geq (1 - q)\theta/2 + q(1 - p)\theta, \end{aligned}$$

and to the *ex interim* incentive compatibility constraints (for the hawk and dove, respectively)

$$\begin{aligned} I_H &\geq (1 - q)((1 - p_L)p\theta + p_L/2) + q((1 - p_M)\theta/2 + p_M(1 - b)), \\ I_L &\geq (1 - q)((1 - p_M)\theta/2 + p_M b) + q((1 - p_H)(1 - p)\theta + p_H/2). \end{aligned}$$

In order to proceed with the proof, we distinguish two parts. We first show that HMS arbitrators achieve the same peace chance as the optimal institution define above. Then, we show that they achieve the same militarization probability minimization as the optimal institution. The analysis holds for any  $\gamma$ , including the case  $\gamma < 1$ .

To tackle the first problem, we set up the following relaxed problem which describes necessary constraints satisfied by the hypothetical optimal institution defined above. We choose  $\{b, p_L, p_M, p_H, q\}$  so as to minimize the war probability

$$W = (1 - q)^2(1 - p_L) + 2q(1 - q)(1 - p_M) + q^2(1 - p_H)$$

subject to the hawk *interim* individual rationality constraint

$$(1 - q)(p_M b + (1 - p_M)p\theta) + q(p_H/2 + (1 - p_H)\theta/2) \geq (1 - q)p\theta + q\theta/2,$$

and to the dove *interim* incentive compatibility constraint

$$\begin{aligned} & (1 - q)((1 - p_L)\theta/2 + p_L/2) + q((1 - p_M)(1 - p)\theta + p_M(1 - b)) \geq \\ & (1 - q)((1 - p_M)\theta/2 + p_M b) + q((1 - p_H)(1 - p)\theta + p_H/2). \end{aligned}$$

and to the militarization indifference condition (4).

To solve the relaxed problem, we first solve  $b$  in the militarization indifference condition, and substitute it in the hawk *interim* individual rationality constraint, and in the hawk *interim* incentive compatibility constraint. Rearranging, they now take the forms:

$$\begin{aligned} H &= k + \frac{1}{2}\theta - kq - p\theta - \frac{1}{2}q\theta + pq\theta + \frac{1}{2}p_L - qp_L + qp_M - \frac{1}{2}\theta p_L + q\theta p_L \\ &\quad - q\theta p_M + \frac{1}{2}q^2 p_H + \frac{1}{2}q^2 p_L - q^2 p_M - \frac{1}{2}q^2 \theta p_H - \frac{1}{2}q^2 \theta p_L + q^2 \theta p_M \geq 0 \\ L &= p\theta - \frac{1}{2}\theta - k + \frac{1}{2}\theta p_M + \frac{1}{2}q\theta p_H - p\theta p_M - \frac{1}{2}q\theta p_M - pq\theta p_H + pq\theta p_M \geq 0. \end{aligned}$$

Note now that  $W$  evidently decreases in  $p_L$ , that  $L$  is independent of  $p_L$ , and that  $\partial H/\partial p_L = \frac{1}{2}(q - 1)^2(1 - \theta) > 0$ . Because setting  $p_L = 1$  makes  $W$  as small as possible without violating the constraints  $H$  and  $L$ , it has to be part of the solution.

Substituting  $p_L = 1$  in  $W$ ,  $H$ , and  $L$ , we obtain:

$$\begin{aligned} H &= k - q - kq - p\theta + \frac{1}{2}q\theta + pq\theta + qp_M - q\theta p_M + \frac{1}{2}q^2 - \frac{1}{2}q^2\theta \\ &\quad + \frac{1}{2}q^2 p_H - q^2 p_M - \frac{1}{2}q^2 \theta p_H + q^2 \theta p_M + \frac{1}{2}, \\ L &= p\theta - \frac{1}{2}\theta - k + \frac{1}{2}\theta p_M + \frac{1}{2}q\theta p_H - p\theta p_M - \frac{1}{2}q\theta p_M - pq\theta p_H + pq\theta p_M, \\ W &= 2q(1 - q)(1 - p_M) + q^2(1 - p_H). \end{aligned}$$

Now, we observe that  $\partial L/\partial p_H = -\theta q(p - 1/2) < 0$  that  $\partial L/\partial p_M = -\theta(p - 1/2)(1 - q) < 0$ , and that  $L = -k$  when  $p_M = 1$  and  $p_H = 1$ . Because  $W$  decreases in both  $p_M$  and  $p_H$ , this concludes that the dove incentive compatibility constraint must bind.

