Costly Signaling, Coercion and Deterrence*

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Abstract

Costly signaling has become a primary prescription for peace, yet our understanding thereof remains underdeveloped. We have an even poorer appreciation of what I call pure coercion. Using a series of bargaining models, I evaluate the ability of three foreign policy instruments – military preparation, audience costs, and economic sanctions – to deter through either costly signaling or pure coercion. The results refine our understanding of deterrence in a number of ways. Costly signaling may be least relevant when it is most needed – when states are near parity. In contrast, pure coercion may prevent wars even between states near parity. The military instrument is unique in facilitating costly signaling under plausible conditions, but it is also the only instrument that can be expected to make war *more* likely in equilibrium. Sanctions have the potential to destabilize, but are not employed in equilibrium under such conditions.

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If information problems are a primary cause of war, then information revelation might naturally be expected to prevent war.[1] Scholars have thus sought to determine whether and how states can credibly communicate their private information.[2] The typical means of communication between states is diplomacy, but given the incentive states have to misrepresent their value for war, many argue that diplomatic statements are insufficient for preventing war.[3] One alternative solution that has received considerable attention is costly signaling,[4] which has essentially become the textbook recommendation for preventing war.[5]

Yet the analysis of costly signaling has, thus far, lacked the rich variation found in the study of the causes of war.[6] As a result, we are left unable to answer some important questions. Does it matter that, to date, the analysis of costly signaling has relied upon on models in which goods are indivisible when so much of the study of the causes of war has assumed that issues are divisible? Should we be concerned that the models used to analyze costly signaling exclusively focus on resolve as a source of uncertainty, even though models that assume uncertainty over the likely outcome of war sometimes yield different conclusions?[7] Are defenders who find war less attractive without recourse if they wish to deter would-be challengers? Might it be possible for the defender to achieve a better outcome even if he cannot alter the challenger's beliefs about his privately held information?[8]

[1]Kydd summarizes this view well: "If uncertainty is at the heart of crises, then communication is the key of resolving them," (Kydd 2005, 186). Slantchev (2011, 28) echoes this conclusion.

[2]Much of this work contradicts the conclusion of Banks (1990), who argues that higher valuation types must accept a greater risk of escalation in order to credibly reveal their type. The models analyzed here do not belong to the class of models analyzed by Banks, but it is important to note that contradictory results can be established even for models belonging to that class. See Slantchev (2011) for a detailed discussion.

[3]See Fearon (1995). The intuition here is that cheap talk reveals information if and only if actors' have common interests (Crawford and Sobel 1982), which would itself be a sufficient condition to ensure peace. However, see also Ramsay (Forthcoming) and Sartori (2005) for arguments about how ordinary diplomatic communication may facilitate credible information revelation.

[4]On the general logic of costly signaling in international relations, see Fearon (1997). Important extensions can be found in Slantchev (2005, 2011). For applications beyond the study of international conflict, see especially Austen-Smith and Banks (2000) and Austen-Smith (2002).

[5]See Frieden, Lake and Schultz (2010, 99–105).

[6]See, for example, Powell (1999, 2004, 2006), Wagner (2000), Slantchev (2003), Tarar and Leventoğlu (2008), Fey and Ramsay (2011), and Wolford, Carrubba and Reiter (2011) for prominent examples of studies that have explored the generality of the arguments presented in Fearon (1995).

[7]See Powell (2004) and Fey and Ramsay (2011).

[8]I will refer to the challenger as "she" and the defender as "he" throughout.

I argue that there are essentially two ways in which the use of any given policy instrument might allow a defender to deter a challenger.[9] The two distinct paths through which a given instrument may facilitate deterrence are: costly signaling, which manipulates the challenger's beliefs about the defender's privately held information; and pure coercion, which manipulates the challenger's material incentives for risking war. In this article, I assess the performance of each of three policy instruments with respect to these two approaches: military preparations, audience costs, and economic sanctions.

The results indicate that costly signaling allows defenders to credibly reveal their resolve, but is of no use for credibly revealing martial effectiveness.[10] Moreover, the military instrument appears to be the only instrument that is likely to signal resolve under plausible conditions. Specifically, there exists an equilibrium in which relatively resolved defenders strictly prefer to engage in costly military preparations for war while less resolved defenders strictly prefer not to do so, and thus the challenger can be sure that if she observes military preparations, she is dealing with a relatively resolved defender. Equilibria exist in which generating audience costs or imposing economic sanctions may serve as a costly signal of resolve, but these equilibria are knife-edge, since the relatively resolved defender is indifferent between employing these instruments and not. It is only through making arbitrary assumptions about how actors behave when indifferent that I am able to establish equilibria in which these two instruments have the capacity to signal resolve. As if that were not already cause to doubt the empirical relevance of signaling through audience costs or economic sanctions, the results further indicate that these instruments are only capable of signaling resolve when the costs associated with them exceed the defender's cost of war.[11]

[9] Traditionally, deterrence theorists focus on whether one state challenges the status quo, and whether, if they do so, they back down in the face of resistance from the defender. See Danilovic (2001), Huth (1988), Huth and Russett (1993), Kilgour and Zagare (1991), Quackenbush (2010), Schelling (1960, 1966), Signorino and Tarar (2006), Zagare and Kilgour (2000). However, the general definition of deterrence is simply the attempt to prevent others from taking unwanted actions by threatening to harm them if they do so. Therefore, deterrence might also be thought of as the attempt to alter the challenger's demand. It is in this sense that I will refer to deterrence here.

[10] For the sake of simplicity, I focus on one source of uncertainty at a time. Naturally, states might be uncertain about both resolve and martial effectiveness, and much else besides. I discuss this further below.

[11] Note that while we have experimental evidence of audience costs that differ from zero (Tomz 2007), we

However, I demonstrate that there are conditions under which each of the instruments allows the defender to deter the challenger through pure coercion, though some notable differences are identified with respect to the conditions under which each of the instruments does so. Military preparations are most likely to do so when the challenger is uncertain about the defender's martial effectiveness and the defender had an advantage in military capabilities to begin with.[12] In contrast, audience costs and economic sanctions facilitate deterrence through pure coercion under plausible conditions regardless of the nature of the challenger's uncertainty.[13]

These results have important implications for the study of international conflict. Slantchev (2011, 5) argues that "(t)he likelihood of war depends on the extent to which one is prepared to use military threats to deter challenges to peace." Yet the results here indicate that the decision not to engage in military preparations can often promote peace rather than war.

Further, several prominent arguments claim that the absence of conflict among Western states can be attributed to an increased ability for such states to engage in costly signaling.[14] The results here provide a strong challenge to such claims.[15]

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also have experimental evidence that leaders need only tell the public that circumstances changed in order to escape punishment, indicating that if audience costs tie hands at all, they do so with remarkably loose knots (Levendusky and Horowitz 2012). It is even more unlikely that the cost of economic sanctions exceeds the cost of war, since states typically sever all ties during war anyway, and thus the loss of utility associated with incurring the costs of war presumably already incorporates the foregone benefits of economic cooperation.

[12] When the defender begins with a disadvantage in capabilities, military preparations in fact make war *more* likely – and yet may be employed in equilibrium.

[13] Note, however, that there are conditions under which the use of sanctions would cause the challenger to risk war when otherwise she would not, if the defender were to employ them, which he will not. That is, sanctions appear to have the potential to destabilize crises, but the models analyzed here provide no reason to expect sanctions to be imposed under such conditions. The possibility of states employing sanctions in a manner that increases the risk of war for reasons other than those anticipated by the relatively sparse models here is a topic worthy of further inquiry.

[14] I refer to Western states here because the evidence that democracy and economic interdependence are associated with peace comes primarily from the Western world Dafoe (2011), Henderson (2009). That is, some scholars attribute the apparent association between a relatively low incidence of international conflict, on the one hand, and interdependence (which is particularly high among OECD countries), on the other, to costly signaling (Boehmer, Gartzke and Nordstrom 2004, Gartzke 2007, Gartzke, Li and Boehmer 2001). Similarly, various authors have claimed that the reason threats issued by democratic states appear to be less likely to meet with resistance is that democracies are better able to signal their resolve by generating audience costs (Partell and Palmer 1999, Schultz 2001, 1999).

[15] If we set aside any statistical concerns about whether extant empirical results in fact demonstrate that joint democracy causes peace (Gibler 2007, Henderson 2002), or whether the pacifying effect of bilateral interdependence can generalize to explain aggregate changes in the incidence of conflict (Martin, Mayer and

Taken together, the results indicate that it is problematic to observe that some pairs of states are less likely to come into conflict with one another than are other pairs of states and, from this, infer that these states find it easier to credibly reveal their private information.[16] Yet such results are consistent with a growing literature challenging the view that where there is peace, there is information revelation, and where there is information revelation, there is peace.[17]

I proceed in three steps. First, I use the basic ultimatum crisis bargaining model to motivate a discussion of the logic of deterrence in a bargaining framework, which differs in some subtle but important respects from traditional approaches.

Second, I introduce three variants of the basic model. In each of these, prior to the challenger issuing her demand, the defender decides whether or not to employ some policy instrument. In addition to potentially serving to reveal information, each instrument manipulates the material incentives of at least one side. Military preparation shifts the expected outcome of war in the defender's favor, but requires him to sink costs. Invoking audience costs through public statements makes accepting a negotiated outcome less attractive to the defender. Economic sanctions imposts costs on both the challenger and the defender.

Third, I discuss the effectiveness of each instrument both in terms of costly signaling and pure coercion. I do so under two different assumptions about the defender's private information, contrasting uncertainty about resolve with uncertainty about martial effectiveness.

I conclude with a discussion of the broader implications this analysis has, both theoretical and empirical, for the study of international conflict.

Thoenig 2008), we must still acknowledge that all that has been demonstrated is that democracies and states with high level of economic interdependence are less likely to come into conflict with one another than are other pairs of states. Direct evidence that belief updating is the mechanism producing such a result has not been provided. And the results here suggest that it is unlikely that costly signaling *is* the mechanism.

[16] Other important criticisms of costly signaling interpretations of the liberal peace have been made. With respect to economic interdependence, see Polachek and Xiang (2010) and **?**. With respect to audience costs, see Tarar and Leventoğlu (N.d.), Weeks (2008) and Slantchev (2006).

[17] Arena and Wolford (2012) argue that intelligence gathering, which by assumption allows an uninformed state to acquire information its opponent held private, may sometimes may make war *more* likely. See also Fey and Ramsay (2010), who argue that the apparent association between mediation and peace typically has little to do with information revelation.

A Basic Logic of Deterrence

Traditional approaches to deterrence treat the issue in dispute as indivisible. The two critical questions then are whether the defender prefers war to surrendering control of the good, and whether the challenger prefers the status quo to war. All else equal, the more confident the challenger is that the defender prefers conflict to surrendering the good, the more likely the challenger is to accept the status quo. Additionally, the less attractive conflict with the defender is to the challenger, the more likely she is to accept the status quo.[18]

In contrast, I assume that the issue in dispute is continuously divisible.[19] Rather than focusing on whether each side prefers the status quo to war, I focus on what terms the challenger proposes, and what terms the defender is willing to accept.[20] Here, the challenger's demand depends on both her beliefs about the defender and her own value for war.

The basic ultimatum crisis bargaining game is as follows. A challenger, C, demands $x \in [0, 1]$ of a defender, D. If D accepts, the good is divided accordingly.[21] Let $\nu_C > 0$ denote the value C ascribes to the good in dispute, and $\nu_D > 0$ the same for D. Then if D accepts C's demand of x, C's payoff is $\nu_C x$ while D's is $\nu_D(1 - x)$.

Should D reject x, the two fight a war. Let $w \in [0, 1]$ denote the share of the good that is expected to fall under C's control by war's end,[22] where $w \equiv \dfrac{e_C m_C}{e_C m_C + e_D m_D}$ and $e_i \in [0, 1]$ indexes how effectively $i \in \{C, D\}$ fights given material capabilities $m_i > 0$.

[18]See, inter alia, Zagare and Kilgour (2000), Danilovic (2001) and Slantchev (2011).

[19]This does not necessarily require that all issues are continuously divisible. Through issue linkage, the overall bargaining space may be made divisible even if some of the issues involved are not.

[20]I have implicitly assumed that the challenger is dissatisfied with the status quo. However, none of the results depend upon such an assumption. See Powell (1999) for a discussion of the role of the distribution of benefits under the status quo in a bargaining framework.

[21]I assume away the possibility that the challenger retracts her offer once it is accepted or that the defender fails to comply with the agreement. See Meirowitz and Ramsay (N.d.) on the innocuous nature of the first assumption. While Schultz (2010) demonstrates that commitment problems arise if the challenger can monitor the defender's compliance with an agreement, costly signals are only relevant for information problems, so the assumption of enforceable agreements does nothing to detract from the relevance of this analysis to the discussion of costly signals.

[22]It is conventional to describe wars in this context as costly lotteries, where the victor is assumed to obtain full control of the good in dispute. However, the substantive interpretation of the model is the same if we instead assume that the war will eventually end in a negotiated agreement, so long as the terms of the *expected* war-ending agreement are given by w.

By convention, player i pays costs $c_i \in (0, 1]$, and receives no benefits from war independent of the distributive outcome.[23] Taken together, then, C's overall payoff for war is $\nu_C w - c_C$ while D's war payoff is $\nu_D(1 - w) - c_D$.

For the moment, assume complete information. So long as $\nu_D(1 - x) \geq \nu_D(1 - w) - c_D$, which can be rewritten as $x \leq w + \frac{c_D}{\nu_D}$, we can expect D to accept C's demand. Since $\nu_C(w + \frac{c_D}{\nu_D})$, the payoff C receives when making the largest demand that she knows to be acceptable to D, is greater than $\nu_C w - c_C$, her war payoff, C will not provoke a war.[24]

Now let us introduce incomplete information. We might either assume that C is uncertain about D's value for the good in dispute, ν_D, or D's martial effectiveness, e_D.[25] Following convention, I assume that actors who ascribe a low value to the good in dispute lack resolve, while those who value it highly are deemed highly resolved.

Regardless of the source of C's uncertainty, let D's type be relatively low (i.e., $\nu_D = \underline{\nu}_D$ or $e_D = \underline{e}_D$) with probability q_u, and relatively high ($\nu_D = \overline{\nu}_D$ or $e_D = \overline{e}_D$) with probability $1 - q_u$, where $u \in \{\nu, e\}$ indicates the source of uncertainty.

As discussed in the Appendix, in any perfect Bayesian equilibrium (PBE), C will either set $x = \overline{x}_u$ or $x = \underline{x}_u$, where $\underline{x}_u < \overline{x}_u$. When issuing the larger demand, $\overline{x}_u$, C risks war. In contrast, peace is certain to obtain if C instead demands $\underline{x}_u$. Of course receives better outcomes when D concedes to $\overline{x}_u$. Thus, we see that C faces the familiar risk-return tradeoff – the more she demands, the better off she will be in the event that war is avoided, but the more likely it is that war will *not* be avoided.[26]

More formally, regardless of the source of uncertainty, there are two perfect Bayesian equilibria: one in which C sets $x = \underline{x}_u$, and one in which she sets $x = \overline{x}_u$. In each case, C's strategy can be characterized by comparing q_u to a unique cutpoint, denoted $\hat{q}_u$.[27]

[23] This reflects the assumption that war is a costly means to an end rather than an end unto itself.

[24] Though I use slightly different notation, this informal proof mirrors that from Fearon (1995).

[25] Assume, then, that before the game begins, Nature selects D's type and reveals it to D but not C.

[26] Note that while this setup allows equilibria with a zero probability of war, in contrast to more general treatments such as Fearon (1995), it nonetheless ensures broadly similar substantive implications.

[27] By one convention, we might say that there is a unique perfect Bayesian equilibrium (PBE), in which C chooses $x = \underline{x}_u$ if $q_u \leq \hat{q}_u$ and sets $x = \overline{x}_u$ otherwise. Throughout the paper, I treat cases where C's choice of x, and thus the equilibrium probability of war, is unique as distinct equilibria, so as to facilitate

The precise values of $\hat{q}_\nu$ and $\hat{q}_e$ are defined in the Appendix. The substantive implications, which are straightforward, are the same regardless of the source of uncertainty. The more confident C is that D will accept her demand even if she opts for $x = \overline{x}_u$, the more willing C is to risk war in hopes of extracting maximal concessions.

