Mediation and Strategic Militarization

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Abstract

This paper challenges the received wisdom that mediation is a weak institution. Much of this perspective is supported by variations of three arguments. First, mediators often do not have access to privileged information, beyond what is relayed to them by disputants. Second, mediators recommendations need to be self-enforcing as they are not backed by appropriate enforcement institutions. Third, a mediator's mandate is usually set within an already ongoing dispute, and does not include the long-term objective of preventing militarization. The first point has been taken to suggest that anything a disputant is willing to share with the mediator she would also be willing to share with an adversary. The second point limits the role of mediation to information sharing which is undermined by the first incentive, and the third raises the possibility that even if a mediator could improve on things in the short-run, a time consistency problem would cause mediation to induce perverse incentives for militarization. We show that these concerns are misplaced in settings where the states posses private information about their own capacity to fight. We find that mediation turns out to be just as effective as a hypothetical optimal institution with strong enforcement power and the ability to internalizes the long-term consequences of its behavior on subsequent militarization decisions. Comparing mediation with the best possible unmediated peace talks we find that when militarization costs are relatively low, mediation strictly improves the equilibrium chances of peace.

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1 Introduction

It is common for disputants in international conflict to involve third parties to help them reach peaceful solutions. For example Martti Ahtisaari won the 2008 Nobel Peace prize for a life long effort to help resolve international conflicts. Further, according to the International Crisis Behavior (ICB) project, the most comprehensive empirical effort to date, 30% of international crises for the entire period 1918–2001 were mediated, and the fraction rises to 46% for the period 1990–2001 (see Wilkenfeld et al., 2005). In fact, since the end of the Cold War the number of third party interventions in conflict has grown at an increasing rate. These interventions come in a number of forms, ranging from the offering of good offices to information mediation or conflict management strategies that are more structured, like adjudication through international judicial bodies.

Increasingly, policy makers are looking for means to settle international disputes peacefully, or at a minimum, design institutions to limit escalation to open military conflict. Also scholars have turned more attention to conflict management and the study of various forms of third party intervention to try to better understand which strategies are affective and to make prescriptions as to how to best intervene to reduce the costs of conflict. Despite the prevalence of instances of mediation, the academic literature in international relations fails to reach a consensus on the possible mechanisms by which mediation or arbitration might facilitate peaceful resolution of conflicts (see for exampe Kydd 2010).

Intuitively, the natural starting point of a formal analysis of third party intervention in dispute resolution is to consider mediation by a neutral third party who lacks privileged access to information and strong enforcement power.[1] This form of mediation seems to be a very weak institution to foster peaceful dispute resolution. There appears to be some consensus among scholars that such a weak institution fails to achieve all of the possible benefits of third-party intervention and cannot even improve on unmediated peace talks. In order to approach the issue, let us consider these arguments in detail.

[1] To be sure, third-party states that mediate conflict, such as the United States, are neither unbiased nor powerless, but single states account for less than a third of the mediators in mediated conflicts (Wilkenfeld, 2005).

First, it is often argued that if a mediator has no information beyond what is common knowledge among the disputants, then she cannot contribute to the communication in any meaningful manner. In fact, this result has been proven by Kydd (2003) and Fey and Ramsay (2010) in cases where the potential source of conflict is private information of *private value;* i.e., the case in which what a disputant does not know about the opponent does not directly effect the payoff of the disputant if conflict occurs.[2] However, it often appears that part of the private information relevant to the dispute is information of *interdependent value,* i.e., information on variables that directly effect the payoff of both disputants in case of conflict. Examples of information of interdependent value include the opponent's military capacity, or the resolve of its armed forces in case of conflict.

Second, it seems uncontroversial that providing mediators with the ability to enforce settlements would necessarily increase the chance of peace resolution. This distinction between *pure mediation,* involving information gathering and settlement proposal making, and *power mediation,* which instead also involves mediator's power to reward, punish or enforce was made by Fisher (1995). But an opposite view is advanced by Kelman (1958): "A mediated settlement that arises as a consequence of the use of leverage may not last very long because the agreement is based on compliance with the mediator and not on internalization of the agreement-changed attitudes and perceptions".

A further apparent weakness of mediation lies in the narrow breadth of mediators' mandates, which are usually limited to minimize the chance of war of the specific crisis they are called to mediate. The long-term objective of preventing other international crises and militarization cannot realistically be part of their mandates. As a result, mediators' strategies cannot take into account the following potential dilemma: An institution that is effective at managing a crisis in the short run might induce countries to militarize aggressively–which might result in more frequent and higher stakes disputes.

The potential conflict between the mandate to resolve crises and the objective of pre-

[2] Arguments of this form also emerged in the less formal literature. Moravcsik (1999), for example, dismisses the possibility that mediation would be valuable when parties possess private information "Even if governments were able to withhold vital information, moreover (without mediation), it is unclear why a third party, let alone a supranational one, should be able to elicit it" (p. 279). However, Koremenos et al. (2001) argue that the information role of mediators is crucial even when powerless.

venting militarization is particularly stark when considering some features of mediation. First, it aims at minimizing the overall loss of provoking international crises by maximizing the probability of their peaceful resolution. Second, in order to be convinced not to fight, militarily strong players must receive on average larger peaceful settlement proposals by mediators than weaker players. This means that there is an incentive to arm to get better settlements in times of peace and bigger expected payoffs in the case of war.

While these intuitive critiques of pure mediation as a form of third party intervention seem to be compelling, they have never collectively passed the verification test of precise formal analysis. To gain leverage on these questions we draw on a recent paper by Horner, Morelli and Squintani (2010) (HMS henceforth) which calculates the optimal techniques of an unbiased mediator who has no privileged information, nor enforcement power, and who relates to disputants who possess private information of interdependent value. We expand the crisis resolution model presented in HMS, by adding an "initial stage," in which potential disputants decide whether to militarize or not. We determine whether peace talks yield higher welfare to the disputants when they are conducted by a mediator who has no privileged information, no enforcement power, and who does not consider the effects of her behavior on on the militarization choices. Further, we determine whether such a form of mediation achieves the same *ex-ante* welfare as a hypothetical optimal institution which can enforce its settlements, and whose choices take into account the disputants incentives for militarization.

Provided that participation in dispute resolution by the optimal institution is voluntary, we surprisingly prove that an institution that is far sighted and has enforcement capabilities does not improve the disputants' welfare relative to our seemingly much weaker form of mediation.[3] Further, we find that mediation may yield a strict welfare improvement over unmediated peace talks. Specifically, if the cost of militarization is low, then mediation strictly improves upon unmediated peace talks, which, in fact, turns out to be incapable of preventing war. Instead, if the militarization costs are high, then it turns out that

[3]A special case of this result has been proved in HMS. That paper does not consider the militarization stage. Given that militarization is exogenous, they prove that the power of enforcing settlements is redundant for a mediator to achieve the constrained second best.

mediation yields the same welfare as unmediated communication. We see these results as making the case for the widespread use of mediations as an institution to resolve conflict resolution. The paper may also provide some insights into which types of disputes would benefit from the use of mediation.

Before discussing the related literature, we briefly describe our main modeling choices and how they relate to features of third-party intervention institutions. We consider a simple model of conflict where two players are in a contest over a fixed amount of resources. In the initial stage, the players simultaneously choose whether to invest in militarization and become strong or not invest and remain weak. The outcome of this militarization effort remains private information. If the two players are of the same type, war is a fair lottery, otherwise the stronger wins with higher probability .

Mediation is modeled in a stylized manner. In our model a third party collects private messages from the two disputants and recommends a message-dependent split of the contested resources, possibly randomizing. Players separately decide whether to accept the split or not, and peace ensues only if both players accept the mediators' proposal. The mediator chooses her policy recommendation by taking the militarization strategy of the disputants as exogenous. Before the game is played, the two players simultaneously choose militarization levels given their expectations of how the mediator will attempt to resolve the dispute.

We compare the optimal form of mediation with a hypothetical optimal institution which can enforce its settlements, and which chooses its policy by anticipating how the disputants' choice of militarization reacts to the dispute resolution policy. We also compare the optimal form of mediation with the best equilibrium of an optimally chosen unmediated communication game, in which the disputants send messages to each other before deciding whether to agree on a peaceful split of the resources or not. Unlike mediation, the optimal equilibrium of the unmediated peace talks may in principle take into account how the disputants' choice of militarization reacts to the future peace talks.