We now solve for  $p_M$  in the constraint  $L = 0$  and substitute it into the expressions for

$W$  and  $H$ . We obtain

$$\begin{aligned} W &= q^2 p_H + K_1(p, \theta, q, k) \\ H &= -\frac{1}{2} q^2 (1 - \theta) p_H + K_2(p, \theta, q, k), \end{aligned}$$

where the explicit formulas of  $K_1$  and  $K_2$  are inessential. Because  $W$  increases in  $p_H$  and  $H$  decreases in  $p_H$ , this concludes that the constraint  $H = 0$  must bind, unless  $p_H = 0$  (which does not matter, as it is part of the HMS arbitration solution).

Solving  $p_H$  in the hawk ex interim individual rationality constraint, and substituting the solution in the objective  $W$ , we obtain:

$$W = \frac{1}{\theta - 1} (2kq - 2k + 2p\theta + q\theta - 2pq\theta - 1).$$

This function increases in  $q$  for  $k \leq (1 - \theta)\gamma/2 = p\theta - 1/2$ , because:

$$\frac{\partial W}{\partial q} = \frac{2p\theta - \theta - 2k}{1 - \theta} \geq \frac{2p\theta - \theta - (2p\theta - 1)}{1 - \theta} = 1 > 0.$$

Hence, the minimization of  $W$  under the constraints that  $H = 0$ ,  $L = 0$ ,  $0 \leq p_M \leq 1$ ,  $0 \leq p_H \leq 1$  and  $0 \leq q \leq 1$  is equivalent to the minimization of  $q$  subject to the constraints that  $H = 0$ ,  $L = 0$ ,  $0 \leq p_M \leq 1$ ,  $0 \leq p_H \leq 1$  and  $0 \leq q \leq 1$ .

Note now that setting  $q = 0$  together with  $H = 0$  and  $L = 0$  yields  $p_H = \frac{\theta(2p-1)(2p\theta-2k-1)}{0} \rightarrow +\infty$ , because  $\theta(2p-1)(2p\theta-2k-1) \geq 0$  when  $k \leq p\theta - 1/2$ . Hence, the solution must have an interior  $q$ .

We are now ready to show that the minimal value of  $q$  subject to the constraints that  $H = 0$ ,  $L = 0$ ,  $0 \leq p_M \leq 1$ , and  $0 \leq p_H \leq 1$  is exactly the equilibrium value of  $q$  in the militarization game, assuming that disputes are solved with the HMS optimal arbitration solution. In order to do so, we take the following approach. We first reparametrize all expressions in  $\lambda = q/(1 - q)$  and  $\gamma = (2p\theta - 1)/(1 - q)$ . Then, we prove that, for every  $\lambda$ , the minimal value of  $k$  subject to the constraints that  $H = 0$ ,  $L = 0$ ,  $0 \leq p_M \leq 1$ , and  $0 \leq p_H \leq 1$  coincides with the expressions (5) and (6) obtained when solving the militarization indifference condition (4) after plugging in the HMS optimal arbitration solution. Because the expressions for  $k(\lambda)$  in (5) and (6) are strictly decreasing in  $\lambda$ , this concludes that the inverse function  $k^{-1}(k) = \lambda$  identifies the minimal  $q$  subject to the constraints that  $H = 0$ ,  $L = 0$ ,  $0 \leq p_M \leq 1$ , and  $0 \leq p_H \leq 1$ , via the increasing relation  $q/(1 - q) = \lambda$ .

By reparametrizing the expressions for  $H$  and  $L$ , setting both of them equal to zero,

and solving for  $k$  and  $p_H$  as a function of  $p_M$ , we obtain

$$p_H = \frac{(2\lambda p_M - p_M - \gamma p_M + 1)}{(\gamma - \lambda + 1)\lambda} \quad (7)$$

$$k(\lambda) = -\frac{1}{2}(1 - \theta) \frac{(\lambda p_M - \lambda\gamma - \gamma + \lambda^2)(\gamma + 1)}{(\gamma + 1 - \lambda)(\lambda + 1)}. \quad (8)$$

Because  $k$  decreases in  $p_M$  for all  $\lambda < \gamma$ , we want to set  $p_M$  as large as possible. When  $p_M = 1$ ,  $p_H = \frac{(2\lambda - \gamma)}{(\gamma - \lambda + 1)\lambda}$ , which is positive if and only if  $\lambda > \gamma/2$ .