But note that the same is true as $\hat{q}_u$ decreases. As $\hat{q}_u$ decreases, C need not be quite as optimistic before she finds it optimal to set $x = \overline{x}_u$.

Put differently, if D undertakes some action that decreases C's posterior belief that he is relatively lacking in either resolve or martial effectiveness, a belief I denote q'_u for notational convenience, it becomes less likely that C sets $x = \overline{x}_u$, since, as q'_u decreases, it becomes less likely that $q'_u > \hat{q}_u$. However, as $\hat{q}_u$ increases, C is also less likely to set $x = \overline{x}_u$. Thus, there is no compelling reason to focus exclusively on changes in C's beliefs. War can be avoided either by increasing C's belief that she faces a type of D who is willing to reject relatively large demands, *or* by decreasing C's material incentives to issue such demands.

Our preoccupation with costly signaling effectively privileges changes in q'_u while neglecting the importance of changes in $\hat{q}_u$. Through costly signaling, higher types of D decrease q'_u. Through pure coercion, D can increase $\hat{q}_u$. Either of these effects, if sufficiently large, can ensure that C opts for $\underline{x}_u$ when she might otherwise have chosen $\overline{x}_u$.

This simple analysis is sufficient to demonstrate that extant work has largely ignored half the story when it comes to deterrence. Even if costly signaling worked as well as it is commonly assumed to – and we will see below that there are important limitations in this respect – this would be worth correcting.

In the following sections, I analyze a series of extensions of the above model in order to clarify the conditions under which various policy instruments can facilitate successful deterrence, whether they do so by serving as costly signals or through pure coercion, and whether those results depend upon the nature of C's uncertainty.

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interpretation of the relationship between D's strategy and the likelihood of war. There are no cases of overlapping pure strategy equilibria in any of the models herein. For any given set of beliefs held by C, we can uniquely identify C's choice of x and the attendant probability of war.

The Policy Instruments

Each of the extensions of the basic model follows the same form. Prior to C's demand, D chooses either to employ a policy instrument or not. The instruments to be considered include: engaging in military preparations for war, declaring publicly that he will not compromise,[28] thereby ensuring that any negotiated outcome will impose audience costs upon the defender, and imposing economic sanctions. After she observes D's decision, C issues her demand, and D decides whether to accept or reject.

Let $\overline{x}_{n,u}$ and $\underline{x}_{n,u}$ refer to the large and small demands when D does not use the relevant policy instrument, given uncertainty type u; $\overline{x}_{m,u}$ and $\underline{x}_{m,u}$ the demands when D employs the military instrument; $\overline{x}_{a,u}$ and $\underline{x}_{a,u}$ the demands when D generates audience costs; and $\overline{x}_{e,u}$ and $\underline{x}_{e,u}$ the demands when D threatens economic sanctions. Similarly, let $\hat{q}_{n,u}$, $\hat{q}_{m,u}$, $\hat{q}_{a,u}$, and $\hat{q}_{e,u}$ refer to the thresholds against which C compares posterior beliefs $q'_{n,u}$, $q'_{m,u}$, $q'_{a,u}$, and $q'_{e,u}$, given that D did not use the instrument in question, engaged in military preparations, generated audience costs, and threatened to sever economic ties, respectively.

The variants of the model have much in common with one another. Regardless of the policy instrument available to D or the nature of C's uncertainty, there are two perfect Bayesian equiliria to each variant of the model. As with the basic model presented above, in each case, C either makes a relatively large demand, a demand that risks war, or she makes a more modest demand, one that D accepts regardless of type.

Whether C chooses the larger demand or the smaller demand again can be characterized by whether C's posterior belief falls above or below some cutpoint, with smaller demands being chosen in equilibrium when C's posterior belief lies below the cutpoint and larger demands when her posterior belief lies above it.

The primary differences amongst the variants of the model concern the specific way in which the policy instruments alter the player's payoffs for war or for peaceful outcomes.

[28] Note that Fearon (1997) treats audience costs as the costs of backing down, rather than for compromising – which is impossible by assumption in his model. Both in his model and the one analyzed here, however, audience costs are the costs for not resorting to force after making some clear public statement.

The first variant allows D the option to engage in military preparations for war, which is assumed to increase m_D without altering D's ability to make effective use of said capabilities, e_D. This may take the form of mobilizing existing forces, which both Fearon (1997) and Slantchev (2005, 2011) argue serves as a costly signal.[29] However, any action that is observable and requires D to incur some cost in order to increase his ability to win a war will have the same effect, so we might conceive of this instrument more broadly. That is, negotiating new alliances or assembling *ad hoc* war coalitions should play the same role as any effort D might make to prepare his own forces for combat. Note, however, that military preparations conducted in secret fall outside the scope of this analysis.[30]

While systematic analysis of war outcomes typically finds only a relatively modest observed correlation between military capabilities and war outcomes,[31] we must be careful in interpreting this pattern. Stam (1996) carefully notes that the *potential* impact of military capabilities is impressive, noting that the low correlation observed historically in part reflects selection effects, as states near parity are more likely to go to war than are other pairs of states. Thus, even if other factors appear to better account for variation in the outcome of the wars we have observed historically, it remains reasonable to assume that states with greater military capabilities are more likely to prevail, all else equal.

When D employs this instrument, he incurs cost $\kappa > 0$, a cost that cannot be recouped if war is averted. In this respect, the military instrument sinks costs. Yet at the same time, it makes war more attractive to D. That is, the approach taken here to modeling the military instrument is more similar to that of Slantchev (2005, 2011) than Fearon (1997).

More formally, when D engages in military preparations, m_D is multiplied by some constant, $\beta > 1$. Note that this specification ensures that the benefit of military preparations depends upon the resources D has at his disposal to begin with.

[29] Though note that Fearon (1997) focuses exclusively on the sunk cost aspect of mobilization, whereas Slantchev (2005, 2011) allows military preparations to make war more attractive to the defender.

[30] See Slantchev (2010) for an explication of the logic of feigning weakness.

[31] Stam (1996) identifies a stronger correlation between military strategy and war outcome than he does any other factor. See also Biddle (2003).

A richer approach would allow D to decide precisely how much he is willing to prepare for war, rather than treating β and κ as exogenous. However, while extending the model in such a way surely offers a ripe avenue for future research, the results when C is uncertain about D's resolve are sufficiently similar to those of Slantchev (2005, 2011) to suggest that this simplification is relatively innocuous.

Let w, as defined above, denote C's expected share of the good as a result of war when D did not employ the military instrument, and $w_m \equiv \dfrac{e_C m_C}{e_C m_C + e_D \beta m_D}$ denote C's share when D engages in military preparations. If C is uncertain about e_D, then we must further distinguish between $\underline{w} \equiv \dfrac{e_C m_C}{e_C m_C + \overline{e}_D m_D}$, $\overline{w} \equiv \dfrac{e_C m_C}{e_C m_C + \underline{e}_D m_D}$, $\underline{w}_m \equiv \dfrac{e_C m_C}{e_C m_C + \overline{e}_D \beta m_D}$ and $\overline{w}_m \equiv \dfrac{e_C m_C}{e_C m_C + \underline{e}_D \beta m_D}$. Note that $w > w_m$ and $\underline{w} < \overline{w}$. That is, C expects to fare better against D when the latter has not made additional preparations for war, and also if he is relatively unable to make effective use of his military capabilities.

Taken together then, when D makes military preparations for war, C's and D's payoffs for a negotiated agreement are $\nu_C x_{m,u}$ and $\nu_D(1 - x_{m,u}) - \kappa$, while the payoffs C and D receive from war are $\nu_C w_m - c_C$ and $\nu_D(1 - w_m) - c_D - \kappa$, respectively.

The second variant of the model allows D to proclaim that he cannot compromise on the issue in dispute, such that conceding to D's demand, regardless of its size, will cause his domestic audience to punish him for tarnishing the nation's reputation.[32]

More formally, should D concede to C's demand after generating audience costs, C receives $\nu_C x_{a,u}$ and D receives $\nu_D(1-x_{a,u})-\alpha$. In the event of war, the payoffs are $\nu_C w - c_C$ and $\nu_D(1 - w) - c_D$ for C and D, respectively. The only effect of audience costs then is to discourage D from offering concessions, or to tie D's hands.

Again, it would be preferable to allow the size of α to be determined endogenously. However, the substantive results here would hold so long as α was increasing in x.[33]

[32] Others have noted the similarity between the notion of audience costs and issue indivisibility. See Frieden, Lake and Schultz (2010) and Goddard (2006). Note that I assume that audience costs are incurred if and only if the defender chooses to invoke them through issuing public statements that put the nation's reputation on the line. This view is consistent with Fearon (1997) but differs from that of Fearon (1994).

[33] C must offer D better terms if she expects D to accept after he claims he cannot compromise, but this is less true for more resolved defenders (who requires less compensation in the form of a smaller x to offset the

The third and final variant allows D to impose sanctions on with C, where the severity of such sanctions is allowed to increase with the size of C's demand.

More formally, employing this instrument ensures that C and D each subtract ξ from their payoffs in the event of a negotiated agreement, where $\frac{\partial \xi}{\partial x} \geq 0$. Since there are only two values of $x_{u,e}$ that C selects in equilibrium, let $\underline{\xi}$ denote the loss of utility associated with the sanctions D imposes when C sets $x = \underline{x}_{u,e}$ and $\overline{\xi}$ when C sets $x = \overline{x}_{u,e}$, where $0 < \underline{\xi} < \overline{\xi}$.

Ideally, the precise size of ξ would be chosen strategically by D. Note however that none of the substantive results discussed in the paper depend upon the actual difference between $\overline{\xi}$ and $\underline{\xi}$. It is only important that $\overline{\xi}$ is greater than $\underline{\xi}$ – that is, that D sanctions C more heavily when C behaves more aggressively. I will, however, offer some brief comments on the ways in which the actual difference between $\overline{\xi}$ and $\underline{\xi}$ could make a difference. Future work might profitably allow the size of ξ to be endogenous.

Taken together, if D imposes sanctions on C and then subsequently accepts $x_{e,u}$, C's payoff is $\nu_C x_{e,u} - \xi$, while D's is $\nu_D(1 - x_{e,u}) - \xi$. The war payoffs remain unaffected.[34] That is, when D imposes sanctions, if the crisis escalates to war, C receives $\nu_C w - c_C$ and D receives $\nu_D(1-w) - c_D$, the same as when D does not employ any of the policy instruments.

Note that I have assumed that at the start of the game, D recognizes that C is dissatisfied. Though D imposes sanctions on C before C even makes any explicit decisions here, this can be interpreted as D's attempt to influence the extent to which C revises the status quo.[35]

Having described the policy instruments, I turn now to the analysis of their relative ability to facilitate deterrence through costly signaling and pure coercion.

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loss introduced by α). Once $\alpha > c_D$, the more resolved type actually receives a *worse* distributive outcome. It is only then that the less resolved type loses all incentive to mimic the more resolved type's behavior.

[34] Note that Gartzke, Li and Boehmer (2001) introduce a benefit for preserving ties rather than a cost for severing ties. However, there is no mathematical difference between rewarding cooperation versus punishing the termination thereof. Moreover, this setup facilitates easier comparison with the other models by leaving the payoffs for C and D when C does not sever ties the same as they are in the basic model.

[35] For example, the United States and its allies are currently using sanctions in attempt to alter the size of Iran's *fait accompli*. That is, we might assume that Iran has yet to issue its final ultimatum to the US, yet the US has already imposed sanctions. States of course sometimes do impose sanctions after the fact, rather than in attempt to deter states from engaging in some unwanted action. Analysis of sanctions under such conditions lies outside the scope of this analysis.

Deterring Through Information Revelation

Above, I briefly discussed some of the differences between traditional approaches to deterrence and one based on bargaining theory. Before delving more deeply into a discussion of the results, it is useful to elaborate further on these differences.

Consider the Basic Crisis Game found in Slantchev (2011, 14). Slantchev analyzes several variants of this model, some of which are analogous to the models in Fearon (1997).

In most of the models Slantchev considers, it is assumed that a crisis has already begun and the defender must decide between resistance or appeasing the challenger.[36] Should the defender resist the challenger's claim, the challenger must then decide whether to press her claim. If she does, the defender must then decide whether to escalate to war or back down. If she backs down instead, the defender retains possession of the good. In all cases, the game ends with one side in possession of the full value of the good in dispute.

War never occurs under complete information in the Basic Crisis Game, even though negotiated agreements are not possible. The reason war never occurs in this model is that Slantchev (2011, 15) assumes that war is not only costly, but *so* costly as to ensure that the expected value of war is worse than the status quo, and that this is true even for the most resolved actors. Nonetheless, the model allows for the possibility that war may be preferable to backing down once the crisis escalates. Therefore, equilibria involving a non-zero probability of war become possible under (two-sided) incomplete information. That is, the defender resists in the hopes that the challenger will back down, only to discover that the challenger is unwilling to do so – despite the fact that the challenger prefers the status quo to war.[37] Had the defender known that the challenger would press her claim, the defender would, by assumption, prefer to surrender the good peacefully at the outset of the crisis.

[36]However, in chapter 5, Slantchev extends the Military Threat Model (MTM) to allow the challenger an initial decision over whether to begin a crisis.

[37]More formally, if the defender appeases the challenger at the outset, he receives 0, but if he initially threatens to use force only to back down once the challenger presses her claim, he receives $-\alpha_1$. Similarly, the challenger receives $-\alpha_2$ if she backs away from her claim after the defender threatens to use force. Thus, while the war payoffs for each are strictly negative by assumption, provided α_1 and α_2 are sufficiently large, the actors may be willing to use force.

In the extensions Slantchev considers, the availability of costly signals typically ensures that the defender never threatens to use force unless he is in fact willing to do so.[38] Thus, if and only if the challenger observes the signal, she knows the defender is relatively resolved.

It is important to note that, while the mere availability of costly signaling generally eliminates the possibility of bluffing in the models Slantchev analyzes, costly signaling is not sufficient to eliminate the risk of war. The the defender's ability to credibly reveal his private information naturally does not eliminate his own uncertainty about the challenger. This second source of uncertainty ensures that war remains possible, since the defender would otherwise only resist if he knew that the challenger to back away from her claim.

In the models analyzed here, once the challenger's uncertainty about the defender is removed, so too is the risk of war.[39] For this reason, equilibria in which D employs the instrument in question if and only if he is relatively resolved are necessarily peaceful.

This difference notwithstanding, there are many important similarities between the approaches. Both in the models analyzed here and those in Slantchev (2011), the credible revelation of private information by the defender strictly harms types that find war relatively unattractive. In the models analyzed by Slantchev, such defenders will be forced to surrender full control of the good in dispute where they might have otherwise succeeded in persuading the challenger to back away from her claim. Here, the availability of costly signaling ensures that defenders who have a lower value for war will be forced to make relatively large concessions when they might otherwise have faced smaller demands. That is, under both approaches, some types of defender will not only fail to use the policy instrument, but would in fact strictly prefer that there not even be an option to do so.

[38]Bluffing may occur in equilibrium if the level of resolve for the most resolved defender is sufficiently low; if un-intuitive assumptions about the beliefs held by the challenger off the equilibrium path; if the defender cannot generate arbitrarily large audience costs; or if the instrument employed for costly signaling is the threat that leaves something to chance. See Slantchev (2011, 31–46) for details.

[39]Note that the structure of the model ensures that we would not gain anything by allowing D to be uncertain about ν_C, though the same cannot be said of e_C. That is, the size of ν_C is not relevant to D, whose decision hinges solely upon his own value for a negotiated agreement relative to his own value for war, and ν_C does not enter into D's payoff for either outcome. In contrast, e_C does influence D's value for war, since it shapes w. If we allowed for two-sided uncertainty pertaining to martial effectiveness, then, the defender's use of costly signaling would mitigate, but not eliminate, the probability of war.