For reasons of tractability, this model is very stylized and, as any model, it cannot fully represent the richness of real world mediation techniques. The choice of the specific extensive form game, in which the mediator first collect separate messages in a single round and then makes a single proposal is inspired by the revelation principle (see Myerson, 1979 and 1983). According to this celebrated result, our game form is fully general, and it accounts for any, possibly very complicated, communication protocol between the disputants and the mediator. Regardless of how complicated, and of how many rounds it includes, any such a protocol cannot foster peace more efficiently than the game form we adopt in the model. Hence, our simple game form is the natural theoretical benchmark to describe what can be achieved by mediation, regardless of the richness of mediation procedures and techniques used by real mediators.

Essentially, our analysis focuses on the most effective institutions that do not circumvent a few natural incentive constraints. Namely we work in the domain of institutions that do not themselves possess private information about the disputants and respect the fact that a mediator can only use information that a participant is willing to share. Second, we do not allow the institution to directly alter the incentives of the participants by making side-payments, linking issues or imposing its own threats. Third, we take as an essential component of these problems the idea that institutions lack the ability to make disputant states accept settlement terms that they do not like. So a disputant always has the option to reject an offered settlement and fight.

While it is possible to conceive of additional constraints that may affect the outcome of mediation, we do not deem such constraints as equally salient. In fact, we believe that our modeling choices can be justified on descriptive grounds as well as normative grounds. Third-party intervention may take several different forms in the world of conflict resolution. At a conceptual and practical level grouping various institutions together can be problematic. But we can distinguish between three main types of third-party intervention: *communication facilitation mediation*; *arbitration*; and *procedural mediation*. While facilitation mediation and arbitration have received considerable attention, procedural mediation has been less studied. Facilitation mediation involves recommendations by a third party, but no commitment ex ante by either side to abide by the mediation proposals or to conduct additional forms of negotiation, especially in case that the mediation attempt fails. Arbitration, at the other extreme, involves a pre-play commitment by the parties to implement the arbitrator's decision. Because disputants are sovereign entities, this form of third-party intervention cannot ever actually take place. Procedural mediation can be viewed as an intermediate form of third party involvement. The disputants pre-commit to let the mediator set the procedure for the dispute resolution process. In practice, this seriously limits their capability to negotiate, or renegotiate an agreement outside the mediation process. In this sense, this form of mediation is deceptively the closest to the model adopted in this paper.

While not prevalent, procedural mediation is perceived to be an efficient form of mediation in resolving international disputes. Between 1995 and 2011, 427 disputes have been brought for arbitration in the World Trade Organization (WTO database), but most of these cases could be coded, according to our distinction above, as procedural mediations, since enforcement power is very limited in the presence of sovereignty constraints. Since World War I, over 30 territorial disputes have been brought to an international adjudication body (Huth and Allee 2006), which once again took the form of procedural mediation in our terminology given the absence of real enforcement power. Among all other cases in which mediation was involved (roughly fifty percent of cases according to Wilkenfeld et al. 2005), it is not clear how many were closer to facilitation mediation without procedural commitment and how many closer to procedural mediation, but certainly at least some of them could still be described as applying procedural mediation.

2 Related Literature

Before summarizing the body of scholarship that is closest to ours –theoretical work on mediators who possess no external enforcement powers–it is essential to comment on the theoretical framework that this scholarship builds on. Fearon (1995) is credited with beginning the literature using game-theoretic models of incomplete information to study how negotiations might break down and lead to costly conflict. His paper formalizes the leading rationalist explanation for war; states that possess private information will have incentives to leverage this informational advantage to gain a larger share of the pie while bargaining. In many natural bargaining games this incentive can cause breakdown in bargaining and lead to mutually costly war fighting. Even though Fearon's informal description of possible sources of incomplete information is broad enough to include the cases of both private and interdependent values, his analysis and nearly all subsequent extensions focus only on one form.

Working in the context of private values several papers have shown that mediation is not likely to help. Kydd (2003) makes this point highlighting the fact that what a state is willing to share with a biased mediator it is also willing to share with its opponent. Fey and Ramsay (2010) illustrate how large the set of equilibria to games with cheap talk is and show for any bargaining game the addition of a mediator cannot improve on what is obtainable with unmediated cheap talk.

Moving to the richer case of interdependent values, Bester and Warneryd (2006) consider arbitration in a setting with interdependent values but endow the arbitrator with seemingly strong powers. The arbitrator receives reports from the disputants and then selects and enforces settlements; the arbitrator is assumed to have the capacity to compel states to accept settlements that they may not prefer to fighting. HMS endow the mediator with far weaker commitment abilities and characterize the optimal mechanism to deal with private information problems. In particular the HMS mediator cannot compel the states to accept her offer. She solicites reports from the states and then makes a recommendation. Each retains the option of fighting, whereas the Bester and Warneryd arbitrator can coerce the states to accept her offer. HMS show that in fact this form of mediation can do better than the best equilibrium obtainable without a mediator. The mediator in HMS lacks strong commitment technology or private information yet her presence results in strict reductions of the probability of war. This finding suggests that once we move beyond private value problems the received wisdom of the international relations literature (e.g., Kydd, 2003, and Fey and Ramsay, 2010) no longer holds.

One challenge in comparing the results in HMS and the ones in Fey and Ramsay (2010) is that the two papers use distinct modeling approaches. HMS work in the tradition of optimal mechanism design and consider settings in which following recommendations from the mediator the disputants have only 2 options: accept the recommendation or fight. Although this approach might seem limiting, it is in fact the best way to find out what is possible if one selects the best game (see, Myerson, 1978 and 1983). This approach allows them to characterize the minimal probability of conflict that is obtainable with a mediator and make comparisons with the minimal probability of conflict that is obtainable without a mediator. In contrast Fey and Ramsay (2010) treat the underlying game that the disputants play as a primitive and prove a result that holds for a very large class of possible underlying games. An example of a specific game that they consider is an ultimatum game, where one given disputant makes a take-it-or-leave-it offer to the opponent.

So in addition to the focus on private versus interdependent valuations these two papers also differ in whether they take an underlying game structure as exogenous or allow the mediator to select the game. The payoffs obtained by HMS might not in fact be feasible if mediation is added to some particular games, such as the the ultimatum game. Nevertheless, it is possible to construct a simple example showing that the result in HMS, that mediation can do better than unmediated cheap talks, is not restricted to the environment considered there; and in particular the conclusion that mediation cannot improve on cheap talk does not extend to the case of interdependent values. Consider a game in which two players first simultaneously propose a settlement; if their proposals are the same then they each simultaneously decide to accept or reject this settlement. Mutual acceptance results in consumption of that agreement, if either disputant objects to that settlement the game ends in war. If the first stage offers were not congruent than the game also ends in war. It is immediate that if one takes the cheap talk extension of this game the probability of war in the best equilibrium will be no less than the probability of war in the best mechanism with cheap talk characterized in HMS. On the other hand, the mediated extension of this game possesses an equilibrium in which the mediator solicits reports and then makes the recommendation corresponding to the proposal in the optimal mediation game in HMS. This recommendation involves randomization and links the settlement to the private information of the players, which is what cheap talk cannot achieve. Importantly, there is an equilibrium in which both nations follow the mediators proposal in this game, and in this equilibrium the probability of war is less than that of the best equilibria of the cheap talk extension.

A common feature of the above papers (Bester and Warneryd, Fey and Ramsay, Kydd and HMS) is that militarization probabilities are exogenous. Here we recognize that militarization is itself the result of strategic choices and entertain the possibility that mediation creates incentives which shape these militarization decisions. Moving away from the study of mediation, there is a body of theory on endogenous militarization in the shadow of bargaining and war-fighting. Sartori and Meirowitz (2008) study strategic militarization prior to bargaining but provide only results on the impossibility of avoiding conflict. They do not study optimal mechanisms or provide a full characterization of the equilibrium set. 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 a mediator to solve information problems. Meirowitz and Ramsay (2010) study investment prior to the play of a mechanism and provide a characterization of the equilibrium relationship between the probability of bargaining failure and investment levels. There results draw on incentive compatibility and what we call ex ante obedience constraints. Again they do not study optimal mechanisms and thus remain silent on the institutional choice problem.

3 The Model

The basic model involves a simple game of conflict and unmediated peace talks with a preliminary stage in which states make strategic militarization decisions. Our goal then is to contrast the best equilibria with and without mediation when militarization is itself endogenous. We begin by describing the environment–starting first with the natural benchmark of unmediated peace talks. We then describe the corresponding model with mediation as well as a model that grants even more power to the mediator, arbitration. The model will seem sparse to some, but even with the stark assumptions here, the questions of what is possible and therefore best and comparisons across types of models becomes quite complicated.