Likewise, solving for  $k$  and  $p_M$  as a function of  $p_H$ , we obtain

$$k(\lambda) = \frac{1}{2}(1 - \theta) \frac{(\gamma - \lambda + \lambda\gamma - 2\lambda^2 + \lambda^2 p_H)(\gamma + 1)}{(\gamma - 2\lambda + 1)(\lambda + 1)}. \quad (9)$$

For  $\lambda < \gamma/2$ , it is the case that  $\gamma - 2\lambda + 1 > 0$ , and hence this expression increases in  $p_H$ . We thus set  $p_H = 0$  and it is easy to verify that  $p_M = \frac{1}{\gamma - 2\lambda + 1} \in (0, 1)$ .

Because we have recovered the HMS optimal arbitration solution, the part of the proof concerning peace chance is concluded.

We now turn to show that HMS arbitrators are the optimal mechanism in terms of militarization probability minimization, and achieve the same militarization probability as the optimal institution defined at the beginning of this proof. Our proof approach will be to show that the HMS optimal arbitration solution is the solution of the following relaxed problem:

$$\min_{p_L, p_M, p_H, b} \text{ s.t. } H = 0, L = 0, I_H - k = I_L \quad (10)$$

In order to do so, we first reparametrize all constraints in  $\lambda = q/(1 - q)$  and  $\gamma = (2p\theta - 1)/(1 - q)$ . Then, we prove that, for every  $\lambda$ , the minimal value of  $k(\lambda) = I_H - I_L$  subject to the constraints  $0 \leq p_L \leq 1$ ,  $0 \leq p_M \leq 1$ ,  $0 \leq p_H \leq 1$ ,  $H = 0$  and  $L = 0$  coincides with the expressions (5) and (6). Because these expressions strictly decrease in  $\lambda$ , the same reasoning as in the previous part of the proof then concludes that the problem (10) is solved by the HMS optimal arbitration solution.

So, we first differentiate  $k(\lambda) = I_H - I_L$  with respect to  $p_L$ , and obtain the negative derivative  $-\frac{1}{2}(1 - q)(1 - \theta)$ . Because we know that  $\partial H/\partial p_L > 0$  and  $\partial L/\partial p_L = 0$ , minimization of  $k(\lambda)$  requires setting  $p_L = 1$ . Then, we note that  $\partial k(\lambda)/\partial b > 0$ , whereas  $\partial H/\partial b > 0$ , and hence the constraint  $H = 0$  must bind. Then, we see that  $\partial k(\lambda)/\partial p_M = b - p\theta - q(1 - \theta) < 0$ , because  $H = 0$  implies that  $b - p\theta = \frac{q\theta p_H - qp_H + 2p\theta p_M - 2pq\theta p_M}{2(1 - q)p_M} - p\theta = -\frac{1}{2}(1 - \theta) \frac{qp_H}{(1 - q)p_M} \leq 0$ . This, together with  $\partial L/\partial p_M = -\theta(p - 1/2)(1 - q) < 0$  implies that  $L$  binds.

Solving for  $p_H$  and  $b$  in the constraints  $H = 0$ ,  $L = 0$ , after imposing  $p_L = 1$ , and substituting the results in  $k(\lambda)$ , we again obtain the expressions (7) and (8), so that we conclude that for  $\lambda > \gamma/2$ , the solution is  $p_M = 1$ ,  $p_H = \frac{(2\lambda-\gamma)}{(\gamma-\lambda+1)\lambda}$ . Likewise, solving for  $p_H$  and  $b$  in the constraints  $H = 0$ ,  $L = 0$ , after imposing  $p_L = 1$ , and substituting the results in  $k(\lambda)$ , we obtain expression (9), and conclude that the solution is  $p_H = 0$  and  $p_M = \frac{1}{\gamma-2\lambda+1} \in (0, 1)$ , for  $\lambda < \gamma/2$ .

Because we have recovered the HMS optimal arbitration solution, the part of the proof concerning militarization probability is concluded. ■



# Mediation and Peace

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## Online Appendix not Submitted for Publication

[...]

### Evidence on Commitment

One of the main assumptions of our model is the mediator's commitment to lead to a conflict escalation if this is prescribed by the optimal solution. In the real world, this translates into the mediator's commitment to quit and terminate the mediation, at least with some probability. In this section we provide two types of evidence that mediators in the real world are capable of keeping this commitment, and even that disputants prefer having a mediator with a credible reputation of being able to keep this commitment. The first type of evidence is from a data set that has settlement attempts as units of observation, namely the Issue Correlates of War dataset (ICOW), by Hensel et al (2008). The second type of evidence will be from an illustrative case study.