Let us now turn to the results. We are interested in the existence of perfect Bayesian equilibria in which C sets $x = \overline{x}_{n,u}$ and holds the posterior belief $q'_{n,u} = 1$ if she does not observe D employing the instrument, and sets $x = \underline{x}_{\cdot,u}$ and holds the posterior belief $q'_{\cdot,u} = 0$ otherwise, while D employs the relevant policy instrument if and only if he finds war relatively attractive (i.e., if and only if $\nu_D = \overline{\nu}_D$ or $e_D = \overline{e}_D$).

For ease of exposition, let such equilibria be called **Successful Signaling Equilibria**. In such equilibria, war is always averted. If the challenger knows that the defender would employ the relevant policy instrument if and only if he finds war relatively attractive, then regardless of whether the defender actually employs the instruments, the challenger knows precisely who she is dealing with, and will propose terms that the defender will accept.

Let us begin with the military instrument.

Proposition 1. *When the challenger is uncertain about the defender's resolve, there exists a Successful Signaling Equilibrium to the model with military preparation.*

Corollary 1. *When the challenger is uncertain about the defender's martial effectiveness, no Successful Signaling Equilibrium exists to the model with military preparation.*

Proposition 1 and Corollary 1 establish that the military instrument facilitates deterrence via costly signaling when C is uninformed about ν_D, but the same is not true when her uncertainty pertains to e_D.

The intuition behind this result is that there can be no disincentive for defenders who find war relatively unattractive to mimic the behavior of those who do when the outcome of the crisis does not depend upon D's private information.

The logic behind this result holds irrespective of the particular policy instrument. When the quality that D wishes to signal to C is that he attaches a relatively high value to the issue in dispute, the benefit of succeeding in this regard is by its very nature greater when he in fact possesses this quality.[40]

[40] More formally, $\overline{\nu}_D(1-x) > \underline{\nu}_D(1-x)\ \forall\ x$.

But when D seeks to signal that he is relatively good at waging war, the benefit of persuading C of this is independent of the quality D seeks to signal, and so there can be no equilibria in which D incurs some cost if and only if his martial effectiveness is sufficiently high. That is not to say that it is impossible for D to engage in behaviors that would credibly reveal his martial effectiveness.[41] But there is no *incentive* for D to do so in these models.[42]

Now consider the conditions under which the Successful Signaling Equilibrium referenced by Proposition 1 obtains. As I demonstrate in the Appendix, this result requires that κ neither be too large nor too small. Intuitively, if the cost of employing the military instrument is too small, then the less resolved type won't be discouraged from engaging in military preparations. If the cost is too large, then even the more resolved type will forego them. This result is broadly consistent with Slantchev (2005, 2011).

Yet Corollary 1 suggests an important qualification to Slantchev's arguments. Insofar as it is possible that states are uncertain about one another's ability to effectively wage war, there are limits to the potential for the military instrument to serve as a costly signal.

For the sake of simplicity, I have only allowed C to be uncertain about one parameter at a time. But there is of course little enough reason to rule out the possibility that C might simultaneously be uncertain about both D's resolve and his ability to effectively wage war. What then are we to make of Proposition 1 and Corollary 1?

[41] One might argue that military maneuvers serve this function. See, for example, the discussion in (Slantchev 2011, 78–80). One might further argue that peaceful, routine military demonstrations serve this function. For example, the air shows performed by the Blue Angels, an elite squadron of US fighter pilots, feature a number of maneuvers that would surely end in disaster if the pilots were not exceptionally talented. Such maneuvers might or might not ever be of use in combat, but are unlikely to leave any observer with the impression that US forces are poorly trained. Nonetheless, such demonstrations may well also play an important role in cultivating national pride, so it is difficult to determine whether the primary purpose of such demonstrations is to credibly reveal private information to would-be adversaries or whether they are primarily intended for domestic consumption.

[42] This is partly an artifact of the ultimatum bargaining protocol, where C's proposal power ensures that types with a high value of war always receive a payoff precisely equivalent to their war payoff. However, for more martially effective types of D to be willing to incur a cost to reveal their effectiveness, D would have to be strictly worse off when C chooses larger values of x. The only way this would be possible is if the more martially effective type of D would accept terms that C offers when C believes D to be relatively less effective. Yet, in that case, there would be no risk of war in any equilibrium. Therefore, it is unclear how any model could contain equilibria in which D prevents war by engaging in costly displays of his military effectiveness, even though it is entirely possible that some models contain equilibria in which D strictly improves his expected payoff from a negotiated settlement by doing so.

The following result is useful in answering this question.

Lemma 1. *The difference between $\overline{w}$ and $\underline{w}$ is greatest when m_C and m_D are roughly equal.*

Lemma 1 tells us that as C and D approach parity in terms of their material capabilities, C's uncertainty over e_D becomes ever more consequential. Intuitively, if C is preponderant over D, then C expects to do well in war even if $e_D = \overline{e}_D$, and if D is preponderant over C, then C expects to do poorly even if $e_D = \underline{e}_D$. Yet when m_C and m_D are relatively equal, the difference between $\underline{e}_D$ and $\overline{e}_D$ may have profound implications for the likely outcome of war. Put differently, the challenger's uncertainty over the defender's martial effectiveness matters most when the two are evenly matched because it is only under those conditions that there is room for other factors to determine the outcome of the war.

Costly signaling is therefore more relevant within imbalanced dyads than those near parity.[43] When one state is preponderant over the other, then even when C is technically uncertain about both ν_D and e_D, the latter may be sufficiently irrelevant in terms of creating uncertainty over w that it will almost be as if C is in fact only uncertain about ν_D after all.[44] Thus *the mere availability of the military instrument* can be sufficient to prevent wars that would otherwise occur.

[43]However, there may be an exception to the general relationship between parity and uncertainty over the likely outcome of war. Insofar as the danger posed by parity is that it exacerbates the impact of C's uncertainty over e_D, one might conjecture that if the defender has recently fought a war, whether against the challenger or not, then the challenger might have a fairly good sense of the likely outcome of a potential war with the defender That is, as Slantchev (2003) and Powell (2004) both argue, states cannot manipulate the outcomes of battles the way they can misrepresent their type at the negotiating table. Consider, for example, the Berlin Blockade of 1948–1949 and subsequent airlift by the US and its allies in an attempt to prevent the Soviet Union from consolidating its hold on Berlin. Though the US and its allies possessed roughly the same material capabilities as the USSR, one might argue that the Soviets could reasonably anticipate the likely outcome of a war, having just a few short years earlier fought alongside these very powers. The Soviets might well have questioned the resolve of its former allies, however, particularly in light of the massive US demobilization that followed World War II. To be sure, the campaign served an important humanitarian purpose. Nonetheless, one could argue that *one* of the effects of the airlift was to allow the US and its allies to demonstrate resolve. It seems unlikely that the US and its allies would undertake such a campaign if they deemed the issue unimportant, as the airlift campaign was quite costly. All told, it cost approximately $224 million, or more than $2 billion in today's dollars (The Federal Reserve Bank of Minneapolis 2011, The German Way 2011). The Berlin Airlift may then be the exception that proves the rule that costly signaling is less relevant among states with roughly equal military capabilities.

[44]More formally, as the difference between $\underline{w}$ and $\overline{w}$ decreases, $\hat{q}_{e,n}$ and $\hat{q}_{e,m}$ increase, and $q'_{e,n}$ or $q'_{e,m}$, as the case may be, would need to take on larger values before C would be willing to risk war.

But among states that are near parity, the conditions under which the possibility of war would be removed through the credible revelation of private information are considerably more restrictive.[45] This suggests that, at least amongst states with roughly equal material capabilities, there is little basis for concluding that war is most likely when states are least willing to engage in military preparation. This stands in contrast to Slantchev, who argues, "The likelihood of war depends on the extent to which one is prepared to use military threats to deter challenges to peace," (Slantchev 2011, 5).

Analysis of the other instruments reveals further limitations of costly signaling.

Proposition 2. *When the challenger is uncertain about the defender's resolve, there exists a Successful Signaling Equilibrium to the model with audience costs.*

Corollary 2. *When the challenger is uncertain about the defender's martial effectiveness, no Successful Signaling Equilibrium exists to the model with audience costs.*

Proposition 3. *When the challenger is uncertain about the defender's resolve, there exists a Successful Signaling Equilibrium to the model with economic sanctions.*

Corollary 3. *When the challenger is uncertain about the defender's martial effectiveness, no Successful Signaling Equilibrium exists to the model with economic sanctions.*

Propositions 2 and 3 indicate that both audience costs and economic sanctions facilitate costly signaling if and only if C is uncertain about ν_D, just like the military instrument.

[45] This does not imply that such conditions do not exist. Suppose, for example, C believed D could take on four types: one with $\nu_D = \underline{\nu}_D$ and $e_D = \underline{e}_D$; one with $\nu_D = \underline{\nu}_D$ and $e_D = \overline{e}_D$; one with $\nu_D = \overline{\nu}_D$ and $e_D = \underline{e}_D$; and one with $\nu_D = \overline{\nu}_D$ and $e_D = \overline{e}_D$. Let C's prior belief that she faces the first type be $q_\nu q_e$, with $q_\nu(1 - q_e)$ being the probability of facing the second, $(1 - q_\nu)q_e$ the probability she faces the third, and $(1 - q_\nu)(1 - q_e)$ the probability that she faces the last type. If C knew that she would observe military preparations from any type with $\nu_D = \overline{\nu}_D$ but not from any type with $\nu_D = \underline{\nu}_D$, then for arbitrarily high values of q_ν and arbitrarily low values of q_e, war would be possible if κ were either very large or very small (in which case it could not be true that D's decision would reveal information about ν_D), but war would not be expected to occur if κ took on moderate values (and thus C could safely infer D's type from his decision over whether to engage in military preparations). Put simply, even when C's uncertainty is not going to be eliminated by military preparations, we do not necessarily always expect C to risk war. If C is sufficiently pessimistic about the likely value of e_D whilst being optimistic about ν_D, then elimination of C's uncertainty about ν_D would prevent C from risking war when she otherwise would have done so.

However, this is somewhat misleading, as we see when we examine the conditions under which the equilibria described by these two propositions obtain.

For the defender to signal his resolve either by generating audience costs or imposing sanctions, the loss of utility associated with compromising after the defender claimed that he would not (i.e., α), or with severing economic ties (i.e., ξ), must exceed the loss of utility associated with incurring the costs of war (i.e., c_D).[46]

The intuition behind this result is as follows. When D generates audience costs or imposes sanctions, he reduces his incentive to accept any given agreement. Of course, if C sweetens the terms enough, she can compensate D for the loss of utility represented by α or ξ, and so compromise remains possible. The more resolved the defender is, the more value he derives from a marginal improvement in the terms of a negotiated agreement, and thus the *less* he needs to be compensated for incurring α or ξ. Thus, the larger these costs, the less incentive there is for defenders with relatively low resolve to mimic the behavior of those with relatively high resolve. In contrast, the larger the *costs of war*, the *greater* the incentive for defenders with relatively low resolve to mimic the behavior of those with relatively high resolve.[47] Once α or ξ reach the point that they meet or exceed c_D, the former effect trumps the latter and the less resolved D loses all incentive to mimic the behavior of the more resolved type.

Moreover, as I prove in the appendix, the Successful Signaling Equilibria referred to by Propositions 2 and 3 rest upon arbitrary assumptions about how the more resolved defender will behave when he is indifferent, whereas the Successful Signaling Equilibrium identified in Proposition 1. Thus, while we cannot rule out the *possibility* that audience costs or economic sanctions *could* be used to signal resolve, we ought to skeptical that they in fact *are* used for such a purpose. There is no need for such skepticism with respect to the military instrument.

[46] At time, such as earlier in the paper, I used more casual language. However, it is worth noting that α, ξ and c_D reflect the loss of utility, in subjective terms, measured on an arbitrary scale. In practice, the magnitude of audience costs may be best measure by differences in a leader's likelihood of retaining office, while the costs of war might be measured in lives lost and money spent. Direct comparisons between the two would therefore be difficult if not impossible.

[47] More formally, $\overline{x}_{a,\nu} - \underline{x}_{a,\nu}$ decreases as α increases and increases as c_D increases, and $\overline{x}_{e,\nu} - \underline{x}_{e,\nu}$ decreases as ξ increases and increases as c_D increases.

Deterring through Pure Coercion

Let us now turn to pure coercion. Where costly signaling seeks to dissuade the challenger from issuing a relatively large demand by manipulating her estimate of the probability that such a demand would be rejected, pure coercion focuses on manipulating the challenger's material incentives for issuing such demands.

Note that the challenger's material incentives for engaging in the risk-return tradeoff depend upon two factors. The first is the relative difference between what she gets from gambling when her gamble pays off and the defender concedes to the larger demand and what she gets from playing it safe and issuing the smaller demand (i.e, the difference between $\nu_C \overline{x}_{\cdot,u}$ and $\nu_C \underline{x}_{\cdot,u}$). We might think of this as the upside to gambling. The second is the relative difference between what the challenger gets when she plays it safe and issues the smaller demand, a demand to which she knows the defender will concede regardless of his type, and what she gets from gambling when her gamble does not payoff and she finds herself fighting an unwanted war (i.e., the difference between $\nu_C \underline{x}_{\cdot,u}$ and $\nu_C w - c_C$). We might think of this as the downside to gambling. Holding the challenger's belief about the *likelihood* that her gamble pays off constant, as the upside to gambling decreases or the downside to gambling increases, she becomes more likely to play it safe.

Pure coercion seeks to do just that. More formally, pure coercion relies upon increasing $\hat{q}_{\cdot,u}$, and $\hat{q}_{\cdot,u}$ increases as the downside from gambling increases and decreases as the upside from gambling increases.[48] Let a **Successful Coercive Equilibrium** be defined as a perfect Bayesian equilibrium in which C sets $x = \overline{x}_{n,u}$ and holds posterior belief $q'_{n,u} > \hat{q}_{n,u}$ if she does not observe D employing the instrument, and sets $x = \underline{x}_{\cdot,u}$ and holds the posterior belief $q'_{\cdot,u} \leq \hat{q}_{\cdot,u}$ otherwise, while D employs the relevant policy instrument regardless of type.

[48] Where pure coercion succeeds here, it is through decreasing the upside from gambling. However, policy instruments that focus strictly on making war less attractive for the challenger without making it more attractive to the defender, such as those that focus on imposing heavier costs on the challenger, would serve a similar function. Provided such policy instruments were costly, however, the defender would have no incentive to employ them. I have in fact analyzed a model where D can increase c_C to $\overline{c}_C$ by incurring some cost himself, and, as expected, I find that the cutpoint determining when C will set $x = \overline{x}$ increases when D employs such an instrument, but D in fact never does so in equilibrium.

In such equilibria, war is always averted, the same as with the Successful Signaling Equilibria. But here, deterrence succeeds without the defender having to reveal his private information. Accordingly, such equilibria represent instances of the defender succeeding in deterring the challenger even when he has a relatively low value for war. The mere existence of these equilibria provides a question to second question raised above. There are indeed options for defenders who find war less attractive. As discussed above, in Successful Signaling Equilibria, defenders who ascribe a relatively low value to war are forced to concede to relatively large demands (i.e., $\overline{x}_{\cdot,u}$). Information revelation benefits C and one type of D, at the expense of the other type of D. In contrast, in Successful Coercive Equilibria, the defender will grant relatively small concessions (i.e., $\underline{x}_{\cdot,u}$) regardless of type. Pure coercion benefits both types of D, at the expense of C.

We turn now to the results.

Proposition 4. *When the challenger is uncertain about the defender's martial effectiveness, there exists a Successful Coercive Equilibrium to the model with military preparation.*

Corollary 4. *When the challenger is uncertain about the defender's resolve, no Successful Coercive Equilibrium exists under plausible values to the model with military preparation.*

Proposition 4 and Corollary 4 indicate that the conditions under which the military instrument facilitates deterrence through pure coercion are the mirror image of the conditions under which the military instrument facilitates deterrence through costly signaling. This might lead one to conclude that the military instrument is a particularly powerful instrument for deterrence, and a uniquely capable force for peace. When the challenger is uncertain about the defender's resolve, the mere availability of the military instrument can at times prevent wars that would otherwise occur. When the challenger is uncertain about the defender's martial effectiveness, the military instrument enables both types of defender to prevent the challenger from risking war when she would otherwise have been willing to do so. What more could we ask?