3.1 The benchmark model of unmediated peace talks

Two players, A and B, dispute a prize or cake of size normalized to one. If no settlement is reached the disputants fight. We follow the literature and abstract away from war-fighting to capture other aspects of the problem that remain poorly understood. War is treated as a lottery which shrinks the value of the cake to $\theta < 1$. The key difference from the private values setting is the assumption that the expected payoffs in case of war depend on both players' private *types.* Each player can be of type H or L. We will often refer to type H as a "hawk" and to a L type as a "dove" (with no reference to the hawk-dove game). When the two players are of the same type, the expected share of the cake in case of war is $1/2$ for both. When a type H player fights against an L type, her expected share of the cake is $p > 1/2$, and hence her expected payoff is $p\theta$, which we assume to be larger than $1/2$, otherwise the dispute can be trivially resolved by splitting the cake in half.[4]

In the initial militarization stage A and B each decide whether to be doves or to arm and become hawks at a cost $k > 0$.We characterize an arming strategy by $q \in [0, 1]$, the probability of arming and becoming a hawk. The militarization decisions are treated as hidden actions, so neither player observes the choice of the other state but in an equilibrium the states hold correct conjectures of the equilibrium strategy-and thus they know the probability that their opponent has armed. For technical reasons, we restrict attention to equilibria that are symmetric in the militarization probability q. This restriction to symmetric equilibria reduces the proliferation of parameters making the problem tractable (although still quite cumbersome).

Following the militarization stage unmediated peace talks take place. The mechanism design approach allows us to capture a very large class of negotiation games by way of a very stark and tractable representation. In this context every equilibrium to every possible game form that selects either war or a settlement can be represented by analysis of a very simple class of games. The games are described by a message space, $\{l, h\}$, and a mapping,

[4]It is instructive to contrast this setup with the more common private values models. Here whether or not country A is type H or L influences country B's payoff from fighting. In the case of private values this interdependence is assumed to be absent. Country B's war payoff would not depend on the capacity of its opponent, A.

$x(\cdot)$, from the message space into lotteries over settlements. In particular the players first simultaneously send messages $m_i \in \{l, h\}$ to each other, with $i = A, B$. Then, they simultaneously choose whether to agree to a given cake division $(x(m), 1 - x(m))$, where $x(m) \in [0, 1]$ possibly depends on the messages $m = (m_A, m_B)$ and on the realization of a public randomization device. Unless both players agree to the split, war takes place. If instead both players accept the split $(x(m), 1 - x(m))$, this prevents war. We put off discussion of how this class of games is analyzed until the next section.

HMS show that it is without loss of generality to consider equilibria such that, when messages are (h, h), the players coordinate the peaceful split $(1/2, 1/2)$ with probability p_H, whereas war occurs with probability $1 - p_H$; when messages are (h, l), the players accept the split $(b, 1 - b)$ —and, symmetrically, the split $(1 - b, b)$ when messages are (l, h), with probability p_M, and on war with probability $1 - p_M$; and given messages (l, l), the players coordinate on $(1/2, 1/2)$ with probability p_L, and on war with probability $1 - p_L$. Our welfare analysis will focus on three measures: The equilibrium militarization probability q, the probability of peaceful conflict resolution V, and the utilitarian ex-ante welfare $W = \theta(1 - V) + V - 2kq$. The equilibrium that maximizes the peace chance may be found by solving a linear program. Because its exposition is somewhat involved, we relegate it to the Appendix.

3.2 Models of mediated peace talks

We consider mediators who have a mandate to minimize the probability of war when the international crisis takes place after the militarization stage. Our mediators are weak in the sense that they do not have any private information and they cannot compel states to accept the offers they put on the table. These mediators are also assumed to have a narrow mandate in that they do not take into account the incentives to militarize of disputants who anticipate their mediation techniques. Rather, they take the (symmetric) equilibrium probability q that each player is strong, as given and try to minimize the chance that this dispute ends in war.

These mediators may be thought of as suffering from a long-term commitment problem.

We have, however, endowed the mediator with some power. We do assume that she can commit to not renegotiating with the disputants within the crisis resolution attempt. That is, the mediator can commit to holding firm if she puts a proposed split on the table and one or both states reject it–the mediator can quit and credibly refuse to broker any subsequent deals. We have also assumed that the disputants cannot broker there own deals following the decision to reject the mediator's offers. As argued in the introduction, this game form is closer to procedural mediation, than to other forms of mediation. By construction, it is the most efficient form of mediation, within the class of institutions that do not have enforcement power, nor access to privileged information, and whose mandate does not include militarization prevention. Selection of the most efficient form of mediation is appropriate given that we are ultimately interested in determining if the short term gains from mediation are dissipated by the incentives for militarization that mediation might create.

For exogenous values of q, HMS prove that such mediators can achieve their objectives by means of the following simple mechanism. First, players secretly report their type to the mediator. These reports are treated as hidden actions observed only by the mediator. Then, the mediator makes recommendations as follows. Given reports (h, h), the mediator recommends the peaceful split $(1/2, 1/2)$ with probability q_H, and war with probability $1 - q_H$. Given reports (h, l), the mediator recommends the peaceful split $(1/2, 1/2)$ with probability q_M, the split $(b, 1-b)$ with probability p_M, and war with probability $1-p_M-q_M$, for some b. Given reports (l, l), the mediator recommends the peaceful split $(1/2, 1/2)$ with probability q_L, the splits $(b, 1 - b)$ and $(1 - b, b)$ with probability p_L each, and war with probability $1 - 2p_L - q_L$.

In HMS the probability of being a hawk, q is exogenous and the optimal mechanism with a mediator is found by selecting the control variables b, p_L, q_L, p_M, q_M, and q_H so as to minimize the probability of war

$$(1 - 2p_L - q_L)(1 - q)^2 + (1 - p_M - q_M)\, 2q(1 - q) + (1 - q_H)\, q^2,$$

while making sure that players report their types truthfully (interim IC* constraints), and that they accept the peaceful splits b and $1 - b$, when these are the recommendations (ex-post IR constraints). The form of these constraints is rather involved, and so, it is relegated to the Appendix. Loosely speaking, however, the ex-post IR constraints are specified to require that the disputants prefer (weakly) to accept any settlements that the mediator offers to fighting when they evaluate the expected payoffs from fighting with beliefs about their opponent's capacity that optimally take into consideration the fact that the mediator's proposed split might contain information about the opponents capacity. The IC* constraints are specified to make sure that when reporting her type (hawk or dove) to the mediator a player prefers (weakly) being honest and then following the mediator's recommendation to lying at the reporting stage and then cleverly deciding whether to follow the mediators' recommendation subsequently.

A stronger notion of mediation, arbitration has been studied by Bester and Wärneryd (2006). Rather than imposing *ex post* IR constraints and *ex interim* IC* constraints in our basic game of conflict, they study the same set up with *ex interim* IR and IC constraints. These weaker constraints capture the idea that the states must be willing to authorize the arbitrator to take their dispute, but they also assume that once the arbitrator decides on a settlement the disputants are stuck with this split. In settings where international enforcement is weak and the states maintain their ability to fight this approach might be thought to give too much power to the arbitrator.

The analysis of Bester and Wärneryd proceeds as follows. Consider arbitrators who take the militarization probability as given, as it is the case for mediators. Invoking the version of the revelation principle proved by Myerson (1979), the Bester-Wärneryd problem can be summarized as follows. The parties truthfully report their types L, H to the arbitrator. The arbitrator recommends the peaceful settlement $(1/2, 1/2)$ with probability p_L after reports (l, l), the settlement $(b, 1-b)$ with probability p_M after reports (l, h) – and symmetrically, the settlement $(1-b, b)$ after report (h, l), and the settlement $(1/2, 1/2)$ with probability p_H after the reports (h, h). Again, the control variables b, p_L, p_M, and q_H are chosen so as to minimize the probability of war, while making sure that players report their types truthfully (interim IC* constraints). But, crucially, it is not required that players accept the peaceful splits b and $1-b$, when these are the recommendations (ex-post IR constraints).

Rather, these constraints are substituted with the potentially much weaker constraint that the players are willing to participate to the arbitration (interim IR constraints). Again, the form of these constraints is relegated to the Appendix.