In fact, mediators often make clear to the disputants under which circumstances they will quit. Such contingent plans of action often include deadlines. According to Avi Gil, one of the key architects of the Oslo peace process, "A deadline is a great but risky tool. Great because without a deadline it's difficult to end negotiations. [The parties] tend to play more and more, because they have time. Risky because if you do not meet the deadline, either the process breaks down, or deadlines lose their meaning" (Watkins, 1998). Among the many cases in which this technique was used, see for instance Curran and Sebenius (2003)'s account of how a deadline was employed by former Senator George Mitchell in the Northern Ireland negotiations. Committing to such deadlines might be somewhat easier for professional mediators whose reputation is at stake, but they have been also used both by unofficial and official individuals, including Pope John Paul II and former U.S. President Jimmy Carter.<sup>30</sup> Meanwhile, institutions like the United Nations increasingly set time limits to their involvement up-front (see, for instance, the U.N. General Assembly report, 2000).

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<sup>30</sup>Bebchik (2002) describes how Clinton and Ross attempted to impress upon Arafat the urgency of accepting the proposal being offered for a final settlement, calling it a "damn good deal" that would not be within his grasp indefinitely.

## Evidence from settlement attempts data

The ICOW data set considers each settlement attempt as a distinct observation.<sup>31</sup> The key source of variation is whether mediators resume the mediation process through a new settlement attempt following failure or whether they withdraw for good. The theory assumes the mediator’s commitment to withdraw from mediation, expecting that this condition is essential to successful mediation. Mediation attempts in the presence of commitment to quit should be expected to be more successful, and mediators with such a reputation more sought after to serve as a mediator compared to mediators that cannot commit to quit. We probe the ICOW data for information that is consistent with these two hypotheses.

To ascertain whether these patterns exist, we construct rough indicators of mediation termination and differentiate cases according to the circumstances under which they terminated. The settlement attempt may end with 1) an agreement fully implemented; 2) an agreement reached but not ratified by at least one party; 3) an agreement reached and ratified but not complied with by at least one party; 4) no agreement reached and/or escalation of violent hostilities.<sup>32</sup> We say a mediator has “quit” if the mediator does not initiate a new mediation attempt involving the same two primary disputants within at least 10 years of the end of the mediation failure. We consider this a “responsive quit” if the settlement attempt ended under any conditions 2–4. A non trivial proportion of failed mediation attempts satisfy this criteria and a significant portion of the mediators in the sample will have quit at least once. Mediators who have established a reputation for actually following through on commitments to withdraw from the process in response to disputant transgressions should be considered more effective mediators and therefore should be more likely to be invited as a mediator in future settlement attempts.

Variable	frequency	Rel. Frequency (total)	Rel. Frequency (failed)
quit1	38	28.4% (134 total)	41.8% (91 total)
quit2	39	29.1% (134 total)	41.5% (94 total)

Table 1 describes how frequently mediators quit in the sample of 134 mediation attempts present in the ICOW dataset. The relative frequency of quitting in the panel varies slightly based on the definition of quitting used, which vary by how strict the criteria are for coding the result as a responsive quit, but overall the data suggest that approximately 30%

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<sup>31</sup>We use ICOW instead of other datasets because it’s level of analysis is appropriate for our purposes. The International Crisis Bargaining dataset (ICB), Brecher and Wilkenfeld (1997 and 2000) for example, would not be useful because it collapses all settlement attempts for each crisis into one observation.

<sup>32</sup>We use two alternative definitions of agreement, leading to quit1 and quit2 variables, but they lead to very similar results.

of the mediation attempts resulted in the mediator quitting by our definition. Of failed mediation attempts, mediators quit responsively in approximately 42% of cases. It is clear that mediators do quit in a significant portion of cases in which quitting is called for.

Variable	frequency	Rel. Frequency (total)
Quit1	116	86.6% (134 total)
Quit2	116	86.6% (134 total)

Table 2 demonstrates that an overwhelming majority of mediators in the sample quit the process (by our definition) at least once in their career. 116 of the 134 mediation attempts in the data were mediated by a third party that had quit at least once previously in the panel. This suggests mediators that demonstrate they will withdraw in response to belligerent transgressions are those asked again to mediate crises. The imprecision of the measurement and the limited variation does not allow us to claim that this is airtight evidence that the mediator’s capability to credibly threaten to quit when appropriate is a key factor in determining the mediator selection, but the evidence is at least consistent with the general perception that the ability to commit we assume in our model is an important characteristic of real world mediation.