Indeed, I would argue that the military instrument *is* a remarkable tool for enabling states to achieve their objectives. But we must remember that however much we as analysts might value peace, states themselves have other concerns. By assumption, war is inefficient, and so we naturally do not expect any state to seek it out. But states also have preferences over the distributive outcomes of crises, and might be willing to engage in behavior that increases the risk of war if such behavior also increases their expected share of the good.

This leads us to our next result.

Proposition 5. *When the challenger is uncertain about the defender's martial effectiveness, there exists a PBE to the model with military preparation in which military preparations are destabilizing yet both types of defender engage in military preparations.*

More formally, Proposition 5 refers to a PBE in which C sets $x = \underline{x}_{n,\nu}$ if D does not engage in military preparations and sets $x = \overline{x}_{m,\nu}$ if D does, and thus war is possible if and only if D engages in military preparations, and yet both types of D do so in equilibrium.

On the surface of it, this may surprise some. Why would the defender engage in behavior he knows to be destabilizing? The key to understanding Proposition 5 is to recognize that while, by assumption, no state strictly prefers to see a crisis escalate to war, states may be willing to accept the possibility of war if it means achieving a better distributive outcome. When $\underline{x}_{n,\nu}$ is greater than $\overline{x}_{m,\nu}$, which is possible when D is initially weak compared to C (i.e., $m_D < m_C$) yet profits sufficiently from military preparations (i.e, large β), D may be willing to engage in military preparations despite knowing that doing so creates a possibility of war where none would otherwise exist.

Consider the following hypothetical scenario.

Suppose that the challenger presently enjoys an advantage in terms of military capabilities that are immediately available (i.e., $m_C > m_D$).[49] Then, if war were to break out in the near term, the outcome would be expected to favor the challenger.

[49] Note that m_C and m_D do *not* refer to the total potential capabilities of each state. If they did, there would be little sense in assuming that D can enhance m_D by β.

Though the challenger does not know precisely what she can get the defender to concede, since she does not know how well trained the few forces the defender has available are, the difference between what she could get a relatively martially effective defender to give up (i.e., $\underline{x}_{n,e}$) and what a less martially effective defender would concede (i.e., $\overline{x}_{n,e}$) are relatively trivial. With such a small upside to gambling, the challenger will play it safe and issue a demand that would be accepted to the defender even if he is relatively martially effective ($\underline{x}_{n,e}$). This demand will nonetheless be relatively large in absolute terms.

If the defender engages in military preparations, and if those preparations have a sufficiently large impact on the distribution of capabilities that can be brought to bear in a conflict should one break out in the near term (i.e., large β), then the challenger's uncertainty over the defender's martial effectiveness is no longer so trivial. The difference between what the different types of defender would concede is more substantial. With the upside from gambling now relatively large, the challenger may choose to risk war by issuing a demand that would be acceptable to the defender if and only if he is less martially effective ($\overline{x}_{m,e}$). Yet this demand, which is larger than the demand the challenger would make if she sought to play it safe ($\underline{x}_{m,e}$), is nonetheless smaller than the demand the challenger would have made had the defender not deployed troops to the region ($\underline{x}_{n,e}$). Thus, even though war becomes possible where it otherwise was not, the defender expects to surrender a significantly smaller share of the disputed good than had he foregone military preparations. For this reason, provided the cost of military preparations (κ) is sufficiently low, the defender will engage in military preparations, despite knowing that doing so destabilizes the crisis.

This is not to deny that the military instrument is an essential tool of statecraft. Rather, taken altogether, the results for the military instrument indicate that we must recognize not only that war can be prevented without information revelation – even if we assume that war occurs only due to information problems – but also that states do not always aspire to preventing war. Thus, the failure to prevent war need not be indicative of an unwillingness to employ the military instrument, contra Slantchev (2005, 2011).

Now let us consider the other two policy instruments.

Proposition 6. *When the challenger is uncertain about the defender's resolve, there exists a Successful Coercive Equilibrium to the model with audience costs.*

Corollary 5. *When the challenger is uncertain about the defender's martial effectiveness, there exists a Successful Coercive Equilibrium to the model with audience costs.*

Proposition 7. *When the challenger is uncertain about the defender's resolve, there exists a Successful Coercive Equilibrium to the model with economic sanctions.*

Corollary 6. *When the challenger is uncertain about the defender's martial effectiveness, there exists a Successful Coercive Equilibrium to the model with economic sanctions.*

Propositions 6 and 7 and Corollaries 5 and 6 tell the defender can achieve deterrence through pure coercion either by claiming that he will not compromise, and thereby generating audience costs, or by imposing economic sanctions on the challenger. Moreover, these two instruments facilitate deterrence through pure coercion regardless of the nature of the challenger's uncertainty, unlike the military instrument.

At this point, it may seem that these two instruments are essentially identical. There is perhaps greater similarity between them than has previously been recognized, in that both create disincentives for the defender to accept any given agreement and thereby reduce the opportunity costs of war. But there are two important differences between audience costs and economic sanctions. One concerns the fundamental logic by which they operate, specifically their impact on the challenger's willingness to risk war. The other is more practical.

First, the theoretical distinction.

Proposition 8. *Regardless of the source of the nature of the challenger's uncertainty, generating audience costs never increases the material incentives for the challenger to risk war, either on or off the equilibrium path.*

Proposition 9. *Regardless of the source of the nature of the challenger's uncertainty, imposing economic sanctions can increase the material incentives for the challenger to risk war, but only off the equilibrium path.*

Propositions 8 and 9 tell us that neither audience costs nor economic sanctions ever increase the risk of war in equilibrium, but there is nonetheless a subtle difference between the two. Imposing economic sanctions has the *potential* to be destabilizing, whereas generating audience costs does not. However, unlike the military instrument, which the defender may employ in equilibrium even when doing so causes the challenger to risk war where she otherwise would not, economic sanctions do not directly increase the value of the defender's outside option. Since sanctions do not enhance the defender's bargaining leverage directly, there is no incentive to employ them when their use is destabilizing.

Note that the model here treats states as unitary actors and thus assumes away the possibility that states impose sanctions when there is domestic pressure to "do something", even if their use is not otherwise optimal (Whang 2011). If leaders of states employ sanctions in practice under conditions that the model analyzed here indicates that they would not, it might be possible that the use of sanctions, in practice, would be destabilizing. Indeed, there is evidence of such (Letzkian and Sprecher 2007).

Put differently, the theoretical difference between audience costs and economic sanctions is that they have identical impacts on the defender's behavior, and are employed under analogous conditions, but they have different impacts on the challenger. Specifically, audience costs only affect the challenger indirectly, either by revealing information about the defender or reducing the challenger's incentive to gamble by reducing the difference between what she can get the different types of defender to concede.

In contrast, economic sanctions directly impact the challenger, in two ways. First, sanctions reduce the opportunity cost of war, and thus encourage the challenger to gamble. Second, since the severity of the sanctions, by assumption, depends upon the size of the challenger's demand, the defender's use of this instrument tends to discourage gambling.

Which of the two effects predominates depends upon the actual crafting of the sanctions. The larger is $\overline{\xi}$ and the smaller is $\underline{\xi}$, the less likely it is that sanctions would be destabilizing (i.e., less likely that $\hat{q}_{e,u} < \hat{q}_{n,u}$). In the limit, if the defender threatened to impose sanctions if and only if the challenger issued a relatively large demand (i.e., $\xi = 0 \ \forall \ x \leq \underline{x}_{e,u}$ and $\xi > 0 \ \forall \ x > \underline{x}_{e,u}$), economic coercion would never be destabilizing.

Of course, sanctions would also have no ability to signal resolve. If threats to impose sanctions do not need to be carried out when they successfully persuade the challenger that the defender is relatively resolved, they *cannot* persuade the challenger that the defender is resolved, since the defender would be willing to issue the threat, regardless of his type.

Taken together, this analysis suggests that economic sanctions coerce best when they are designed in such a way as to minimize their ability to signal. If the defender would impose stiff sanctions on the challenger even if the challenger issued a relatively modest demand (i.e., $x = \underline{x}_{e,u}$), then the imposition of sanctions might well serve as a signal of resolve. It is not at all clear, however, why a relatively resolved defender would be willing to impose sanctions in order to signal his resolve, as discussed above.

In short, while a fuller exploration of how states decide when to sanction, and how severely to sanction, awaits future analysis, we can at least say that when economic sanctions work, it is probably because of pure coercion rather than costly signaling.[50]

Much the same can be said of audience costs, and for much the same reasons. However, there is perhaps an important difference between the two in practice. Quite simply, there is no disputing that states employ economic sanctions. In contrast, for all the interest audience costs have generated among scholars, the evidence that states issue clear public statements of the sort necessary to generate audience costs is far from overwhelming.[51] What we observe instead are vague promises of "grave consequences" and the like. In short, audience costs probably do not signal, and it remains an open question how relevant they are in practice.[52]

[50] This echoes the conclusion of Polachek and Xiang (2010).

[51] Fearon (1997) himself marveled at the lack of such statements.

[52] To be clear, what I am questioning here is whether states *do* generate audience costs, not whether they *should*. On the optimal design of audience costs, see Ashworth and Ramsay (N.d.).

Conclusion

I began by noting that the analysis of costly signaling has not been characterized by the rich variation found in the analysis of the causes of war, and asking whether this might have important implications for our understanding of how and when costly signaling works.

The results of this analysis suggest a number of ways in which it does. The theoretical models analyzed here were all straightforward extensions of the canonical ultimatum model popularized by Fearon (1995). Some of the results reaffirm extant claims. Specifically, I find that the relatively resolved defenders can and often will signal their resolve through costly military preparations. However, many of the other results challenge or at least refine extant claims. No instrument appears to be likely to be used in order to signal their ability to wage wars effectively. Since uncertainty about martial effectiveness is most destabilizing among states near parity, a condition scholars have long associated with an elevated probability of war,[53] this suggests that costly signaling may work best when it is least needed.

In contrast, pure coercion remains viable even when states are near parity. Moreover, each of the three instruments I have considered can facilitate deterrence through pure coercion, and both audience costs and economic sanctions can do so regardless of the nature of the challenger's uncertainty. Of course, some states may be either unwilling or unable to employ these instruments. I do not wish to claim that pure coercion is a panacea. Only that, overall, it would appear that pure coercion facilitates deterrence under a broader range of conditions than does costly signaling, and it is therefore troubling that scholars of international relations devote so much attention to the study of costly signaling while paying so little attention to the possibility that states might prevent war simply by manipulating material incentives. As tempting as it might be to infer that the revelation of information must be the primary path to peace if the primary cause of war is a lack of information, this analysis, like a growing number of studies, challenges such a conclusion.

[53] See, inter alia, Bennett and Stam (2004), Kugler and Lemke (1996), Lemke (2002, 2008), Lemke and Werner (1996), Organski and Kugler (1980) and Reed (2003).

I also raised the question of whether defenders who find war relatively unattractive have any options. Currently, scholarship on international conflict largely indicates that those who desire peace have relatively few options in the short run. In the long term, we are led to believe, states can hope to bring about a more peaceful world by promoting democracy, economic interdependence, and membership in international organizations. But these claims, even if we take them at face value, offer little to states who find themselves in an acute crises. Our one short term prescription is to engage in costly signaling.[54]

But, by its very nature, this advice is only practicable for some actors. Costly signaling would not work if not for the fact that it isn't worthwhile for those who find war relatively less attractive. In contrast, pure coercion allows those defenders who find war relatively unattractive to obtain a better outcome. Put simply, if we focus on manipulating material incentives rather than manipulating beliefs, we see that deterrence is possible not only under a wider range of conditions, but also for a wider range of actors.

With respect to the specific instruments, there are important differences in how and when each will facilitate deterrence. The military instrument may be the only instrument that we should actually expect states to use to signal resolve. Yet it may also be the only instrument that states would be willing to employ even when its use is destabilizing.

Ultimately, different states will find different instruments more or less useful depending upon the circumstances they face. Perhaps it is true, as some have argued, that democracies are better able to generate audience costs. It is almost certainly true that states with relatively few economic linkages will find it difficult to influence one another's behavior by threatening to sever their minimal ties. I have argued that attempts to explain the democratic peace by linking democracy and economic interdependence to a greater capacity for costly signaling are problematic. But one might instead conclude that they are nonetheless critical forces for peace since they might make it easier for states to practice pure coercion.

[54] Slantchev (2011) argues that the military instrument prevents war both because it signals resolve and because it rearranges incentives. That conclusion is more similar to the one here than is often found in the literature, though, as we have seen, the military instrument can at times be *destabilizing*.

I would caution, however, that such arguments rely not only upon much more than claims about the theoretical possibility of audience costs and economic sanctions facilitating deterrence.[55] Therefore, I will simply observe that the results of this analysis could be construed as consistent with such a claim, but do not, by themselves, establish such a claim.

Nor does this analysis speak to the broader question of how effective sanctions are as a tool of statecraft. The assumption here was that sanctions are used during crisis bargaining, which allowed me to speak to claims about economic sanctions serving as costly signals. Insofar as economic sanctions, rather than war, can themselves be the outside option, the analysis here at best offers a partial view of how and when sanctions work.

For the sake of simplicity, given the sheer number of models analyzed here, I have adopted stronger assumptions in some cases than might otherwise be desirable. I have tried to address the likely implications of relaxing these assumptions, but it might nonetheless be fruitful for future work to allow both the defender's type and his strategies to vary continuously. It might also be useful to consider models in which the challenger is *simultaneously* uncertain about both the defender's resolve and his martial effectiveness.

[55] The link between regime type and audience costs remains contested (Slantchev 2006, Weeks 2008). As does, for that matter, the link between joint democracy and peace (Gibler 2007, Henderson 2002). Moreover, even if bilateral economic interdependence reduces the likelihood of conflict within a given dyad, the dramatic increase in trade over the past several decades, particularly but not exclusively among the world's democracies, may not actually have decreased the probability of bilateral conflict between any two given states, since increases in multilateral interdependence tend to make it easier to find substitutes for any given trade partner (Martin, Mayer and Thoenig 2008).

Appendix

Basic Ultimatum Crisis Bargaining Model

I begin with the complete information case. Analogous results are well established in the literature, but I will follow a similar logic and employ similar notation throughout the appendix, so it is useful to go through the proof in detail.

D accepts if and only if (iff) $u_D(\text{neg}) \geq EU_D(\text{war})$, which is equivalent to

$$\nu_D(1-x) \geq \nu_D(1-w) - c_D. \tag{1}$$

This can be rewritten as

$$x \leq w + \frac{c_D}{\nu_D}. \tag{2}$$

Let $\hat{x}$ be defined as $w + \dfrac{c_D}{\nu_D}$. Then we can say that D accepts iff $x \leq \hat{x}$. In this case, establishing the cutpoint $\hat{x}$ brings only marginal benefits in terms of reducing clutter. But I will follow this convention throughout, so for the sake of consistency, I do so here.

C can thus readily infer that setting $x \leq \hat{x}$ ensures D acceptance, while setting $x > \hat{x}$ ensures that D will reject and the two will fight a war.

Note that I assume that $\hat{x} < 1$, and will similarly assume all critical values of x derived throughout the appendix are less than 1, to ensure interior solutions.

If C chooses to set $x \leq \hat{x}$, she must prefer to set x precisely equal to $\hat{x}$. Provided that a negotiated agreement is reached, C's utility is strictly increasing in x, and so C cannot profit from setting $x < \hat{x}$ rather than $x = \hat{x}$.

If C chooses to set $x > \hat{x}$, war is certain to occur. Since C's war utility is not a function of x, we can treat all proposals of this type as equivalent. Technically, C has an infinite number of options when setting $x > \hat{x}$, since I have assumed $\hat{x} < 1$. But C's payoff is the same through this entire range.