When comparing mediators and arbitrators that suffer from the above mentioned long-term commitment problem, with the actual optimal institutions in the militarization and conflict game, we need to modify the work in Bester-Wärneryd and HMS, so as to include the strategic militarization probability q as a control variable, and add further constraints to the peace-chance maximization program. Such conditions are technically dubbed *ex-ante obedience* constraints. Informally they require that the disputants are willing to play the militarization strategy q determined in the optimal solution, when choosing whether to militarize or not. Again, the specific form of these constraints in presented only in the Appendix. Loosely speaking however, the obedience constraints are constructed to require that whenever q is non-degenerate each disputant is indifferent between arming, reporting her type honestly and accepting the mediator's offer, and remaining weak, reporting honestly and accepting the offer of the mediator. When q is degenerate each state must weakly prefer the pure militarization decision it is supposed to employ, followed by truthful reporting and acceptance of the mediators offer to a different militarization decision and subsequent optimal decisions.

4 Preliminaries

Our main result establishes that despite some seemingly strong restrictions on its ability to commit (narrow mandate) and enforcement (disputants may refuse the mediator's proposals) a mediator with no private information is second best even when her behavior can perversely encourage states to militarize. The argument proceeds in a few steps. We first gain some insights into the structure of equilibria in the mediation problem. We then draw upon results from HMS to show that, for any given exogenous q, an optimal institution who can enforce recommendation is exactly as effective in promoting peace as a mediator who can only propose self-enforcing agreements. This result seems powerful, but it is limited to the case in which, as well as the mediation, also the "optimal institution" has a narrow mandate: It takes the strategic militarization probability as given, when called to minimize conflict in an ongoing dispute, instead of taking into account how militarization incentives are shaped by the anticipation of the crisis resolution techniques that are in place.

4.1 Militarization Game Equilibrium with Mediation

We begin our analysis by characterizing all symmetric equilibria, when mediators are called in to deal with international disputes. Suppose that each state militarizes with probability q. It is convenient to work with the associated odd ratio $\lambda = q/(1-q)$. Recall that we are interested in understanding how mediators that face a long-term commitment problem compare with the best institution that lacks mediation. Accordingly, it is appropriate to consider the set of equilibria in which mediators take the equilibrium probability of arming q as given and given the chosen equilibrium to the mediation problem q satisfies the obedience constraint. In other words, our approach to characterizing equilibria here is to first take q as given and characterize the best equilibrium with mediation. We then take this correspondence mapping q into equilibria and look for a fixed point, q such that given an equilibrium resulting from it the obedience constraint is satisfied. For any fixed q the specific values of the control variables and the peace probability that solve the mediation problem are calculated in HMS and are as follows:

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

The parameter $\gamma \equiv [p\theta - 1/2]/[1/2 - \theta/2]$ represents the ratio of benefits over cost of war for a hawk: the numerator is the gain for waging war against a dove instead of accepting the equal split, and the denominator is the loss for waging war against a hawk rather than accepting equal split. It subsumes the two parameters θ and p in a single parameter, and allows a more parsimonious representation of the results.

Because in the mediator's solution $2p_L + q_L = 1$ for all λ and γ, the interim payoffs of a hawk and dove type in the mediation game are, respectively:

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

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

Hence, the payoff for militarizing is $I_H(q) - k$, whereas the payoff for staying 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 $I_L(q) = I_H(q) - k$.

The following result establishes equilibrium uniqueness and characterizes the equilibrium militarization and conflict probability. It is convenient to express these as functions of the cost of arming, k. Subsequently we will compare these quantities with the benchmark cases without mediation. In the interest of readability and space, we do not report the equilibrium strategy.

Proposition 1 *Suppose that international crises are mediated. For any militarization cost k, there is a unique symmetric equilibrium militarization probability $q^*(k)$. The associated odds ratio $\lambda^*(k) = q^*(k)/[1-q^*(k)]$ strictly decreases in k for $k \in [0, (1-\theta)\gamma/2]$, with $\lambda(0) = \gamma$, $\lambda\left((1-\theta)\frac{(\gamma+1)\gamma}{2(\gamma+2)}\right) = \gamma/2$, and $\lambda(k) = 0$ for $k \geq (1-\theta)\gamma/2$. The resulting probability of peace is U-shaped in the militarization cost k, and reaches the minimum at $k = (1-\theta)\frac{(\gamma+1)(\gamma+6)\gamma}{2(\gamma+3)^2}$.*

It is immediate that the conflict probability is unique as this is the value of the minimization problem, but the fact that exactly one q solves this program for each configuration of the parameters is interesting. While the explicit formula is cumbersome, we show that the militarization probability strictly decreases in the militarization cost. Due to this monotonicity result, the U-shaped relation between probability of peace and militarization probability in the mediation solution transfers to a U-shaped relation between probability of peace and militarization cost in the unique equilibrium of the militarization game.

Subsequently we will contrast these findings with the corresponding values from the unmediated model. We first contrast these results with the corresponding solutions to the problem with a stronger arbitrator.

4.2 The Role of Enforcement given Militarization Strategies

This section reports a result from HMS, Proposition 2 below, showing that when the militarization probability is exogenous, mediation does not necessarily suffer from an enforcement problem. Specifically, we show that arbitration and mediation are equivalent in terms of peace chance maximization. Proposition 2 is limited to the case in which the optimal institution, arbitration, does not take into account the incentives to militarize in shaping its conflict resolution techniques. This result, however, provides a simple approach to prove our main result, Theorem 1, in the following section. That result states that, although mediators cannot enforce their recommendations, and they may not be concerned about the incentives that they create for strategic militarization, mediators achieve the same outcome as a hypothetical optimal institution in the militarization and dispute resolution game. This optimal institution takes into account the incentives to militarize in shaping its conflict resolution techniques. Instead of comparing mediation with the optimal institution, in light of Proposition 2, we can more simply conduct the comparison between the arbitration and the optimal institution.

In general, the solution of the program with an arbitrator (with enforcement power) provides an upper bound to the solution of the program with a mediator (without enforcement power). Surprisingly, HMS prove that the solution of the latter program yields the same welfare as the solution of the former program. Specifically, for $\lambda \leq \gamma/2$, the mechanisms with and without enforcement coincide. When $\lambda > \gamma/2$, the simplest optimal mechanism with enforcement is such that $b < p\theta$, which is not self-enforcing. But the optimal mechanism without enforcement obfuscates the players' reports, and this obfuscation succeeds in fully circumventing the enforcement problem.

Proposition 2 (Horner, Morelli, Squintani, 2009) *Suppose that the strategic militarization probability q is given. For any q, an arbitrator who can enforce recommendation* *is exactly as effective in promoting peace as a mediator who can only propose self-enforcing agreements.*

The results from HMS are powerful, but they are limited to the case in which both the mediator and the arbitrator suffer from a long-term commitment problem: they take the strategic militarization probability as given, when they are called to minimize conflict in a dispute. The optimal institutional mechanism should at least in principle take into account that its recommended settlements, anticipated by the disputants, may influence the militarization strategies of future disputants. This is the topic of the next and primary section of the paper.

5 The Institutional Optimality of Mediation

This section studies optimal institutions taking into account the long term effects of conflict resolution institutions. Recall there are two forces working against mediation. Although the revelation principle (Myerson, 1979) identifies mediation as an efficient institution to deal with conflicts due to asymmetric information, international relations scholars consider mediation a relatively weak institution. Part of the reason for these scholar's skepticism is the lack of enforcement and the narrow mandate of mediators. Indeed, mediators cannot enforce their recommendations. Proposition 2, however, shows that at least when millitarization is exogenous these commitment problems are not severe. The second concern is that when a mediator is called in a dispute, her mandate is usually set within the boundaries of the dispute. The long-term objective of preventing disputes and militarization is not realistically part of her commitment. The extent to which a mediator can effectively reduce the risk of war can paradoxically incentivise arming and thus ultimately raise the risk of war. We now show that in fact the short-sited mediator is an optimal institution. The seemingly insurmountable lack of enforcement power, and narrow mandate of mediators turn out to be irrelevant.

Theorem 1 *Although mediators cannot enforce their recommendations, and they may not take into account the incentives that they create for strategic militarization, mediators are* *the optimal institution in the militarization game, both in terms of arms reduction and peace chance maximization, among all budget-balanced institutions.*

The intuition underlying the proof of this Theorem is somewhat subtle. As pointed out in the previous section, we can prove the Theorem simply by showing that the HMS arbitration mediation solution achieves the second best in the militarization game. In order to do so, we distinguish two parts in the proof. We first show that HMS arbitrators are the optimal mechanism in terms of peace chance maximization. We then show that they are the optimal mechanism in terms of militarization probability minimization. The details for the specific steps used to achieve these two intermediate results are fairly involved. The interested reader is referred to the Appendix.