### **Illustrative Case Study: Kofi Annan in Kenya and Syria**

When the contested December 2007 Kenyan Presidential election resulted in widespread ethnic violence, threatening to escalate to full-scale civil war, the international community rushed to establish peace-making efforts. After weeks of multiple uncoordinated mediation attempts that failed to bring the disputants closer to a negotiated settlement, the African Union appointed former UN Secretary-General Kofi Annan to head the Panel of Eminent African Personalities, a coalition of political actors to bring about a solution to the escalating violence. The most important pillar of Annan’s mediation strategy was the consolidation of the disparate mediation efforts and interested third parties behind a single process. He demanded, and received, assurances that the international community back the Panel’s efforts and refrain from pedaling alternative or competing mediation attempts. Throughout the negotiations, Annan constantly devised signals to communicate the lack of alternative negotiating channels to the disputants in order to ensure their engagement with the Panel’s efforts and proposals.

While working hard to overcome the challenges associated with bridging the bargaining gap separating Kibaki and Odinga, Annan also made a point early on to communicate to the disputants that the Panel would not remain involved indefinitely. As the pace of

progress slowed, Annan reiterated that he ‘would not be available forever and that an alternative had to be found’ (Lindenmayer and Kaye, 2009). When the two sides began stalling for time, refusing to make meaningful concessions on the political issue, Annan announced a suspension of the talks. In an interview with the Centre for Humanitarian Dialogue, Griffiths (2008), Annan described the motivation for his decision:

“...Look, this is getting nowhere, so I’ve decided I’m suspending talks.” ...“I had done my duty and believed the leaders should do theirs.”

Annan clearly used the suspension of the mediation process, and the threat of its termination, to coerce the parties into giving up more than they hoped at the bargaining table. He even went so far to strengthen his signal by suggesting his successor, Cyril Ramaphosa of South Africa. Kibaki and the PNU vehemently rejected this proposed replacement, claiming Ramaphosa to be partial to Odinga’s claim. But nevertheless, the signal seems to have been perceived as credible, as the disputants increased the urgency with which they engaged with the Panel’s peace-making process (Lindenmayer and Kaye 2009).

Annan’s commitment to withdraw from mediation in the event the parties refused to abide by his negotiating plan was a calculated complement to his demand to consolidate the international community behind one mediation process. These two tactics served the strategy to remove the disputants’ ability to shop around for alternative mediators and conflict resolution avenues, leaving them with the option of following Annan’s lead or continuing a fight neither side wanted. This strategy fit the crisis well because it was clear that both parties wanted to end the conflict, but that the possibility of alternative means to attain their political goals tempted them away from conceding too much at the negotiating table.

Despite a mixed record of success (failure in Rwanda and Bosnia; success in Kenya), Annan was asked again to step into the mediator’s role as Special Envoy for the U.N and the Arab League in Syria’s escalating civil war. One of the prominent reasons cited for his appointment was his recent success in Kenya. But, unlike in the Kenya case, in Syria Annan faced a deeply divided international community. Though nominally unanimous in support of Annan’s role and his six-point peace plan, the competing world powers almost immediately took actions to undermine the mediation process. The U.S. and Western allies began arming rebel forces and continued to call for Assad to step down while Russia and China continued to prop up Assad’s regime. Without the international community united behind the process, the situation deteriorated. Annan quit in response to continued escalation of violence and both parties’ violation of the six-point plan. As such, Annan maintained his credibility to commit to withdraw from his role in the event disputants become uncooperative.

# Mediation and Arbitration Without Commitment

We here explore the conflict resolution capabilities of mediators who pursue peace at all costs in all circumstances. To provide a framework to our analysis, we focus on truthful revelation mechanisms, as in the analysis of the mediators with commitment of section ???. Each disputant  $i$  privately sends a message  $m_i \in \{h, l\}$  to the mediator, who then makes a (public) recommendation. The only difference with respect to section ??? is that, here, the mediator does not have any commitment capability: given her (equilibrium) beliefs with respect to the types of disputants as a function of the received message, she makes recommendations that induces beliefs which leads to the equilibrium that maximizes the chance of peace.

We argue that such mediators are ineffective. Specifically, we first show that there do not exist equilibria in which the players reports their types truthfully and agree to the mediator's recommendations. Hence, mediators who seek peace in all circumstances cannot improve upon un-mediated communication by means of standard truthful revelation mechanisms. This result follows from Theorem 2 by Fey and Ramsay (2009), but because the setting is slightly different, we present a proof.