More formally,

$$u_C(x) = \begin{cases} \nu_C x & \text{if } x \leq \hat{x} \\ \nu_C w - c_C & \text{if } x > \hat{x}. \end{cases}$$

Thus, while C has an infinite number of strategies available, the only question is whether C prefers to set $x = \hat{x}$ or $x > \hat{x}$. We thus evaluate $u_C(x = \hat{x}) \geq EU_C(x > \hat{x})$, or

$$\nu_C \hat{x} \geq \nu_C w - c_C, \tag{3}$$

or

$$\nu_C(w + \frac{c_D}{\nu_D}) \geq \nu_C w - c_C, \tag{4}$$

which simplifies to $c_C + c_D \dfrac{\nu_C}{\nu_D} \geq 0$. This must be true since, by assumption, the costs of war are strictly positive, and states do not ascribe negative value to the issue in dispute.

Therefore, under complete information, there is a unique subgame perfect equilibrium in which C sets $x = \hat{x}$ and D accepts iff $x \leq \hat{x}$. In this equilibrium, negotiated agreements are reached with certainty.

Now let us turn to incomplete information.

First, consider the case where C is uncertain about D's resolve. More formally, prior to C selecting a value of x, Nature sets $\nu_D = \underline{\nu}_D$ with probability q_ν and $\nu_D = \overline{\nu}_D$ with probability $1 - q_\nu$, then reveals the value of ν_D to D.

C does not know D's type, but knows how likely it is that she is facing each type. Moreover, she can infer how each type will behave. This helps us establish C's choice of x.

The less resolved D accepts iff $u_D(\text{neg}) \geq EU_D(\text{war})$, which is equivalent to

$$\underline{\nu}_D(1 - x) \geq \underline{\nu}_D(1 - w) - c_D. \tag{5}$$

This can be rewritten as

$$x \leq w + \frac{c_D}{\underline{\nu}_D} \equiv \overline{x}_\nu. \tag{6}$$

Similarly, we can readily establish that the more resolved type accepts iff $x \leq \underline{x}_\nu$, where $\underline{x}_\nu \equiv w + \dfrac{c_D}{\overline{\nu}_D}$.

We can immediately establish that C never sets $x < \underline{x}_\nu$, $x > \overline{x}_\nu$ or $x = x_1$ where $\underline{x}_\nu < x_1 < \overline{x}_\nu$. When C sets $x \leq \underline{x}_\nu$, D is certain to accept regardless of type, and so $U_C(x \leq \underline{x}_\nu) = \nu_C x$. Thus, it follows that $U_C(x < \underline{x}_\nu)$ is strictly dominated by $U_C(x = \underline{x}_\nu)$.

Since $EU_C(x = x_1) \geq EU_C(x = \overline{x}_\nu)$ is equivalent to

$$q_\nu(\nu_C x_1) + (1 - q_\nu)(\nu_C w - c_C) \geq q_\nu(\nu_C \overline{x}_\nu) + (1 - q_\nu)(\nu_C w - c_C), \tag{7}$$

or $x_1 \geq \overline{x}_\nu$, which cannot be true, setting $x = x_1$ is strictly dominated by $x = \overline{x}_\nu$.

Finally, because $EU_C(x > \overline{x}_\nu) \geq EU_C(x = \overline{x}_\nu)$ is equivalent to

$$q_\nu(\nu_C w - c_C) + (1 - q_\nu)(\nu_C w - c_C) \geq q_\nu(\nu_C \overline{x}_\nu) + (1 - q_\nu)(\nu_C w - c_C), \tag{8}$$

or $c_C + c_D \dfrac{\nu_C}{\underline{\nu}_D} \leq 0$, which also cannot be true, setting $x > \overline{x}_\nu$ is strictly dominated by $x = \overline{x}_\nu$.

Thus the only values of x that C may select in equilibrium are $x = \underline{x}_\nu$, which D accepts regardless of type, and $x = \overline{x}_\nu$, which D accepts iff $\nu_D = \underline{\nu}_D$.

C can thus readily infer the following

$$pr(\text{war}) = \begin{cases} 0 & \text{if } x \leq \underline{x}_\nu \\ 1 - q_\nu & \text{if } \underline{x}_\nu < x \leq \overline{x}_\nu \\ 1 & \text{if } x > \overline{x}_\nu, \end{cases}$$

and

$$EU_C(x) = \begin{cases} \nu_C x & \text{if } x \leq \underline{x}_\nu \\ q_\nu(\nu_C x) + (1-q_\nu)(\nu_C w - c_C) & \text{if } \underline{x}_\nu < x \leq \overline{x}_\nu \\ \nu_C w - c_C & \text{if } x > \overline{x}_\nu. \end{cases}$$

Given this, and the fact that C has no incentive to select any value of x other than $\underline{x}_\nu$ or $\overline{x}_\nu$, we now turn to evaluating $u_C(x = \underline{x}_\nu) \geq EU_C(x = \overline{x}_\nu)$. This is equivalent to

$$\nu_C \underline{x}_\nu \geq q_\nu(\nu_C \overline{x}_\nu) + (1-q_\nu)(\nu_C w - c_C), \tag{9}$$

or

$$q_\nu \leq \frac{c_C + c_D(\frac{\nu_C}{\overline{\nu}_D})}{c_C + c_D(\frac{\nu_C}{\underline{\nu}_D})} \equiv \hat{q}_\nu. \tag{10}$$

Since $c_C + c_D(\frac{\nu_C}{\overline{\nu}_D}) < c_C + (c_D \frac{\nu_C}{\underline{\nu}_D}) \Leftrightarrow \underline{\nu}_D < \overline{\nu}_D$, it must be true that $\hat{q}_\nu \in (0,1)$.

The following beliefs and strategies therefore comprise a PBE: C sets $x = \underline{x}_\nu$ and believes $q_\nu \leq \hat{q}_\nu$ before and after D responds; the less resolved type of D accepts iff $x \leq \overline{x}_\nu$, and the more resolved type accepts iff $x \leq \underline{x}_\nu$.

Similarly, the following beliefs and strategies also comprise a PBE: C sets $x = \overline{x}_\nu$ and believes $q_\nu > \hat{q}_\nu$ prior to D's response, updating to certainty afterwards; the less resolved type accepts iff $x \leq \overline{x}_\nu$, and the more resolved type accepts iff $x \leq \underline{x}_\nu$.

Note that C's ability to update her beliefs following D's response is of no consequence. Therefore, I will disregard C's beliefs following D's decision to either accept or reject from this point forward. Henceforth, when I refer to C's posterior belief, I refer to the belief C holds upon observing D's choice over whether to employ the relevant policy instrument, though, technically, C faces two opportunities to revise her beliefs.

Observe that the two equilibria occupy non-overlapping regions of the parameter space. We can determine which equilibrium obtains by comparing q_ν to $\hat{q}_\nu$.

Now consider the version where C is uncertain about D's martial effectiveness. The general logic here is identical to the preceding case, though the actual cutpoints differ.

First, note that there are now two values of w. Recall that, generically, $w \equiv \dfrac{e_C m_C}{e_C m_C + e_D m_D}$. Now that e_D may either equal $\underline{e}_D$ or $\overline{e}_D$, it follows that

$$w = \begin{cases} \underline{w} \equiv \dfrac{e_C m_C}{e_C m_C + \overline{e}_D m_D} & \text{if } e_D = \overline{e}_D \\ \overline{w} \equiv \dfrac{e_C m_C}{e_C m_C + \underline{e}_D m_D} & \text{if } e_D = \underline{e}_D \end{cases}$$

Since Nature sets $e_D = \underline{e}_D$ with probability q_e and $e_D = \overline{e}_D$ with probability $1 - q_e$, w therefore equals $\overline{w}$ with probability q_e and equals $\underline{w}$ with probability $1 - q_e$.

The less martially effective D accepts iff $x \leq \overline{x}_e$, where $\overline{x}_e \equiv \overline{w} + \dfrac{c_D}{\nu_D}$. The more martially effective type accepts iff $x \leq \underline{x}_e$, where $\underline{x}_e \equiv \underline{w} + \dfrac{c_D}{\nu_D}$. Since $\underline{w} < \overline{w}$, it follows that $\underline{x}_e < \overline{x}_e$.

Similar to above, C always selects either $\underline{x}_e$ or $\overline{x}_e$. C prefers $\underline{x}_e$ provided $q_e \leq \hat{q}_e$, where

$$q_e \equiv \frac{c_C + c_D(\frac{\nu_C}{\nu_D})}{\nu_C(\overline{w} - \underline{w}) + c_C + c_D(\frac{\nu_C}{\nu_D})}. \tag{11}$$

Since $\overline{w} > \underline{w}$ and thus $\nu_C(\overline{w} - \underline{w}) > 0$, it readily follows that $\hat{q}_\nu \in (0, 1)$.

The following beliefs and strategies therefore comprise a PBE: C sets $x = \underline{x}_e$ and believes $q_e \leq \hat{q}_e$ before and after D responds; the less martially effective type of D accepts iff $x \leq \overline{x}_e$, and the more effective type accepts iff $x \leq \underline{x}_e$.

Similarly, following beliefs and strategies therefore comprise a PBE: C sets $x = \overline{x}_e$ and believes $q_e > \hat{q}_e$ before and after D responds; the less martially effective type of D accepts iff $x \leq \overline{x}_e$, and the more effective type accepts iff $x \leq \underline{x}_e$.

Thus, in the basic model, there is little difference between uncertainty over ν_D versus e_D. In each case, there are two non-overlapping equilibria, differentiated by the relative ordering of q_u and $\hat{q}_u$. In each case, the equilibrium in which C risks war by setting $x = \overline{x}_u$ is more likely to obtain as either q_u increases or $\hat{q}_u$ decreases.

Proofs of the Propositions

Proposition 1. First, note that if D does not use any of the policy instruments, the acceptance rules for D and the cutpoints determining C's optimal proposal are the same as in the Basic Ultimatum Crisis Bargaining Model. That is, $\underline{x}_{n,u}$, $\overline{x}_{n,u}$ and $\hat{q}_{n,u}$ are precisely equal to what I above termed $\underline{x}_u$, $\overline{x}_u$ and $\hat{q}_u$. Above we only needed to differentiate terms according to the source of C's uncertainty. Now we must also denote the policy instrument D employed. Cleverly enough, n stands for "none."

If D engages in military preparations, the less resolved type accepts iff $u_D(\text{neg}|m) \geq EU_D(\text{war}|m)$, which is equivalent to

$$\underline{\nu}_D(1-x) - \kappa \geq \underline{\nu}_D(1-w_m) - c_D - \kappa. \tag{12}$$

This can be rewritten as

$$x \leq w_m + \frac{c_D}{\underline{\nu}_D} \equiv \overline{x}_{m,\nu}. \tag{13}$$

Similarly, after D engages in preparations, the more resolved type accepts iff $x \leq \underline{x}_{m,\nu}$, where $\underline{x}_{m,\nu} \equiv w_m + \dfrac{c_D}{\overline{\nu}_D}$.

Note that $\underline{x}_{m,\nu}$ and $\overline{x}_{m,\nu}$ differ from $\underline{x}_{n,\nu}$ and $\overline{x}_{n,\nu}$ in that the former contain w_m and the latter w, where $w_m < w$ since $\dfrac{e_C m_C}{e_C m_C + e_D \beta m_D} < \dfrac{e_C m_C}{e_C m_C + e_D m_D}$.

For the same reasons as above, when D employs the military instrument, C either sets $x = \underline{x}_{m,\nu}$ or $x = \overline{x}_{m,\nu}$, and when D does not, C either sets $x = \underline{x}_{n,\nu}$ or $x = \overline{x}_{n,\nu}$.

Upon observing D prepare for war, C prefers $x = \underline{x}_{m,\nu}$ to $x = \overline{x}_{m,\nu}$ iff $u_C(x = \underline{x}_{m,\nu}) \geq EU_C(x = \overline{x}_{m,\nu})$, which is equivalent to

$$\nu_C \underline{x}_{m,\nu} \geq q'_{m,\nu}(\nu_C \overline{x}_{m,\nu}) + (1 - q'_{m,\nu})(\nu_C w_m - c_C). \tag{14}$$

This simplifies to

$$q'_{m,\nu} \leq \frac{c_C + c_D(\dfrac{\nu_C}{\overline{\nu}_D})}{c_C + c_D(\dfrac{\nu_C}{\underline{\nu}_D})} \equiv \hat{q}_{m,\nu}. \tag{15}$$

Note that $\hat{q}_{m,\nu}$ is precisely equal to $\hat{q}_{n,\nu}$, a point we will return to below.

Having established D's decision rule and the cutpoint determining C's choice of x when D engages in military preparations, we are now prepared to evaluate specific equilibria. Note that we will draw upon the information above not only for this proposition, but whenever evaluating equilibria to the model with military preparations and uncertainty over ν_D.

The following beliefs and strategies comprise a PBE: C sets $x = \underline{x}_{m,\nu}$ and believes $q'_{m,\nu} = 0$ if D employs the military instrument and sets $x = \overline{x}_{n,\nu}$ and believes $q'_{n,\nu} = 1$ if D does not; the less resolved type D accepts iff $x \leq \overline{x}_{n,\nu}$ when he does not employ the military instrument, accepts iff $x \leq \overline{x}_{m,\nu}$ if he does, but does not employ the instrument; and the more resolved type accepts iff $x \leq \underline{x}_{n,\nu}$ if he does not employ the military instrument, accepts iff $x \leq \underline{x}_{m,\nu}$ if he does, and does employ the military instrument.

Note that $pr(\nu_D = \underline{\nu}_D|m) = \dfrac{pr(m|\nu_D = \underline{\nu}_D) \cdot pr(\nu_D = \underline{\nu}_D)}{pr(m|\nu_D = \underline{\nu}_D) \cdot pr(\nu_D = \underline{\nu}_D) + pr(m|\nu_D = \overline{\nu}_D) \cdot pr(\nu_D = \overline{\nu}_D)}$ and $pr(\nu_D = \underline{\nu}_D|n) = \dfrac{pr(n|\nu_D = \underline{\nu}_D) \cdot pr(\nu_D = \underline{\nu}_D)}{pr(n|\nu_D = \underline{\nu}_D) \cdot pr(\nu_D = \underline{\nu}_D) + pr(n|\nu_D = \overline{\nu}_D) \cdot pr(\nu_D = \overline{\nu}_D)}$ by Bayes' Theorem, where m indicates that D engaged in military preparations and n that D did not. The updated beliefs stipulated above thus follow readily, since $pr(m|\nu_D = \underline{\nu}_D) = 0$, $pr(m|\nu_D = \overline{\nu}_D) = 1$, $pr(n|\nu_D = \underline{\nu}_D) = 1$ and $pr(n|\nu_D = \overline{\nu}_D) = 0$.

Given these posterior beliefs, the optimality of C's demands follows readily, since C sets $x = \underline{x}_{\cdot,\nu}$ iff $q'_{\cdot,\nu} \leq \hat{q}_{\cdot,\nu}$ and $0 \leq \hat{q}_{m,\nu}$ and $1 > \hat{q}_{n,\nu}$ trivially hold.

Thus, C's beliefs and strategies are sequentially rational and consistent with Bayes' Theorem. All that remains is to consider the incentive compatibility conditions for D.

Holding constant C's beliefs and strategies, the less resolved type receives $\underline{\nu}_D(1 - \overline{x}_{n,\nu})$ if he abides by the equilibrium and $\underline{\nu}_D(1 - \underline{x}_{m,\nu}) - \kappa$ if he employs the military instrument.

Thus incentive compatibility requires $\kappa \geq \underline{\kappa}_\nu$, where $\underline{\kappa}_\nu \equiv \underline{\nu}_D(w - w_m + \frac{c_D}{\underline{\nu}_D} - \frac{c_D}{\overline{\nu}_D})$.

If the relatively resolved type complies with the equilibrium strategy, he receives $\overline{\nu}_D(1 - \underline{x}_{m,\nu}) - \kappa$. If he deviates, he will reject $\overline{x}_{n,\nu}$ and receive $\overline{\nu}_D(1 - w) - c_D$. Thus, incentive compatibility for this type requires $\kappa \leq \overline{\kappa}_\nu$, where $\overline{\kappa}_\nu \equiv \overline{\nu}_D(w - w_m)$.