It may seem natural to ask how large is the loss incurred when mediation is not possible. The result below characterizes the optimal equilibrium of the militarization game when it is followed by unmediated cheap talk. This is the natural benchmark for the best possible outcome absent mediation. We find the comparison to be quite stark. When the militarization cost is above a give threshold, there is no gain in calling in a mediator in the potential dispute. But when the cost of militarization is below that threshold, then unmediated cheap talk is extremely ineffective as a dispute resolution institution, as it results in arming and war with probability one. In this region of the parameter space evidently, mediation allows great welfare gains on top of unmediated communication. Put more succinctly, when the costs of arming are sufficiently high there may be no gain from mediation, but when the cost is lower, mediation makes peace possible while the absence of mediation makes arming and warfighting a foregone conclusion. For simplicity, the next Proposition is proved in the environment in which $\gamma \geq 1$, i.e. the benefits of war are sufficiently large relative to the cost.

Proposition 3 *Suppose that $\gamma \geq 1$ and that peace talks are not mediated. For $k \geq (1-\theta)\frac{(\gamma+1)\gamma}{2(\gamma+2)}$, the welfare maximizing equilibrium is the same as when talks are mediated. But for $k < (1-\theta)\frac{(\gamma+1)\gamma}{2(\gamma+2)}$, the unique equilibrium without mediation is such that both disputants arm and then fight.*

The intuition for this result is again somewhat subtle. The proof is developed in two parts. First, we suppose that peace talks are not mediated and that, for any symmetric militarization strategy, the split values and equilibrium that minimizes the chance of war are selected in the communication game. The militarization game equilibrium is calculated for this case. Second, it is shown that, even allowing for any equilibrium strategies in the unmediated communication game of conflict resolution, the solution to the welfare maximizing problem is the same as in the first part. Again, the interested reader is referred to the Appendix.

6 A simple game that weakly implements the mechanism

As discussed in the introduction the approach taken here (as well as in HMS) differs from the approach taken in Fey and Ramsay. The latter consider augmentations of explicit and exogenous games to include cheap talk or mediation, while the former consider the mechanism design problem in which the mediator chooses the game subject to ex-poste rationality constraints. In this section we sketch out a double auction that can be augmented to include mediation which weakly implements the optimal mechanisms characterized above. The game is simple if not canonical. In period 1 both states make simultaneous (and hidden) investment decisions. In period 2 they make simultaneous reports to the mediator. In stage three the mediator makes suggestions to the states and then the states play the following simple double auction. In the double auction, the states each announce a demand, x_1 and x_2 both in $[0, 1]$. If the sum of the demands is less than 1, then the split that emerges from the bargaining give each state her demand and half the surplus. If the demands are incompatible (sum to more than 1) then no split emerges and the only option is war. Finally the states make simultaneous decisions about whether to accept or veto the splits that emerge from the protocol. It is not difficult to see that he constraints in our analysis are are sufficient to establish that in this game there is an equilibrium in which the mediator's reports comply with the ones in the optimal mechanism above, the states use the investment strategies from our solution above, they both make truthful reports to the mediator and then comply with her suggestions. This example illustrates exactly how interdependent values breaks the result in Fey and Ramsay and illustrates that fairly simple games can be used to decentralize the mechanism characterized above.

7 Conclusion

This paper has contributed to an ongoing agenda, which adopts mechanism design techniques to identify optimal international conflict resolution institutions (Bester and Warneryd, 2006; Fey and Ramsay, 2009, 2010; Horner, Morelli and Squintani 2010; Meirowitz and Ramsay, 2010). The agenda proposes novel theoretical challenges. For instance, unlike previous mechanism design work, agreements must be self-enforcing in this context, because Nations are sovereign entities. Previous work has uncovered many novel insights on institutions such as mediation, arbitration and peace talks.

This paper counters the common view by international relations scholars that mediation is a weak institution. The revelation principle (Myerson, 1979, 1983) identifies mediation as an efficient institution to deal with conflicts due to asymmetric information. But this result is subject to two concerns. First, there is the issue of enforcement: Mediators recommendations need to be self-enforcing, unlike arbitrates whose decisions are backed by appropriate enforcement institutions. Second, there is the issue of commitment: A mediator's mandate is usually set within an already ongoing dispute, and does not include the long-term objective of preventing other disputes and militarization. Apparently, mediation may bread perverse incentives for militarization, because it minimizes the cost of entering a dispute, by minimizing the chance of war. This paper surprisingly shows that both these two concerns are misplaced. In a fairly simple but natural environment mediation turns out to be an optimal institution even when considering the long-term objective of preventing disputes and militarization, and even when allowing for the possibility enforced decisions. Further, if the cost of militarization is low, then mediation strictly improves upon unmediated peace talks, which, in fact, turns out to be incapable of preventing war. This result stands in stark contrast with previews received wisdom (see, e.g. Moravcik, 1999) that mediators cannot improve upon the outcome of unmediated peace talks, if they do not have access to privileged sources of information, beyond what is relayed to them by the disputants.

The use of formalized mechanism design techniques in the context of international relations may be very useful in checking and sometimes overturning common informal views. Namely, we surprisingly show that some issues pertaining to enforcement and commitment are much less relevant that previously thought. Contrary to a common view, Theorem 1 shows that mediation turns out to be a very powerful institution for conflict resolution. Also, the comparison between mediation and non-mediated institutions in Proposition 3 provides an interesting perspective. We may not expect to see much effort go into mediation for settings in which the costs of arming are high; here, mediation offers no gain over the best equilibrium with cheap talk. We should expect to see mediators in settings in which there is a real gain to mediation (specifically, settings in which the militarization cost is relatively low), but we should not expect them to fully avoid conflict. The fact that war sometimes occur when there is mediation need not be taken as evidence of the limitation of mediation. It is precisely these contexts in which the absence of mediation would result in dramatically different behavior – disputants would militarize more aggressively and conflict would be a foregone conclusion. This perspective sheds light on a subtle selection problem in the cases we observe and suggests that commentators and historians might need to be careful when they specify the appropriate counter-factual.

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8 Appendix

The HMS unmediated peace talks program. HMS show that the optimal equilibrium is characterized by the following program:

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

subject to ex-post IR constraints

$$b \geq p\theta,\ 1/2 \geq \theta/2, 1-b \geq (1-p)\theta.$$

to the IC* constraint for the low type

$$(1-q)\left((1-p_L)\frac{\theta}{2}+p_L\frac{1}{2}\right)+q\left((1-p_M)(1-p)\theta+p_M(1-b)\right) \geq$$
$$(1-q)\left((1-p_M)\frac{\theta}{2}+p_M\max\{b,\frac{\theta}{2}\}\right)+q\left((1-p_H)(1-p)\theta+p_H\max\{\frac{1}{2},(1-p)\theta\}\right);$$

and for the high type

$$(1-q)\left((1-p_M)p\theta+p_M b\right)+q\left((1-p_H)\frac{\theta}{2}+p_H\frac{1}{2}\right) \geq$$
$$(1-q)\left((1-p_L)p\theta+p_L\max\{\frac{1}{2},p\theta\}\right)+q\left((1-p_M)\frac{\theta}{2}+p_M\max\{1-b,\frac{\theta}{2}\}\right).$$

The HMS mediation program. HMS show that optimal mediation can de determined by studying the following program:

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

subject to the high-type *ex post* IR constraint

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

to the low type *ex post* IR constraint

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

to the high-type *ex interim* IC* constraint

$$
\begin{aligned}
&q(q_H/2+(1-q_H)\theta/2)+(1-q)(p_M b+q_M/2+(1-p_M-q_M)p\theta)\geq\\
&\max\{(qp_M+(1-q)p_L)(1-b),qp_M\theta/2+(1-q)p_Lp\theta\}+\max\{(1-q)p_Lb,(1-q)p_Lp\theta\}\\
&+\max\{(qq_M+(1-q)q_L)\cdot 1/2,qq_M\theta/2+(1-q)q_Lp\theta\}\\
&+q(1-p_M-q_M)\theta/2+(1-q)(1-2p_L-q_L)p\theta,
\end{aligned}
$$

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

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

The HMS arbitration program. The arbitrator chooses b, p_L, p_M and p_H so as to solve the program

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

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

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

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

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

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

The militarization and conflict optimal 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)

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

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

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

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

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

$$= \begin{cases} \frac{1-\theta}{2(1+\lambda)}\frac{(2\lambda-\gamma+1)}{(\gamma-2\lambda+1)}\lambda & if \lambda < \gamma/2 \\ \frac{1-\theta}{2(1+\lambda)}\frac{\lambda+1}{\gamma-\lambda+1}\lambda & if \gamma/2 \le \lambda < \gamma \\ \frac{1-\theta}{2}\gamma & if \lambda \ge \gamma. \end{cases}$$

These quantities are all positive.