The first step is to note that if there were an equilibrium, it would be one in which peace is achieved with probability one. In fact, because the players would truthfully reveal their types, the mediator can achieve peace with probability one by making the proposals  $(p\theta, 1 - \theta)$  after reports  $(h, l)$ ,  $(1 - \theta, p\theta)$  after reports  $(l, h)$ , and  $(1/2, 1/2)$  otherwise.

Because the equilibrium achieves peace with probability one, the high-type's incentive compatibility constraint with double deviation reduces to:

$$\int_0^1 b dF(b|h) \geq \int_0^1 \max\{b, \Pr[l|b, l]p\theta + \Pr[h|b, l]\theta/2\} dF(b|l), \quad (11)$$

and the low-type's incentive compatibility constraint with double deviation reduces to:

$$\int_0^1 b dF(b|l) \geq \int_0^1 \max\{b, \Pr[l|b, h]\theta/2 + \Pr[h|b, h](1 - p)\theta\} dF(b|h). \quad (12)$$

These two constraints are stronger than the following high-type and low-type incentive compatibility constraints without double deviation:

$$\int_0^1 b dF(b|h) \geq \int_0^1 b dF(b|l) \text{ and } \int_0^1 b dF(b|l) \geq \int_0^1 b dF(b|h),$$

which evidently, can only be satisfied if

$$\int_0^1 b dF(b|h) = \int_0^1 b dF(b|l) \equiv B \leq 1/2.$$

Let us turn to the *ex post* participation constraint for the high type. For any  $b \in (0, 1)$  such that  $\Pr[b, h] > 0$ , this constraint is:

$$b \geq \Pr[l|b, h]p\theta + \Pr[h|b, h]\theta/2, \quad (13)$$

Integrating this constraint, we obtain:

$$1/2 \geq B = \int_0^1 b dF(b|h) \geq \int_0^1 (\Pr[l|b, h]p\theta + \Pr[h|b, h]\theta/2) dF(b|h),$$

or, with a minor notational violation,

$$\begin{aligned} 1/2 &\geq \int_0^1 \left[ \frac{f[l, b|h]}{f(b|h)} p\theta + \frac{f[h, b|h]}{f(b|h)} \theta/2 \right] f(b|h) db \\ &= \Pr[l|h]p\theta + \Pr[h|h]\theta/2 \\ &= q\theta/2 + (1 - q)p\theta \end{aligned}$$

which contradicts

$$q\theta/2 + (1 - q)p\theta > 1/2, \text{ i.e., } \lambda < \gamma.$$

We have shown that there do not exist equilibria in which the players reports their types truthfully and agree to the mediator's recommendations. Hence, mediators who seek peace in all circumstances cannot improve upon un-mediated communication by means of standard truthful revelation mechanisms.

We now turn to consider arbitration without commitment. For comparability with mediation without commitment, we set the analysis in a revelation game. The players choose whether to participate and then report their types to the arbitrator, who imposes peaceful splits. It is easy to show that there cannot exist any equilibrium in which the players agree to participate and play any strategy (including mixed strategies) at the report stage of the game.

In fact, arbitration without commitment establishes peaceful splits  $(b, 1 - b)$  for any pair of messages  $(m_1, m_2)$ , according to the symmetric distribution  $F(b, 1 - b|m_1, m_2)$ . Let  $F(b|m)$  be the distribution of either player  $i$ 's split  $b$ , given  $i$ 's message. In equilibrium,

letting  $\sigma_t$  be the mixed strategy of a player of either type  $t$ , and any message  $m \in \text{Supp}(\sigma_t)$  and it must be that:

$$\int_0^1 b dF(b|m) \geq \int_0^1 b dF(b|m'),$$

for any other message  $m'$ . As in the above argument, these inequalities can only be simultaneously satisfied if  $\int_0^1 b dF(b|m) = \int_0^1 b dF(b|m') \leq 1/2$  for all  $m$  and  $m'$  in  $\text{Supp}(\sigma_t)$ . But then, the interim participation constraint of the hawk fails, because, again

$$q\theta/2 + (1 - q)p\theta > 1/2, \text{ when } \lambda < \gamma.$$

Hence, the finding of Proposition 1 is confirmed for the case of third party intervention without commitment. The arbitrator is no more effective than the mediator, even in absence of commitment.

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