So long as $\underline{\kappa}_\nu < \overline{\kappa}_\nu$, there are certain to be values of κ that satisfy both incentive compatibility constraints, and thus establish the equilibrium. Inspecting the two terms, it is readily apparent that this may indeed be the case, provided c_D is sufficiently small and the difference between $\underline{\nu}_D$ and $\overline{\nu}_D$ is sufficiently large. $\square$

Corollary 1. The main elements of this proof are similar to those of the previous proposition.

When D does not employ the military instrument, the acceptances rules for D and cutpoint determining C choice of x are the same as in the basic model.

Recall that, as discussed in the text, the model with uncertainty over e_D and the option for D to engage in military preparations requires us to distinguish between four different values of w, since w depends both on e_D and β.

More formally,

$$w = \begin{cases} \underline{w} \equiv \dfrac{e_C m_C}{e_C m_C + \overline{e}_D m_D} & \text{if } e_D = \overline{e}_D \text{ and no military preparations} \\ \overline{w} \equiv \dfrac{e_C m_C}{e_C m_C + \underline{e}_D m_D} & \text{if } e_D = \underline{e}_D \text{ and no military preparations} \\ \underline{w}_m \equiv \dfrac{e_C m_C}{e_C m_C + \overline{e}_D \beta m_D} & \text{if } e_D = \overline{e}_D \text{ and military preparations} \\ \overline{w}_m \equiv \dfrac{e_C m_C}{e_C m_C + \underline{e}_D \beta m_D} & \text{if } e_D = \underline{e}_D \text{ and military preparations.} \end{cases}$$

If D engages in military preparations, the less martially effective type accepts iff $x \leq \overline{x}_{m,e}$, where $\overline{x}_{m,e} \equiv \overline{w}_m + \dfrac{c_D}{\nu_D}$, while the more martially effective type accepts iff $x \leq \underline{x}_{m,e}$, where $\underline{x}_{m,e} \equiv \underline{w}_m + \dfrac{c_D}{\nu_D}$. Again, note that $\underline{x}_{m,e}$ and $\overline{x}_{m,e}$ differ from $\underline{x}_{n,e}$ and $\overline{x}_{n,e}$ in that the former contain w_m and the latter w, where, generically, $w_m < w$.

As ever, C's choice of x boils down to choosing between two precise demands: $\underline{x}_{m,e}$ or $x = \overline{x}_{m,e}$ if D employs the military instrument and $x = \underline{x}_{n,e}$ or $x = \overline{x}_{n,e}$ if he does not.

If D prepares for war, C prefers $x = \underline{x}_{m,e}$ to $x = \overline{x}_{m,e}$ iff $q'_{m,e} \leq \hat{q}_{m,e}$, where

$$\hat{q}_{m,e} \equiv \frac{c_C + c_D(\frac{\nu_C}{\nu_D})}{\nu_C(\overline{w}_m - \underline{w}_m) + c_C + c_D(\frac{\nu_C}{\nu_D})}. \tag{16}$$

The following beliefs and strategies comprise the candidate PBE of interest: C sets $x = \underline{x}_{m,e}$ and believes $q'_{m,e} = 0$ if D employs the military instrument and sets $x = \overline{x}_{n,e}$ and believes $q'_{n,e} = 1$ if D does not; the less martially effective type D accepts iff $x \leq \overline{x}_{n,e}$ when he does not employ the military instrument, accepts iff $x \leq \overline{x}_{m,e}$ if he does, but does not employ the instrument; and the more martially effective type accepts iff $x \leq \underline{x}_{n,e}$ if he does not employ the military instrument, accepts iff $x \leq \underline{x}_{m,e}$ if he does, and does employ the instrument.

By the same logic as above, C's strategies and beliefs are sequentially rational and consistent with Bayes' Theorem. So we turn to the incentive compatibility constraints for D.

Holding constant C's beliefs and strategies, the less martially effective type receives $\nu_D(1 - \overline{x}_{n,e})$ if he abides by the equilibrium and $\nu_D(1 - \underline{x}_{m,e}) - \kappa$ if he does not.

Thus incentive compatibility requires $\kappa \geq \underline{\kappa}_e$, where $\underline{\kappa}_e \equiv \nu_D(\overline{w} - \underline{w}_m)$.

If the relatively martially effective type complies with the equilibrium strategy, he receives $\nu_D(1-\underline{x}_{m,e})-\kappa$. If he deviates, he will reject $\overline{x}_{n,e}$ and receive $\nu_D(1-\underline{w})-c_D$. Thus, incentive compatibility for this type requires $\kappa \leq \overline{\kappa}_e$, where $\overline{\kappa}_e \equiv \nu_D(\underline{w} - \underline{w}_m)$.

So long as $\underline{\kappa}_e < \overline{\kappa}_e$, there are certain to be values of κ that satisfy both incentive compatibility constraints, and thus establish the equilibrium.

We must therefore evaluate $\underline{\kappa}_e < \overline{\kappa}_e$, which is equivalent to

$$\nu_D(\overline{w} - \underline{w}_m) < \nu_D(\underline{w} - \underline{w}_m), \tag{17}$$

which simplifies to $\overline{w} < \underline{w}$, and clearly cannot be true. Thus there can be no such equilibrium. This establishes the result. $\square$

Lemma 1. Consider $\dfrac{\partial(\overline{w} - \underline{w})}{\partial m_C}$, or the effect of m_C on the difference between C's expected share of the good following a war fought against a relatively less martially effective type of D compared to a relatively more martially effective D.

This is equivalent to $\dfrac{\partial \overline{w}}{\partial m_C} - \dfrac{\partial \underline{w}}{\partial m_C}$, or

$$\frac{(e_C m_C + \underline{e}_D m_D)e_C - (e_C m_C)e_C}{(e_C m_C + \underline{e}_D m_D)^2} - \frac{(e_C m_C + \overline{e}_D m_D)e_C - (e_C m_C)e_C}{(e_C m_C + \overline{e}_D m_D)^2}, \tag{18}$$

which simplifies to

$$\frac{\underline{e}_D m_D e_C}{(e_C m_C + \underline{e}_D m_D)^2} - \frac{\overline{e}_D m_D e_C}{(e_C m_C + \overline{e}_D m_D)^2}. \tag{19}$$

This is positive so long as

$$\frac{\underline{e}_D m_D e_C}{(e_C m_C + \underline{e}_D m_D)^2} > \frac{\overline{e}_D m_D e_C}{(e_C m_C + \overline{e}_D m_D)^2}, \tag{20}$$

which simplifies to,

$$m_C \leq m_D \frac{\sqrt{\underline{e}_D \overline{e}_D}}{e_C}. \tag{21}$$

That is, the difference between $\overline{w}$ and $\underline{w}$ is initially increasing in m_C, but begins to decline with further increases in m_C after a certain point. The point at which further increases in m_C cease to increase the difference between $\overline{w}$ and $\underline{w}$ is when m_C equals $m_D \dfrac{\sqrt{\underline{e}_D \overline{e}_D}}{e_C}$.

Intuitively, this tells us that if the challenger is more martially effective than she expects the defender to be (i.e., if e_C is greater than the geometric mean of $\underline{e}_D$ and $\overline{e}_D$), which ensures that $\sqrt{\underline{e}_D \overline{e}_D} < e_C$, then the maximum difference between $\overline{w}$ and $\underline{w}$ occurs before m_C reaches m_D. If she is not more martially effective than she expects the defender to be (i.e., if $e_c < \sqrt{\underline{e}_D \overline{e}_D}$), then the maximum difference occurs after that point. Though it is not at *exact* parity that the difference is at its greatest, it is *roughly* at parity, as per the result. $\square$

Proposition 2. This proof follows a similar logic to that of Proposition 1.

After claiming he will not compromise, and thereby generating audience costs, the less resolved type accepts iff $x \leq \overline{x}_{a,\nu}$, where $\overline{x}_{a,\nu} \equiv w + \dfrac{c_D - \alpha}{\underline{\nu}_D}$.

The more resolved type of D accepts after claiming he will not compromise, and thereby generating audience costs, iff $x \leq \underline{x}_{a,\nu}$, where $\underline{x}_{a,\nu} \equiv w + \dfrac{c_D - \alpha}{\overline{\nu}_D}$.

Note that $\underline{x}_{a,\nu}$ and $\overline{x}_{a,\nu}$ differ from $\underline{x}_{n,\nu}$ and $\overline{x}_{n,\nu}$ in that the former contain, generically, $\dfrac{c_D - \alpha}{\nu_D}$, while the latter contain $\dfrac{c_D}{\nu_D}$. This ensures that $x_{a,\nu} < x_{n,\nu}$.

As ever, C's choice of x boils down to choosing between two precise demands: $\underline{x}_{a,\nu}$ or $x = \overline{x}_{a,\nu}$ if D generates audience costs and $x = \underline{x}_{n,\nu}$ or $x = \overline{x}_{n,\nu}$ if he does not.

Upon observing D claim that he will not compromise, C prefers $x = \underline{x}_{a,\nu}$ to $x = \overline{x}_{a,\nu}$ iff $q'_{a,\nu} \leq \hat{q}_{a,\nu}$, where $\hat{q}_{a,\nu} \equiv \dfrac{c_C + (c_D - \alpha)(\frac{\nu_C}{\overline{\nu}_D})}{c_C + (c_D - \alpha)(\frac{\nu_C}{\underline{\nu}_D})}$.

We can now evaluate individual equilibria.

The following beliefs and strategies comprise a PBE: C sets $x = \underline{x}_{a,\nu}$ and believes $q'_{a,\nu} = 0$ if D claims that he will not compromise, thereby generating audience costs, and sets $x = \overline{x}_{n,\nu}$ and believes $q'_{n,\nu} = 1$ if D does not; the less resolved type D accepts iff $x \leq \overline{x}_{n,\nu}$ when he does not claim that he will not compromise, accepts iff $x \leq \overline{x}_{a,\nu}$ if he does make such a claim, but does not in fact make the claim; and the more resolved type accepts iff $x \leq \underline{x}_{n,\nu}$ if he does not claim that he will not compromise, accepts iff $x \leq \underline{x}_{a,\nu}$ if he does makes the claim, and does in fact make the claim.

As with the other Successful Signaling Equilibria we have evaluated, the above posterior beliefs are consistent with Bayes' Theorem and the above strategies for C are sequentially rational. What remains then is to consider the incentive compatibility conditions for D.

Holding constant C's beliefs and strategies, the less resolved type receives $\underline{\nu}_D(1 - \overline{x}_{n,\nu})$ if he abides by the equilibrium and chooses not to generate audience costs and receies a payoff of $\underline{\nu}_D(1 - \underline{x}_{a,\nu}) - \alpha$ if, contrary to the equilibrium, he claims he cannot compromise and thereby generates audience costs.

Thus incentive compatibility requires

$$\underline{\nu}_D(1 - w - \frac{c_D}{\underline{\nu}_D}) \geq \underline{\nu}_D(1 - w - \frac{c_D - \alpha}{\overline{\nu}_D}) - \alpha, \tag{22}$$

which is equivalent to

$$\alpha(1 - \frac{\underline{\nu}_D}{\overline{\nu}_D}) \geq c_D(1 - \frac{\underline{\nu}_D}{\overline{\nu}_D}), \tag{23}$$

or, simply, $\alpha \geq c_D$, consistent with the discussion in the text.

If the relatively resolved type complies with the equilibrium strategy and claims that he will not compromise, thereby generating audience costs, he receives a payoff of $\overline{\nu}_D(1 - \underline{x}_{a,\nu}) - \alpha$. If he deviates from the equilibrium strategy, he will reject $\overline{x}_{n,\nu}$ and receive $\overline{\nu}_D(1-w) - c_D$. Thus, incentive compatibility for this type requires

$$\overline{\nu}_D(1 - w - \frac{c_D - \alpha}{\overline{\nu}_D}) - \alpha \geq \overline{\nu}_D(1 - w) - c_D, \tag{24}$$

which is equivalent to

$$\overline{\nu}_D(1 - w) - c_D + \alpha - \alpha \geq \overline{\nu}_D(1 - w) - c_D, \tag{25}$$

where the two are of course precisely equal, since the α terms drop out.

Intuitively, C compensates the more resolved type of D for generating audience costs just enough to leave him with a payoff equivalent to what he gets from war. But, of course, had he never generated audience costs, he'd be offered terms that leave him with the same payoff as he would get from war as well, and his war payoff does not depend upon whether he generated audience costs. Thus we see that the more resolved type of D has no incentive to generate audience costs, as discussed in the text. Yet neither does he have any incentive not to, and so, as long as $\alpha \geq c_D$, the equilibrium trivially holds. $\square$

Corollary 2. This proof follows a similar logic to that of Corollary 1.

If D claims that he will not compromise, the less martially effective type accepts iff $x \leq \overline{x}_{a,e}$, where $\overline{x}_{a,e} \equiv \overline{w} + \frac{c_D - \alpha}{\nu_D}$, while the more martially effective type accepts iff $x \leq \underline{x}_{a,e}$, where $\underline{x}_{a,e} \equiv \underline{w} + \frac{c_D - \alpha}{\nu_D}$. Again, note that $\underline{x}_{a,e}$ and $\overline{x}_{a,e}$ differ from $\underline{x}_{n,e}$ and $\overline{x}_{n,e}$ in that the former contain $\frac{c_D - \alpha}{\nu_D}$ while the latter contain $\frac{c_D}{\nu_D}$.

As ever, C's choice of x boils down to choosing between two precise demands: $\underline{x}_{a,e}$ or $x = \overline{x}_{a,e}$ if D generates audience costs and $x = \underline{x}_{n,e}$ or $x = \overline{x}_{n,e}$ if he does not.

If D generates audience costs, C prefers $x = \underline{x}_{a,e}$ to $x = \overline{x}_{a,e}$ iff $q'_{a,e} \leq \hat{q}_{a,e}$, where

$$\hat{q}_{a,e} \equiv \frac{c_C + (c_D - \alpha)(\frac{\nu_C}{\nu_D})}{\nu_C(\overline{w} - \underline{w}) + c_C + (c_D - \alpha)(\frac{\nu_C}{\nu_D})}. \tag{26}$$

The following beliefs and strategies comprise the candidate PBE of interest: C sets $x = \underline{x}_{a,e}$ and believes $q'_{a,e} = 0$ if D claims he cannot compromise and sets $x = \overline{x}_{n,e}$ and believes $q'_{n,e} = 1$ if D does not; the less martially effective type D accepts iff $x \leq \overline{x}_{n,e}$ when he does not claim he will not compromise, accepts iff $x \leq \overline{x}_{a,e}$ if he does, but does not make such a claim; and the more martially effective type accepts iff $x \leq \underline{x}_{n,e}$ if he does not claim he will not compromise, accepts iff $x \leq \underline{x}_{a,e}$ if he does, and does make such a claim.

Again, C's beliefs are consistent with Bayes' Theorem and her strategies are sequentially rational, so our only concern is the incentive compatibility constraints for D.

Holding constant C's beliefs and strategies, the less martially effective type receives $\nu_D(1 - \overline{x}_{n,e})$ if he abides by the equilibrium and $\nu_D(1 - \underline{x}_{a,e}) - \alpha$ if he does not.

Thus incentive compatibility requires

$$\nu_D(1 - \overline{w} - \frac{c_D}{\nu_D}) \geq \nu_D(1 - \underline{w} - \frac{c_D - \alpha}{\nu_D}) - \alpha, \tag{27}$$

which simplifies to $\overline{w} \leq \underline{w}$, and clearly cannot be true. Thus there can be no such equilibrium. This establishes the result. □

Proposition 3. This proof also follows a similar logic to that of Proposition 1.

After imposing economic sanctions, the less resolved type of D accepts iff $x \leq \overline{x}_{e,\nu}$, where $\overline{x}_{e,\nu} \equiv w + \dfrac{c_D - \overline{\xi}}{\underline{\nu}_D}$, while the more resolved type of D accepts iff $x \leq \underline{x}_{e,\nu}$, where $\underline{x}_{e,\nu} \equiv w + \dfrac{c_D - \underline{\xi}}{\overline{\nu}_D}$.