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

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

Case 1. $\lambda \le \gamma/2$. Substituting the mediator's solution into the expressions (1) and (2), 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, q, we obtain the k which makes the players indifferent for λ and γ and θ fixed:

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

Because $2\lambda \le \gamma$, 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 λ 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 in the expressions

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

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

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

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

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:o

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

This concludes that, for $k \in \left[0, (1-\theta)\frac{(\gamma+1)}{(\gamma+2)}\frac{\gamma}{2}\right]$, 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 $k = (1-\theta)\frac{(\gamma+1)}{(\gamma+2)}\frac{\gamma}{2}$.

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 hawk with probability one is never an equilibrium.

We conclude by calculating the derivative of the resulting probability of peace V with respect to the militarization cost k.

For $\gamma/2 \leq \lambda < \gamma$, we differentiate $V = \frac{\gamma+1}{(\gamma-\lambda+1)(\lambda+1)}$ with respect to λ, to obtain:

$$\frac{\partial V}{\partial \lambda} = \frac{(2\lambda-\gamma)(\gamma+1)}{(\gamma-\lambda+1)^2(\lambda+1)^2} > 0.$$

Differentiating $V = \frac{\gamma+1}{(1+\gamma-2\lambda)(1+\lambda)^2}$ with respect to λ for $\lambda \leq \gamma/2$, instead, yields:

$$\frac{\partial V}{\partial \lambda} = 2\frac{(3\lambda-\gamma)(\gamma+1)}{(\gamma-2\lambda+1)^2(\lambda+1)^3},$$

which is negative for $\lambda \leq \gamma/3$ and positive thereafter. We thus conclude that V is U-shaped in k, reaching the minimum at

$$k(\gamma/3) = (1-\theta)\frac{(\gamma+1)(\gamma+6)\gamma}{2(\gamma+3)^2}.$$

We complement this proof with the analysis of the comparative statics of the welfare W in the militarization cost k, when crises are optimally mediated. The welfare is measured as the sum of the expected utilities:

$$W = \theta(1-V) + V - 2qk$$

where note that the two players are ex-ante identical.

Differentiating W with respect to k, we obtain:

$$\begin{aligned}\frac{\partial W}{\partial k} &= (1-\theta)\frac{\partial V}{\partial \lambda}\frac{\partial \lambda}{\partial k} - 2q - 2k\frac{\partial q}{\partial \lambda}\frac{\partial \lambda}{\partial k} \\ &= -2\frac{\lambda}{\lambda+1} + \left[(1-\theta)\frac{\partial V}{\partial \lambda} - \frac{2k}{(\lambda+1)^2}\right]\left(\frac{\partial k}{\partial \lambda}\right)^{-1}. \end{aligned} \quad (3)$$

We thus distinguish two cases.

1. For $\lambda \leq \gamma/2$, i.e., $[k \in (1-\theta)\frac{(\gamma+1)\gamma}{2(\gamma+2)}, (1-\theta)\frac{\gamma}{2})$, recall that $V = \frac{\gamma+1}{(1+\gamma-2\lambda)(1+\lambda)^2}$ and that $k(\lambda) = (1-\theta)\frac{(\gamma-\lambda+\lambda\gamma-2\lambda^2)(\gamma+1)}{2(\gamma-2\lambda+1)(\lambda+1)}$.

Hence,

$$\frac{\partial V}{\partial \lambda} = -2\frac{(\gamma-3\lambda)(\gamma+1)}{(\gamma-2\lambda+1)^2(\lambda+1)^3},\ and \frac{\partial k}{\partial \lambda} = \frac{1}{2}(1-\theta)\frac{(1+4\lambda-\gamma)(\gamma+1)}{(\gamma-2\lambda+1)^2(\lambda+1)^2}.$$

Substituting all expressions in (3), we obtain:

$$\begin{aligned}\frac{\partial W}{\partial k} &= -2\frac{\lambda}{\lambda+1} + \left(-2\frac{(\gamma-3\lambda)(\gamma+1)}{(\gamma-2\lambda+1)^2(\lambda+1)^3}(1-\theta) - \frac{2(1-\theta)\frac{(\gamma-\lambda+\lambda\gamma-2\lambda^2)(\gamma+1)}{2(\gamma-2\lambda+1)(\lambda+1)}}{(\lambda+1)^2}\right)\cdot \\ &\quad \cdot\left(\frac{1}{2}(1-\theta)\frac{(1+4\lambda-\gamma)(\gamma+1)}{(\gamma-2\lambda+1)^2(\lambda+1)^2}\right)^{-1} \\ &= 2\frac{3\gamma-6\lambda-3\lambda\gamma+4\lambda^2+4\lambda^3+\gamma^2+\lambda\gamma^2-4\lambda^2\gamma}{(\gamma-4\lambda-1)(\lambda+1)}\end{aligned}$$

Note that $3\gamma-6\lambda-3\lambda\gamma+4\lambda^2+4\lambda^3+\gamma^2+\lambda\gamma^2-4\lambda^2\gamma > 0$, because $\lambda \leq \gamma/2$. Hence the derivative $\partial W/\partial k$ has the same sign as $\gamma-4\lambda-1$. Specifically, it is increasing for $\lambda \leq \frac{1}{4}(\gamma-1)$, and decreasing otherwise. Equivalently, i.e., W decreases in k for $k \in \left[(1-\theta)\frac{(\gamma+1)\gamma}{2(\gamma+2)}, (1-\theta)\frac{(6\gamma+\gamma^2+1)(\gamma+1)}{2(\gamma+3)^2}\right]$ and increases in k for $k \in \left[(1-\theta)\frac{(6\gamma+\gamma^2+1)(\gamma+1)}{2(\gamma+3)^2}, (1-\theta)\frac{\gamma}{2}\right]$.

2. For $\gamma/2 \leq \lambda < \gamma$, i.e., $k \in \left[0, (1-\theta)\frac{(\gamma+1)}{(\gamma+2)}\frac{\gamma}{2}\right]$, recall that $V = \frac{\gamma+1}{(\gamma-\lambda+1)(\lambda+1)}$ and that $k(\lambda) = (1-\theta)\frac{(\gamma-\lambda)(\gamma+1)}{2(\gamma-\lambda+1)}$

Hence,

$$\frac{\partial V}{\partial \lambda} = \frac{(2\lambda-\gamma)(\gamma+1)}{(\gamma-\lambda+1)^2(\lambda+1)^2},\ \ and \frac{\partial k}{\partial \lambda} = -\frac{1}{2}(1-\theta)\frac{(\gamma+1)}{2(\lambda-\gamma-1)^2}.$$

Again, substituting in (3),, we obtain:

$$\begin{aligned}\frac{\partial W}{\partial k} &= -2\frac{\lambda}{\lambda+1} + \left((1-\theta)\frac{(2\lambda-\gamma)(\gamma+1)}{(\gamma-\lambda+1)^2(\lambda+1)^2} - \frac{2(1-\theta)\frac{(\gamma-\lambda)(\gamma+1)}{2(\gamma-\lambda+1)}}{(\lambda+1)^2}\right)\cdot \\ &\quad \cdot\left(-\frac{1}{2}(1-\theta)\frac{(\gamma+1)}{2(\lambda-\gamma-1)^2}\right)^{-1} \\ &= 2\frac{4\gamma-7\lambda-4\lambda\gamma+\lambda^2+2\gamma^2}{(\lambda+1)^2}\end{aligned}$$

Hence, the sign of $\partial W/\partial k$ is the same as the sign of the quadratic expression $4\gamma-7\lambda-4\lambda\gamma+\lambda^2+2\gamma^2$. Solving this expression yields the two $\gamma_1 = 2\gamma+\frac{7}{2}-\frac{1}{2}\sqrt{40\gamma+8\gamma^2+49} \in (\gamma/2,\gamma)$, and $\gamma_2 = 2\gamma+\frac{1}{2}\sqrt{40\gamma+8\gamma^2+49}+\frac{7}{2} > \gamma$. Hence, the welfare W increases in λ for $\lambda \leq \lambda_1$ and decreases in λ otherwise; equivalently, W decreases in k for $k \in [0, k(\lambda_1)]$ and increases in k for $k \in [k(\lambda_1), (1-\theta)\frac{(\gamma+1)}{(\gamma+2)}\frac{\gamma}{2}]$

$$k(\lambda_1) = (1-\theta)\frac{\left(\frac{7}{2}-\gamma-\frac{1}{2}\sqrt{40\gamma+8\gamma^2+49}\right)(\gamma+1)}{2\left(\frac{9}{2}-\gamma-\frac{1}{2}\sqrt{40\gamma+8\gamma^2+49}\right)}.$$

This result completes the proof of Proposition 1. □

Proof of Theorem 1. We will proceed in different steps. The first one verifies that the *arbitration* dispute resolution solution of HMS yields the same symmetric equilibrium militarization probability as the *mediation* HMS dispute resolution solution.