Note that $\underline{x}_{e,\nu}$ and $\overline{x}_{e,\nu}$ differ from $\underline{x}_{n,\nu}$ and $\overline{x}_{n,\nu}$ in that the former contain, generically, $\dfrac{c_D - \xi}{\nu_D}$, while the latter contain $\dfrac{c_D}{\nu_D}$. This ensures that $x_{e,\nu} < x_{n,\nu}$.

As ever, C's choice of x boils down to choosing between two precise demands: $\underline{x}_{e,\nu}$ or $x = \overline{x}_{e,\nu}$ if D imposes sanctions and $x = \underline{x}_{n,\nu}$ or $x = \overline{x}_{n,\nu}$ if he does not.

Upon observing D impose sanctions, C prefers $x = \underline{x}_{e,\nu}$ to $x = \overline{x}_{e,\nu}$ iff $q'_{e,\nu} \leq \hat{q}_{e,\nu}$, where

$$\hat{q}_{e,\nu} \equiv \frac{c_C + (c_D - \underline{\xi})(\dfrac{\nu_C}{\overline{\nu}_D}) - \underline{\xi}}{c_C + (c_D - \overline{\xi})(\dfrac{\nu_C}{\underline{\nu}_D}) - \overline{\xi}}. \tag{28}$$

The following beliefs and strategies comprise a PBE: C sets $x = \underline{x}_{e,\nu}$ and believes $q'_{e,\nu} = 0$ if D imposes sanctions on C and sets $x = \overline{x}_{n,\nu}$ and believes $q'_{n,\nu} = 1$ if D does not impose sanctions; the less resolved type D accepts iff $x \leq \overline{x}_{n,\nu}$ when he does not impose sanctions, accepts iff $x \leq \overline{x}_{e,\nu}$ if he does, but does not in fact impose sanctions on C; and the more resolved type accepts iff $x \leq \underline{x}_{n,\nu}$ if he does not impose sanctions, accepts iff $x \leq \underline{x}_{e,\nu}$ if he does, and does in fact impose sanctions on C.

Again, by construction, C's posterior beliefs are consistent with Bayes' Theorem and her strategies are sequentially rational. What remains then is to consider the incentive compatibility conditions for D.

Note that imposing sanctions has essentially the same impact on D's payoffs as generating audience costs. The same exact arguments from above therefore apply here as well. The less resolved type of D is willing to refrain from imposing sanctions iff $\xi \geq c_D$, while the relatively resolved defender is indifferent between sanctioning C and not.

Thus, provided $\xi \geq c_D$, the equilibrium holds trivially. $\square$

Corollary 3. This proof also follows a similar logic to that of Corollary 1.

If D imposes sanctions, the less martially effective type accepts iff $x \leq \overline{x}_{e,e}$, where $\overline{x}_{e,e} \equiv \overline{w} + \frac{c_D - \overline{\xi}}{\nu_D}$, while the more martially effective type accepts iff $x \leq \underline{x}_{e,e}$, where $\underline{x}_{e,e} \equiv \underline{w} + \frac{c_D - \underline{\xi}}{\nu_D}$. Again, note that $\underline{x}_{e,e}$ and $\overline{x}_{e,e}$ differ from $\underline{x}_{n,e}$ and $\overline{x}_{n,e}$ in that the former generically contain $\frac{c_D - \xi}{\nu_D}$ while the latter contain $\frac{c_D}{\nu_D}$.

As ever, C's choice of x boils down to choosing between two precise demands: $\underline{x}_{e,e}$ or $x = \overline{x}_{e,e}$ if D imposes sanctions and $x = \underline{x}_{n,e}$ or $x = \overline{x}_{n,e}$ if he does not.

If D imposes sanctions, C prefers $x = \underline{x}_{e,e}$ to $x = \overline{x}_{e,e}$ iff $q'_{e,e} \leq \hat{q}_{e,e}$, where

$$\hat{q}_{e,e} \equiv \frac{c_C + (c_D - \underline{\xi})(\frac{\nu_C}{\nu_D}) - \underline{\xi}}{\nu_C(\overline{w} - \underline{w}) + c_C + (c_D - \overline{\xi})(\frac{\nu_C}{\nu_D}) - \overline{\xi}}. \tag{29}$$

The following beliefs and strategies comprise the candidate PBE of interest: C sets $x = \underline{x}_{e,e}$ and believes $q'_{e,e} = 0$ if D imposes sanctions and sets $x = \overline{x}_{n,e}$ and believes $q'_{n,e} = 1$ if D does not; the less martially effective type D accepts iff $x \leq \overline{x}_{n,e}$ when he does not impose sanctions, accepts iff $x \leq \overline{x}_{e,e}$ if he does, but does not make impose sanctions; and the more martially effective type accepts iff $x \leq \underline{x}_{n,e}$ if he does not impose sanctions, accepts iff $x \leq \underline{x}_{e,e}$ if he does, and imposes sanctions.

Again, by design, our only concern is the incentive compatibility constraints for D.

Holding constant C's beliefs and strategies, the less martially effective type receives $\nu_D(1 - \overline{x}_{n,e})$ if he abides by the equilibrium and $\nu_D(1 - \underline{x}_{e,e}) - \underline{\xi}$ if he does not.

Thus incentive compatibility requires

$$\nu_D(1 - \overline{w} - \frac{c_D}{\nu_D}) \geq \nu_D(1 - \underline{w} - \frac{c_D - \underline{\xi}}{\nu_D}) - \underline{\xi}, \tag{30}$$

which simplifies to $\overline{w} \leq \underline{w}$, and clearly cannot be true. Thus there can be no such equilibrium. This establishes the result. $\square$

Proposition 4. We turn now to analysis of Successful Coercive Equilibria. Note that many of the essential elements of this proof were derived in the proof of Corollary 1.

The following beliefs and strategies comprise a PBE: C sets $x = \underline{x}_{m,e}$ and believes $q'_{m,e} \leq \hat{q}_{m,e}$ if D employs the military instrument and sets $x = \overline{x}_{n,e}$ and believes $q'_{n,e} > \hat{q}_{n,e}$ if D does not; the less martially effective type of D accepts iff $x \leq \overline{x}_{n,e}$ when he does not employ the military instrument, accepts iff $x \leq \overline{x}_{m,e}$ if he does, and employs the instrument; and the more martially effective type accepts iff $x \leq \underline{x}_{n,e}$ if he does not employ the military instrument, accepts iff $x \leq \underline{x}_{m,e}$ if he does, and employs the military instrument.

By Bayes' Theorem, $q'_{m,e} = q_e$, since $pr(m|e_D = \underline{e}_D) = pr(m|e_D = \overline{e}_D) = 1$. Since $pr(n|e_D = \underline{e}_D) = pr(n|e_D = \overline{e}_D) = 0$, Bayes' Theorem cannot be used to define $q'_{n,e}$. In contrast to the results for Successful Signal Equilibria, we cannot assert that C's beliefs must take on values that will sustain the equilibrium. However, we can stipulate that C's beliefs sometimes will take on such values without violating weak consistency with Bayes' Theorem. When they do, the strategies outlined above for C will be sequentially rational.

That leaves only the question of incentive compatibility for D.

Holding constant C's beliefs and strategies, the less martially effective type receives $\nu_D(1 - \underline{x}_{m,e}) - \kappa$ if he engages in military preparations per the equilibrium and $\nu_D(1 - \overline{x}_{n,e})$ if he deviates from the equilibrium strategies and does not employ the military instrument.

Thus incentive compatibility requires $\kappa \leq \underline{\kappa}_e$, as defined in the proof of Corollary 1.

Similarly, incentive compatibility for the more martially effective type requires $\kappa \leq \overline{\kappa}_e$, which was also defined above.

We have already established that $\underline{\kappa}_e$ must be greater than $\overline{\kappa}_e$. However, since this equilibrium, unlike the one we were evaluating in Corollary 1, requires that κ be relatively low for both types, this does not present a problem here as it did there. Provided $\kappa < \overline{\kappa}_e$, both types will be willing to engage in military preparations, as per the equilibrium. Since $\overline{\kappa}_e$ is strictly positive, sufficiently small values of κ will satisfy the incentive compatibility requirements for both types, and the equilibrium will hold. $\square$

Corollary 4. Many of the elements of this proof were derived in the proof of Proposition 1.

The following beliefs and strategies comprise the candidate PBE of interest: C sets $x = \underline{x}_{m,\nu}$ and believes $q'_{m,\nu} \leq \hat{q}_{m,\nu}$ if D employs the military instrument and sets $x = \overline{x}_{n,\nu}$ and believes $q'_{n,\nu} > \hat{q}_{n,\nu}$ if D does not; the less resolved type of D accepts iff $x \leq \overline{x}_{n,\nu}$ when he does not employ the military instrument, accepts iff $x \leq \overline{x}_{m,\nu}$ if he does, and employs the instrument; and the more resolved type accepts iff $x \leq \underline{x}_{n,\nu}$ if he does not employ the military instrument, accepts iff $x \leq \underline{x}_{m,\nu}$ if he does, and employs the military instrument.

As in Proposition 4, Bayes' Theorem can only tell us that $q'_{m,\nu} = q_{\nu}$. We could again stipulate that C will at times hold the beliefs necessary to sustain the equilibrium without violating weak consistency. However, it is useful here to take a closer look at the off-the-equilibrium-path beliefs that would sustain such a PBE and see whether they are plausible.

As mentioned above, $\hat{q}_{m,\nu}$ is precisely equal to $\hat{q}_{n,\nu}$. Thus, for the strategies outlined above for C to be sequentially rational, C would have to revise upwards her estimate of the probability that D is relatively low in resolve if D does not engage in military preparations.

However, under the parameter values of greatest interest, it is the more resolved type that has less incentive to deviate from his equilibrium strategy. Therefore, applying the intuitive criterion (McCarty and Meirowitz 2007, 240-248) rules out this equilibrium.

Note that the same cutpoints over κ as we derived in the proof of Proposition 1 apply again here. The less resolved type employs the military instrument per the equilibrium iff $\kappa \leq \overline{\kappa}_{\nu}$, while the more resolved type does so iff $\kappa \leq \underline{\kappa}_{\nu}$. Thus, so long as $\underline{\kappa}_{\nu} < \overline{\kappa}_{\nu}$, a marginal increase in κ is more likely to violate incentive compatibility for the more resolved type.

While it is possible for $\underline{\kappa}_{\nu}$ to be larger than $\overline{\kappa}_{\nu}$, this requires that c_D be relatively large and the difference between $\underline{\nu}_D$ and $\overline{\nu}_D$ be relatively small. Yet the larger c_D is and the smaller the difference between $\underline{\nu}_D$ and $\overline{\nu}_D$, the larger is $\hat{q}_{n,\nu}$, and the less plausible it is that C would choose to set $x = \overline{x}_{n,\nu}$ for any given value of $q'_{n,\nu}$ anyway. Therefore, under the only conditions where pure coercion would be relevant in anything but a trivial sense, the intuitive criterion rules out the PBE. $\square$

Proposition 5. Many of the elements of this proof were derived in the proof of Corollary 1.

The following beliefs and strategies comprise a PBE: C sets $x = \overline{x}_{m,e}$ and believes $q'_{m,e} > \hat{q}_{m,e}$ if D employs the military instrument and sets $x = \underline{x}_{n,e}$ and believes $q'_{n,e} \leq \hat{q}_{n,e}$ if D does not; the less martially effective type of D accepts iff $x \leq \overline{x}_{n,e}$ when he does not employ the military instrument, accepts iff $x \leq \overline{x}_{m,e}$ if he does, and employs the instrument; and the more martially effective type accepts iff $x \leq \underline{x}_{n,e}$ if he does not employ the military instrument, accepts iff $x \leq \underline{x}_{m,e}$ if he does, and employs the military instrument.

Again, Bayes' Theorem can only tell us that $q'_{m,e} = q_e$. However, the intuitive criterion would not lead us to rule out this equilibrium, because, under certain conditions, $\hat{q}_{m,e} < \hat{q}_{n,e}$, and thus even if C's off-the-equilibrium-path belief matched her prior belief, C might prefer to set $x = \overline{x}_{m,e}$ following military preparations and $x = \underline{x}_{n,e}$ if D foregoes military preparations.

To see this, consider $\hat{q}_{m,e} < \hat{q}_{n,e}$, which is equivalent to

$$\frac{c_C + c_D(\frac{\nu_C}{\nu_D})}{\nu_C(\overline{w}_m - \underline{w}_m) + c_C + c_D(\frac{\nu_C}{\nu_D})} < \frac{c_C + c_D(\frac{\nu_C}{\nu_D})}{\nu_C(\overline{w} - \underline{w}) + c_C + c_D(\frac{\nu_C}{\nu_D})}. \tag{31}$$

This must be true so long as $\overline{w}_m - \underline{w}_m > \overline{w} - \underline{w}$, which is equivalent to

$$\frac{e_C m_C}{e_C m_C + \underline{e}_D \beta m_D} - \frac{e_C m_C}{e_C m_C + \overline{e}_D \beta m_D} > \frac{e_C m_C}{e_C m_C + \underline{e}_D m_D} - \frac{e_C m_C}{e_C m_C + \overline{e}_D m_D}, \tag{32}$$

which is itself true iff $m_D \leq \hat{m}_D$, where

$$\hat{m}_D \equiv \frac{m_C}{\sqrt{\beta}} \frac{e_C}{\sqrt{\underline{e}_D \overline{e}_D}}. \tag{33}$$

Next, we turn to the incentive compatibility constraints for D.

Holding constant C's beliefs and strategies, the less martially effective type receives $\nu_D(1 - \overline{x}_{m,e}) - \kappa$ if he engages in military preparations per the equilibrium and $\nu_D(1 - \underline{x}_{n,e})$ if he deviates from the equilibrium strategies and does not employ the military instrument.

Thus incentive compatibility requires $\kappa \leq \underline{\omega}$, where $\underline{\omega} \equiv \nu_D(\underline{w} - \overline{w}_m)$. Note that it is possible for $\underline{\omega}$ to be negative, in which case the incentive compatibility constraint cannot possibly be satisfied by any value of κ, which is strictly positive.

If the more martially effective type engages in military preparations per the equilibrium, he will reject $\overline{x}_{m,e}$ and receive his war payoff, $\nu_C(1 - \underline{w}_{m,e}) - c_D - \kappa$. If he deviates and chooses not to engage in military preparations, he will accept $\underline{x}_{n,e}$ and receive $\nu_C(1 - \underline{x}_{n,e}$.

Thus incentive compatibility requires $\kappa \leq \overline{\omega}$, where $\overline{\omega} \equiv \nu_D(\underline{w} - \underline{w}_m)$. Note that $\overline{\omega}$ is strictly positive, unlike $\underline{\omega}$. Thus, provided $\kappa \leq \underline{\omega}$, the incentive compatibility constraints will be satisfied for both types, since $\underline{\omega} < \overline{\omega}$, and the equilibrium will hold. □

Proposition 6. Key elements of this proof were derived in the proof of Proposition 2.

The following beliefs and strategies comprise a PBE: C sets $x = \underline{x}_{a,\nu}$ and believes $q'_{a,\nu} \leq \hat{q}_{a,\nu}$ if D claims he cannot compromise, thereby generating audience costs, and sets $x = \overline{x}_{n,\nu}$ and believes $q'_{n,\nu} > \hat{q}_{n,\nu}$ if D does not; the less resolved type of D accepts iff $x \leq \overline{x}_{n,\nu}$ when he does not claim that he cannot compromise, accepts iff $x \leq \overline{x}_{a,\nu}$ if he does make such claim, and he in fact does make the claim; and the more resolved type of D accepts iff $x \leq \underline{x}_{n,\nu}$ if he does not claim that he cannot compromise, accepts iff $x \leq \underline{x}_{a,\nu}$ if he does make such a claim, and does in fact make the claim.

Again, Bayes' Theorem can only tell us that $q'_{a,\nu} = q_\nu$. We might therefore wish to know if $\hat{q}_{a,\nu}$ is greater than $\hat{q}_{n,\nu}$, in which case it would be possible for C to set $x = \underline{x}_{a,\nu}$ when D claims that he cannot compromise and $x = \overline{x}_{n,\nu}$ when D does not even if C's off-the-equilibrium-path-belief matched her prior belief.