Recall from HMS that the arbitration solution is:

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

2. 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 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 solutions in the indifference condition, we find the expressions:

$$k(\lambda) = (1-\theta)\frac{(\gamma - \lambda + \lambda\gamma - 2\lambda^2)(\gamma+1)}{2(\gamma - 2\lambda + 1)(\lambda+1)}, for \lambda \leq \gamma/2, \quad (5)$$
$$k(\lambda) = (1-\theta)\frac{(\gamma - \lambda)(\gamma+1)}{2(\gamma - \lambda + 1)}, for \gamma/2 < \lambda \leq \gamma. \quad (6)$$

Which correspond to the solutions for the militarization game with the HMS optimal mediation solution.

As a result, we can prove the Theorem simply by showing that the HMS arbitration mediation solution achieves the second best in the militarization game. In order to do so, we distinguish two parts. We first show that HMS arbitrators are the optimal mechanism in terms of peace chance maximization, to then show that they are the optimal mechanism in terms of militarization probability minimization.

To tackle the first problem, we set up the following relaxed problem. 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 hawk *ex interim* individual rationality constraint

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

to the dove *ex interim* incentive compatibility constraint

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

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 *ex interim* individual rationality constraint, and in the hawk *ex 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:

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

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 in 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 solution 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 $p_H = \frac{1}{0}\theta\,(2p-1)\,(2p\theta - 2k - 1) \to +\infty$, 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 λ, 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 λ, 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 $q/\,(1-q) = \lambda$.

So, 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

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

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

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

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

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. Our proof approach will be to show that the HMS optimal arbitration solution is the solution of the following relaxed problem:

$$\min_{p_L, p_M, p_H, b} q s.t. H = 0, L = 0, I_H - k = I_L \tag{10}$$

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 λ, 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 λ, 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 $b - p\theta = \frac{q\theta p_H - q p_H + 2p\theta p_M - 2pq\theta p_M}{2(1-q)p_M} - p\theta = -\frac{1}{2}(1-\theta)\frac{q p_H}{(1-q)p_M} \leq 0$. 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 (**??**) 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, also the part of the proof concerning militarization probability is concluded. □

Proof of Proposition 3. The proof consists of two separate Lemmas.

Lemma 1 *Suppose that peace talks are not mediated and that, for any symmetric militarization strategy, the split values and equilibrium that minimizes the chance of war are selected in the communication game. Then, for $k \geq (1-\theta)\frac{(\gamma+1)\gamma}{2(\gamma+2)}$, the optimal equilibrium militarization strategy is the same as when mediation takes place. But for $k < (1-\theta)\frac{(\gamma+1)\gamma}{2(\gamma+2)}$, there does not exist any symmetric equilibrium in the militarization game*

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

Case 1, $\lambda < \gamma/2$. The interim payoffs are the same as in the mediation case. Hence, we conclude that:

- 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 λ is strictly decreasing in k, it starts at $\lambda = \gamma/2$ for $k = (1-\theta)\frac{(\gamma+1)\gamma}{2(\gamma+2)}$ and reaches $\lambda(k) = 0$ 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. $\lambda \in [\gamma/2, \gamma)$. 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 λ. 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 $q = \lambda = 0$, then $I_L(q) = 1/2$ and $I_H(q) = p\theta$.Hence, $\lambda = 0$ is an equilibrium if and only if $k \geq p\theta - 1/2 = (1 - \theta)\frac{\gamma}{2}$. Suppose that $q = 1$. The cheap talk solution is to assign $p_L = p_M = p_H = 1$, 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 hawk with probability one is never an equilibrium. This concludes the proof of the Proposition 3. □

Next, our approach to complete the proof is to show that when choosing the split values x and equilibrium strategies σ in the communication game so as to minimize the function $k(\lambda; x, \sigma)$ pointwise, one recovers exactly the split values and equilibrium that minimizes the chance of war in the communication game. Recall in fact that $k(\lambda; x, \sigma)$ describes for any λ the value of the militarization cost k which makes each player willing to play a completely mixed strategy if the opponent's militarization odds ratio is exactly λ. Because Lemma 1 implies $k(\lambda; x, \sigma) \geq (1 - \theta)\frac{(\gamma+1)\gamma}{2(\gamma+2)}$ for all λ, whereas $k(\gamma/2; x, \sigma) = (1 - \theta)\frac{(\gamma+1)\gamma}{2(\gamma+2)}$, $k(0; x, \sigma) = (1 - \theta)\gamma/2$ and $\partial k(\lambda; x, \sigma)/\partial\lambda < 0$ for $\lambda \in \left[(1 - \theta)\frac{(\gamma+1)\gamma}{2(\gamma+2)}, (1 - \theta)\gamma/2\right]$, it follows that the optimal equilibrium is as in the statement of Proposition 3.

Lemma 2 *Suppose that disputants communicate without a mediator. For any odds ratio λ, the split value x and symmetric equilibrium strategies σ in the communication game that* *minimize $k(\lambda; x, \sigma)$ coincide with the split values and equilibrium that minimize the chance of war in the communication game.*

Proof. From the analysis in HMS, we know that hawks never randomize in any symmetric equilibrium of the unmediated communication game. Hence, there are two classes of equilibria that we need consider: Separating equilibria and equilibria where doves randomize. We shall divide the proof in two parts.

Part 1. We first show that the split value x and symmetric separating equilibrium strategies σ in the communication game that minimize $k(\lambda; x, \sigma)$ coincide with the split values and equilibrium that minimize the chance of war in the communication game.

Following HMS, any separating symmetric equilibrium may be represented as follows. If both players announce to be hawks, the equal split $(1/2, 1/2)$ is agreed upon with probability p_H, and war takes place with probability $1 - p_H$. If both players announce to be doves, the equal split $(1/2, 1/2)$ is agreed upon with probability p_L, and war takes place with probability $1 - p_L$. In the case of asymmetric announcements, the self-reported hawk is assigned b (and the self-reported dove is assigned $1 - b$) with probability p_M, and war takes place with probability $1 - p_M$.

Further, the equilibrium must satisfy the IC* constraint for the low type

$$\begin{gathered}(1-q)\left((1-p_L)\frac{\theta}{2}+p_L\frac{1}{2}\right)+q\left((1-p_M)(1-p)\theta+p_M(1-b)\right)\geq\\(1-q)\left((1-p_M)\frac{\theta}{2}+p_Mb\right)+q\left((1-p_H)(1-p)\theta+p_H\frac{1}{2}\right)\end{gathered}$$

and to the ex-post IR constraint of the high type:

$$b \geq p\theta.$$

Solving the indifference condition:

$$\begin{aligned}I_H(q)-k &= (1-q)\left((1-p_M)p\theta+p_Mb\right)+q\left((1-p_H)\theta/2+p_H/2\right)-k\\&= (1-q)\left((1-p_L)\theta/2+p_L/2\right)+q\left((1-p_M)(1-p)\theta+p_M(1-b)\right)=I_L(q),\end{aligned}$$

yields a function $k(\lambda)$ whose precise formula is inessential for the analysis, and hence omitted.

We want to find values of the control variables that minimize $k(\lambda)$ for all λ. We first observe that $\partial k/\partial p_L = -\frac{1}{2}(1-\theta)/(\lambda+1) < 0$, $\partial k/\partial p_H = \frac{1}{2}\lambda(1-\theta)/(\lambda+1) > 0$ and $\partial k/\partial b = p_M > 0$. The sign of $\partial k/\partial p_M = \frac{1}{2}(2b - 3\lambda - \gamma + 2b\lambda + 2\theta\lambda + \theta\gamma - \lambda\gamma + \theta\lambda\gamma - 1)/(\lambda+1)$ is ambiguous.

Then, we note that we can set $p_L = 1$ and $b = p\theta$, as this minimizes the function $k(\lambda)$, for all λ, without violating the IC* and ex-post IR constraints. After setting $b = p\theta$, we obtain that $\partial k/\partial p_M = -(1-\theta)\lambda/(\lambda+1) < 0$.

We now distinguish two possibilities.

1. $\lambda \leq \gamma/2$. In this case, we p_H equal to its minimum, $p_H = 0$. Simplifying the IC* constraint, we obtain $p_M \leq \frac{1}{1+\gamma-2\lambda}$. Hence, the solution implies that $p_M = \frac{1}{1+\gamma-2\lambda}$. We have recovered the split values and equilibrium that minimize the chance of war in the communication game.