We thus consider $\hat{q}_{a,\nu} > \hat{q}_{n,\nu}$, or

$$\frac{c_C + (c_D - \alpha)(\frac{\nu_C}{\overline{\nu}_D})}{c_C + (c_D - \alpha)(\frac{\nu_C}{\underline{\nu}_D})} > \frac{c_C + c_D(\frac{\nu_C}{\overline{\nu}_D})}{c_C + c_D(\frac{\nu_C}{\underline{\nu}_D})}, \tag{34}$$

which is equivalent to

$$c_C^2 + c_C c_D \frac{\nu_C}{\overline{\nu}_D} - c_C \alpha \frac{\nu_C}{\overline{\nu}_D} + c_C c_D \frac{\nu_C}{\underline{\nu}_D} + c_D^2 \frac{\nu_C^2}{\underline{\nu}_D \overline{\nu}_D} - c_D \alpha \frac{\nu_C^2}{\underline{\nu}_D \overline{\nu}_D} >$$
$$c_C^2 + c_C c_D \frac{\nu_C}{\overline{\nu}_D} - c_C \alpha \frac{\nu_C}{\underline{\nu}_D} + c_C c_D \frac{\nu_C}{\underline{\nu}_D} + c_D^2 \frac{\nu_C^2}{\underline{\nu}_D \overline{\nu}_D} - c_D \alpha \frac{\nu_C^2}{\underline{\nu}_D \overline{\nu}_D}, \tag{35}$$

which ultimately simplifies to

$$\overline{\nu}_D > \underline{\nu}_D. \tag{36}$$

Thus, it must be true that $\hat{q}_{a,\nu} > \hat{q}_{n,\nu}$ and we need not assume that deviating from the equilibrium strategies causes C to become more confident that she is facing the less resolved type of D in order to establish the equilibrium.

We turn next to the incentive compatibility constraints for D.

Holding constant C's beliefs and strategies, the less resolved type receives $\underline{\nu}_D(1-\underline{x}_{a,\nu})-\alpha$ if he engages he claims he cannot compromise, thereby generating audience costs, per the equilibrium. If he deviates, he will instead receive $\underline{\nu}_D(1-\overline{x}_{n,\nu})$.

Thus incentive compatibility requires

$$\underline{\nu}_D(1 - w - \frac{c_D - \alpha}{\overline{\nu}_D}) - \alpha \geq \underline{\nu}_D(1 - w - \frac{c_D}{\underline{\nu}_D}), \tag{37}$$

which ultimately simplifies to $\alpha \leq c_D$.

If the relatively resolved type complies with the equilibrium strategy and claims that he will not compromise, thereby generating audience costs, he receives a payoff of $\overline{\nu}_D(1-\underline{x}_{a,\nu})-\alpha$. If he deviates from the equilibrium strategy, he will reject $\overline{x}_{n,\nu}$ and receive $\overline{\nu}_D(1-w)-c_D$. This is of course the same condition as in the proof for Proposition 2, where we established that the relatively resolved type is indifferent between claiming he cannot compromise and not. Thus, provided $\alpha \leq c_D$, the incentive compatibility conditions for both types are satisfied and the equilibrium is possible. □

Corollary 5. Many of the elements of this proof were derived in the proof of Corollary 2.

The following beliefs and strategies comprise a PBE: C sets $x = \underline{x}_{a,e}$ and believes $q'_{a,e} \leq \hat{q}_{a,e}$ if D claims he cannot compromise, thereby generating audience costs, and sets $x = \overline{x}_{n,e}$ and believes $q'_{n,e} > \hat{q}_{n,e}$ if D does not; the less martially effective type of D accepts iff $x \leq \overline{x}_{n,e}$ when he does not claim that he cannot compromise, accepts iff $x \leq \overline{x}_{a,e}$ if he does make such a claim, and he in fact does make the claim; and the more martially effective type of D accepts iff $x \leq \underline{x}_{n,e}$ if he does not claim that he cannot compromise, accepts iff $x \leq \underline{x}_{a,e}$ if he does make such a claim, and does in fact make the claim.

As in previous propositions, Bayes' Theorem can only tell us that $q'_{a,e} = q_e$. We therefore wish to know if $\hat{q}_{a,e}$ is greater than $\hat{q}_{n,e}$.

We thus consider $\hat{q}_{a,e} > \hat{q}_{n,e}$, or

$$\frac{c_C + (c_D - \alpha)(\frac{\nu_C}{\nu_D})}{\nu_C(\overline{w} - \underline{w}) + c_C + (c_D - \alpha)(\frac{\nu_C}{\nu_D})} > \frac{c_C + c_D(\frac{\nu_C}{\nu_D})}{\nu_C(\overline{w} - \underline{w}) + c_C + c_D(\frac{\nu_C}{\nu_D})}, \tag{38}$$

which must be true, since $\alpha > 0$ by assumption.

We turn next to the incentive compatibility constraints for D.

Holding constant C's beliefs and strategies, the less martially effective type receives $\nu_D(1 - \underline{x}_{a,\nu}) - \alpha$ if he he claims he cannot compromise, thereby generating audience costs, per the equilibrium. If he deviates, he will instead receive $\nu_D(1 - \overline{x}_{n,\nu})$.

Thus incentive compatibility requires

$$\nu_D(1 - \underline{w} - \frac{c_D - \alpha}{\nu_D}) - \alpha \geq \nu_D(1 - \overline{w} - \frac{c_D}{\nu_D}), \tag{39}$$

which ultimately simplifies to $\overline{w} - \underline{w}$, and thus must be true.

Once again, the type that has a higher value for war is indifferent between claiming that he cannot compromise and not, and so the incentive compatibility constraint is trivially satisfied. This establishes the equilibrium. $\square$

Proposition 7. Key elements of this proof were derived in the proof of Proposition 3.

The following beliefs and strategies comprise a PBE: C sets $x = \underline{x}_{e,\nu}$ and believes $q'_{e,\nu} \leq \hat{q}_{e,\nu}$ if D imposes sanctions, and sets $x = \overline{x}_{n,\nu}$ and believes $q'_{n,\nu} > \hat{q}_{n,\nu}$ if D does not; the less resolved type of D accepts iff $x \leq \overline{x}_{n,\nu}$ when he does not impose sanctions, accepts iff $x \leq \overline{x}_{e,\nu}$ if he does, and does sanction C; and the more resolved type of D accepts iff $x \leq \underline{x}_{n,\nu}$ if he does not impose sanctions, accepts iff $x \leq \underline{x}_{e,\nu}$ if he does, and does sanction C.

Again, Bayes' Theorem can only tell us that $q'_{a,\nu} = q_\nu$. We therefore consider $\hat{q}_{e,\nu} > \hat{q}_{n,\nu}$ to determine whether the equilibrium requires C's off-the-equilibrium-path belief to increase relative to her prior belief in order to sustain the equilibrium. This is equivalent to

$$\frac{c_C + (c_D - \underline{\xi})(\dfrac{\nu_C}{\overline{\nu}_D}) - \underline{\xi}}{c_C + (c_D - \overline{\xi})(\dfrac{\nu_C}{\underline{\nu}_D}) - \overline{\xi}} > \frac{c_C + c_D(\dfrac{\nu_C}{\overline{\nu}_D})}{c_C + c_D(\dfrac{\nu_C}{\underline{\nu}_D})}, \tag{40}$$

which simplifies to

$$\overline{\xi}(c_D \frac{\nu_C^2}{\underline{\nu}_D \overline{\nu}_D} + \frac{\nu_C}{\underline{\nu}_D} + c_D \frac{\nu_C}{\overline{\nu}_D} + c_C) > \underline{\xi}(c_D \frac{\nu_C^2}{\underline{\nu}_D \overline{\nu}_D} + \frac{\nu_C}{\overline{\nu}_D} + c_D \frac{\nu_C}{\underline{\nu}_D} + c_C). \tag{41}$$

Provided this inequality holds, it must be true that $\hat{q}_{e,\nu} > \hat{q}_{e,\nu}$ and we need not assume that deviating from the equilibrium strategies causes C to become more confident that she is facing the less resolved type of D in order to establish the equilibrium.

The incentive compatibility constraints for the two types of D are analogous to those in the equilibrium established by Proposition 6.

That is, holding constant C's beliefs and strategies, the less resolved type receives $\underline{\nu}_D(1 - \underline{x}_{e,\nu}) - \underline{\xi}$ if he imposes sanctions, and if he deviates, he will instead receive $\underline{\nu}_D(1 - \overline{x}_{n,\nu})$. Thus, incentive compatibility requires $\underline{\xi} \leq c_D$. The relatively resolved type will again be indifferent between imposing sanctions and not, as we have seen several times now.

Thus, provided $\underline{\xi} \leq c_D$, the incentive compatibility conditions for both types are satisfied and the equilibrium is possible, establishing the result. $\square$

Corollary 6. Many of the elements of this proof were derived in the proof of Corollary 3.

The following beliefs and strategies comprise a PBE: C sets $x = \underline{x}_{e,e}$ and believes $q'_{e,e} \leq \hat{q}_{e,e}$ if D imposes sanctions, and sets $x = \overline{x}_{n,e}$ and believes $q'_{n,e} > \hat{q}_{n,e}$ if D does not; the less martially effective type of D accepts iff $x \leq \overline{x}_{n,e}$ when he does not claim that he cannot compromise, accepts iff $x \leq \overline{x}_{e,e}$ if he imposes sanctions, and he does impose sanctions; and the more martially effective type of D accepts iff $x \leq \underline{x}_{n,e}$ if he does not claim that he cannot compromise, accepts iff $x \leq \underline{x}_{e,e}$ if he does impose sanctions, which he does.

As in previous propositions, Bayes' Theorem can only tell us that $q'_{e,e} = q_e$. We therefore wish to know if $\hat{q}_{e,e}$ is greater than $\hat{q}_{n,e}$.

We thus consider $\hat{q}_{e,e} > \hat{q}_{n,e}$, or

$$\frac{c_C + (c_D - \underline{\xi})(\frac{\nu_C}{\nu_D}) - \underline{\xi}}{\nu_C(\overline{w} - \underline{w}) + c_C + (c_D - \overline{\xi})(\frac{\nu_C}{\nu_D}) - \overline{\xi}} > \frac{c_C + c_D(\frac{\nu_C}{\nu_D})}{\nu_C(\overline{w} - \underline{w}) + c_C + c_D(\frac{\nu_C}{\nu_D})}, \tag{42}$$

which simplifies to

$$\overline{\xi}(c_D\frac{\nu_C^2}{\nu_D^2} + (c_C + c_D)\frac{\nu_C}{\nu_D} + c_C) > \underline{\xi}(c_D\frac{\nu_C^2}{\nu_D^2} + (c_C + c_D)\frac{\nu_C}{\nu_D} + c_C + \nu_C(\overline{w} - \underline{w})(1 + \frac{\nu_C}{\nu_D})). \tag{43}$$

We turn next to the incentive compatibility constraints for D.

Holding constant C's beliefs and strategies, the less martially effective type receives $\nu_D(1 - \underline{x}_{e,e}) - \underline{\xi}$ if he imposes sanctions and $\nu_D(1 - \overline{x}_{n,e})$ if he does not.

Thus incentive compatibility requires

$$\nu_D(1 - \underline{w} - \frac{c_D - \underline{\xi}}{\nu_D}) - \underline{\xi} \geq \nu_D(1 - \overline{w} - \frac{c_D}{\nu_D}), \tag{44}$$

which ultimately simplifies to $\overline{w} - \underline{w}$, and thus must be true.

Once again, the type that has a higher value for war is indifferent, and so his incentive compatibility constraint is trivially satisfied. This establishes the equilibrium. $\square$

Proposition 8. The proof of this proposition follows readily from the preceding proofs. The proposition states that D never increases C's material incentives to risk war by claiming that he cannot compromise. We have already seen that $\hat{q}_{a,\nu} > \hat{q}_{n,\nu}$ and $\hat{q}_{a,e} > \hat{q}_{n,e}$. Since these cutpoints reflect the material incentives C has to risk war, this is sufficient to establish that C always has less incentive to risk war after D claims that he cannot compromise. □

Proposition 9. The essential elements of this proof are derived in previous proofs.

We have already seen that $\hat{q}_{e,\nu}$ can be either larger or smaller than $\hat{q}_{n,\nu}$, and the same is true of $\hat{q}_{e,e}$ relative to $\hat{q}_{n,e}$. This is sufficient to establish that it is possible for sanctions to increase C's willingness to risk war. What remains is to show that D does not impose sanctions in equilibrium under such conditions.

Consider the following potential PBE: C sets $x = \overline{x}_{e,\nu}$ and believes $q'_{e,\nu} > \hat{q}_{e,\nu}$ if D imposes sanctions, and sets $x = \underline{x}_{n,\nu}$ and believes $q'_{n,\nu} \leq \hat{q}_{n,\nu}$ if D does not; the less resolved type of D accepts iff $x \leq \overline{x}_{n,\nu}$ when he does not impose sanctions, accepts iff $x \leq \overline{x}_{e,\nu}$ if he does, and does sanction C; and the more resolved type of D accepts iff $x \leq \underline{x}_{n,\nu}$ if he does not impose sanctions, accepts iff $x \leq \underline{x}_{e,\nu}$ if he does, and does sanction C.

That C might hold such beliefs follows readily from the proof of Proposition 7, and C's strategies must be sequentially rational given such beliefs, by construction.

To demonstrate that no such equilibrium may obtain, it is sufficient to show that incentive compatibility cannot hold for the less resolved type.

Holding constant C's beliefs and strategies, the less resolved type receives $\underline{\nu}_D(1-\overline{x}_{e,\nu})-\overline{\xi}$ if he imposes sanctions, and if he deviates, he will instead receive $\underline{\nu}_D(1-\underline{x}_{n,\nu})$.

Thus, incentive compatibility requires

$$\underline{\nu}_D(1-w-\frac{c_D-\overline{\xi}}{\underline{\nu}_D})-\overline{\xi} \geq \underline{\nu}_D(1-w-\frac{c_D}{\overline{\nu}_D}), \tag{45}$$

which simplifies to $\dfrac{\underline{\nu}_D}{\overline{\nu}_D} \geq 1$, which cannot be true. Therefore, no such equilibrium can exist when C is uncertain about ν_D.

Now consider the following potential PBE: C sets $x = \overline{x}_{e,e}$ and believes $q'_{e,e} > \hat{q}_{e,e}$ if D imposes sanctions, and sets $x = \underline{x}_{n,e}$ and believes $q'_{n,e} \leq \hat{q}_{n,e}$ if D does not; the less martially effective type of D accepts iff $x \leq \overline{x}_{n,e}$ when he does not impose sanctions, accepts iff $x \leq \overline{x}_{e,e}$ if he does, and does sanction C; and the more martially effective type of D accepts iff $x \leq \underline{x}_{n,e}$ if he does not impose sanctions, accepts iff $x \leq \underline{x}_{e,e}$ if he does, and does sanction C.

That C might hold such beliefs follows readily from the proof of Proposition 6, and C's strategies must be sequentially rational given such beliefs, by construction.

Again, to demonstrate that no such equilibrium may obtain, it is sufficient to show even for one type that incentive compatibility cannot hold.

Holding constant C's beliefs and strategies, the less martially effective type receives $\nu_D(1-\overline{x}_{e,e})-\overline{\xi}$ if he imposes sanctions, and if he deviates, he will instead receive $\nu_D(1-\underline{x}_{n,e})$.

Thus, incentive compatibility requires

$$\nu_D(1 - \overline{w} - \frac{c_D - \overline{\xi}}{\nu_D}) - \overline{\xi} \geq \nu_D(1 - \underline{w} - \frac{c_D}{\nu_D}), \tag{46}$$

which simplifies to $\underline{w} \geq \overline{w}$, which cannot be true. Therefore, no such equilibrium can exist when C is uncertain about e_D.

Taken together, then, it immediately follows that D never imposes sanctions when doing so increases C's material incentives to risk war. $\square$

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