2. $\gamma \geq \lambda > \gamma/2$. In this case, we set p_M equal to its maximum, $p_M = 1$. Simplifying the IC* constraint, we obtain $p_H \geq 1 - \frac{\gamma}{(1+\gamma)\lambda}$. Hence, the solution implies that $p_H = 1 - \frac{\gamma}{(1+\gamma)\lambda}$. Again, we have recovered the split values and equilibrium that minimize the chance of war in the communication game.

Part 2. We now consider symmetric equilibria where doves randomize in the communication game. We use the following notation. We say that the low type mix between the low message (with probability σ) and the high message. We let $\chi \equiv \frac{q}{1-P}$ be the posterior of facing a high type after the high message, where $P \equiv (1-q)\sigma$ is the probability of low message. The militarization stage indifference condition:

$$\begin{aligned} I_H(q) - k &= P((1-p_M)p\theta + p_M b) + (1-P)((1-p_H)(\chi\frac{\theta}{2} + (1-\chi)p\theta) + p_H\frac{1}{2}) - k \\ &= P((1-p_L)\frac{\theta}{2} + p_L\frac{1}{2}) + (1-P)((1-p_M)(\chi(1-p)\theta + (1-\chi)\frac{\theta}{2}) + p_M(1-b)) = I_L(q), \end{aligned}$$

yields a function $k(\lambda)$ whose formula is inessential for the analysis, and hence omitted.

Differentiating k, we obtain $\partial k/\partial b = p_M > 0$, $\partial k/\partial p_L = -\frac{1}{2}(\lambda+1)^{-1}(1-\theta)\sigma < 0$,

$\partial k/\partial p_H = \frac{1}{2}(\lambda+1)^{-1}(\lambda-\gamma(1-\sigma))(1-\theta)$, $\partial k/\partial\sigma = \frac{1}{2}(\lambda+1)^{-1}(\gamma p_H - p_L - (\gamma-1)p_M)(1-\theta)$ and $\partial k/\partial p_M = \frac{1}{2}(\lambda+1)^{-1}(2b+\theta+\sigma-3\lambda+2b\lambda-\theta\sigma+2\theta\lambda-\sigma\gamma-\lambda\gamma+\theta\sigma\gamma+\theta\lambda\gamma-2)$. The latter 3 have ambiguous sign.

All symmetric equilibria where doves randomize in the communication game must satisfy the following indifference condition:

$$
\begin{aligned}
& P((1-p_L)\frac{\theta}{2}+p_L\frac{1}{2})+(1-P)((1-p_M)(\chi(1-p)\theta+(1-\chi)\frac{\theta}{2})+p_M(1-b)) \\
= \; & P((1-p_M)\frac{\theta}{2}+p_M b)+(1-P)((1-p_H)(\chi(1-p)\theta+(1-\chi)\frac{\theta}{2})+p_H\frac{1}{2})
\end{aligned}
$$

together with the hawk ex-post constraint

$$
b \geq p\theta,
$$

and with the constraint that hawks send the high message with probability one,

$$
\begin{aligned}
& P((1-p_M)p\theta+p_M b)+(1-P)((1-p_H)(\chi\frac{\theta}{2}+(1-\chi)p\theta)+p_H\frac{1}{2}) \geq \\
& P((1-p_L)p\theta+p_L\max\{p\theta,\frac{1}{2}\}) \\
& +(1-P)((1-p_M)(\chi\frac{\theta}{2}+(1-\chi)p\theta)+p_M\max\{1-b,\chi\frac{\theta}{2}+(1-\chi)p\theta\}).
\end{aligned}
$$

Simplifying the left-hand side, the latter constraint becomes:

$$
\begin{aligned}
& P((1-p_M)p\theta+p_M b)+(1-P)((1-p_H)(\chi\frac{\theta}{2}+(1-\chi)p\theta)+p_H\frac{1}{2}) \geq \\
& Pp\theta+(1-P)((1-p_M)(\chi\frac{\theta}{2}+(1-\chi)p\theta)+p_M\max\{1-b,\chi\frac{\theta}{2}+(1-\chi)p\theta\}).
\end{aligned}
$$

To minimize $k(\lambda)$ subject to these three constraints, as in part 1, we can set $b = p\theta$ and $p_L = 1$.

Substituting these values in the hawks revelation constraint, and reparamterizing, it simplifies to:

$$
\frac{1}{2}(\lambda+1)^{-1}(\lambda-\gamma(1-\sigma))(1-\theta)p_H \geq 0.
$$

But noting that the expression for $\partial k/\partial p_H$ is exactly $\frac{1}{2}(\lambda+1)^{-1}(\lambda-\gamma(1-\sigma))(1-\theta)$, this implies that minimizing $k(\lambda)$ requires minimizing p_H, possibly by setting $p_H = 0$.

Further, because $\partial k/\partial\sigma = \frac{1}{2}(\lambda+1)^{-1}(\gamma p_H - p_L - (\gamma-1)p_M)(1-\theta)$, minimizing $k(\lambda)$ requires maximizing σ, as long as $\gamma p_H - 1 - (\gamma-1)p_M \leq 0$. Finally, substituting $b = p\theta$ and $p_L = 1$ into $\partial k/\partial p_M$, it becomes $\partial k/\partial p_M = \frac{1}{2}(-2\lambda+\gamma-1-\sigma(\gamma-1))(1-\theta)/(\lambda+1)$, minimizing $k(\lambda)$ requires maximizing p_M, as long as $-2\lambda+\gamma-1-\sigma(\gamma-1) \leq 0$.

The relation between σ, p_M and p_H, determined by the dove's indifference condition, which after substituting $b = p\theta$ and $p_L = 1$ and reparametrizing, becomes:

$$-\frac{1}{2}(p_H - \sigma - p_M - \sigma p_H + 2\lambda p_H + 2\sigma p_M - 2\lambda p_M + \gamma p_M + \lambda\gamma p_H)(1-\theta)/(\lambda+1) = 0.$$

This condition is satisfied if and only if:

$$p_H - \sigma - p_M - \sigma p_H + 2\lambda p_H + 2\sigma p_M - 2\lambda p_M + \gamma p_M + \lambda\gamma p_H = 0.$$

The possible solutions, therefore, are found by comparing corners and imposing the indifference condition. We obtain 3 possibilities:

A. Set $p_H = 0$, $p_M = 1$ and $\sigma = 2\lambda - \gamma + 1 \in (0,1)$, as $p_H = 0$ implies $-2\lambda + \gamma - 1 - \sigma(\gamma-1) = -\gamma(2\lambda-\gamma+1) < 0$

B. Set $p_H = 0$, $\sigma = 1$, $p_M = \frac{1}{1+\gamma-2\lambda} \in (0,1)$, as $p_H = 0$ implies $-1-(\gamma-1)p_M < 0$.

C. Set $p_M = 1$, $\sigma = 1$, $p_H = \frac{2\lambda-\gamma}{\lambda(\gamma+2)} \in (0,1)$, as $\sigma = 1$ implies $-2\lambda+\gamma-1-\sigma(\gamma-1) = -2\lambda < 0$ and $p_M = 1$ implies $\gamma p_H - 1 - (\gamma-1)p_M = \gamma p_H - 1 - (\gamma-1) < 0$.

Indeed, the latter two implications rule out the possibilities $p_M = 1$, $\sigma = 0$ and $p_M = 0$, $\sigma = 1$ as solutions. And the possibility $p_M = 0$ and $\sigma = 0$ yields $p_H = 0$ via the indifference condition, which implies that σ should be maximized, rather than minimized.

The requirement that $2\lambda - \gamma + 1 \in (0,1)$ implies that $2\lambda \geq \gamma - 1$ and $2\lambda - \gamma + 1 \leq 1$; i.e., $\lambda \leq \gamma/2$. Hence, we only need to compare (A) with (B), the latter being the desired solution for $\lambda \leq \gamma/2$. Substituting (A) into the (omitted) expression for $k(\lambda)$, we report obtaining:

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

whereas substituting (B) yields

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

Subtracting the first expression from the latter, we obtain:

$$-\frac{1}{2}\left(\gamma-2\lambda+1\right)^{-1}\left(\lambda+1\right)^{-1}\left(1-\theta\right)\left(\gamma-2\lambda\right)^{2}\left(\gamma+1\right),$$

which is strictly negative for $\lambda \leq \gamma/2$.

This concludes the proof of Lemma 2. □