Bargaining and Signaling in International Crises*

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Abstract

How leaders can credibly signal their private information in international crises, thereby avoiding costly war, is a core topic in the study of international conflict. Existing game-theoretic works that examine this issue use indivisible-good models, despite the fact that most issues over which states have disputes, e.g., territory, are in principle divisible. We game-theoretically investigate how one of the most prominent signaling mechanisms, namely public commitments, operate in a divisible-good setting. Public commitments acquire a bargaining-leverage role that greatly mitigates their signaling role. In fact, public commitments do not allow for signaling in a way which reduces the probability of war or which allows agreements to be reached that otherwise would not, which is the very purpose of credible signaling. We identify an alternative mechanism by which public commitments can reduce the probability of war, but this mechanism has nothing to do with credible signaling.

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1 Introduction

How leaders can credibly signal their private information in international crises, thereby avoiding costly war, is a core topic in the study of international conflict. Given that war is costly, there exist negotiated settlements that both sides to a dispute prefer to war (Fearon 1995). Under conditions of complete information, reaching such a negotiated settlement is usually not problematic.[1] However, states are often uncertain about the resolve and/or military capabilities of their opponents, and hence a negotiated settlement may be hard to reach. This problem is compounded by the fact that states have incentives to bluff about their true resolve or military capabilities, for this can provide bargaining leverage in any negotiated settlement reached. Because of this incentive to misrepresent one's private information to obtain bargaining leverage, it is often argued that costless messages are generally ineffective in credibly conveying private information about one's resolve (e.g., Fearon 1995).

Much research has thus been devoted to understanding how resolved states can *credibly* signal their resolve in international crises, so that a negotiated settlement can be reached and costly war avoided. Examples of credible signaling mechanisms that have been examined include audience costs (Fearon 1994), military mobilization (e.g., Fearon 1997; Slantchev 2005), opposition party endorsement of the government's threats (Schultz 1998), private diplomatic signals (Kurizaki 2007; Sartori 2002), and generating an autonomous risk of war (the "threat that leaves something to chance"; Powell 1990; Schelling 1960).[2] Because of game theory's ability to allow for the rigorous theoretical analysis of issues such as credibility and informational asymmetries, most of this work uses game-theoretic models. However, virtually all of these signaling models treat the disputed good as being indivisible, despite the fact that most issues over which states have disputes, e.g., territory, are in principle divisible.

[1] This can change if the disputed good is indivisible, or if there are commitment problems present (Fearon 1995; Powell 2006).

[2] Jervis (1970) and Schelling (1960) are foundational works on signaling in international relations.

Indeed, there is somewhat of an odd divide within the game-theoretic crisis bargaining literature between those works that identify private information as a rationalist explanation for war (Fearon 1995; Leventoğlu and Tarar 2008; Powell 1996a, 1996b, 1999), and those works that examine how states can credibly overcome informational asymmetries prior to conflict breaking out (see the citations in the previous paragraph). The former works use divisible-good bargaining models, whereas the latter do not.[3]

In this paper, we examine how one of the most prominent signaling mechanisms, namely audience costs or public commitments, operate in a setting in which the disputed good is divisible and full-fledged bargaining is allowed. The basic idea behind audience costs is that a resolved leader, in order to credibly convey its resolve and willingness to go to war if necessary, can make *public* threats or declarations about its intentions. If the leader faces domestic punishment or an "audience cost" for not carrying out these publicly-made threats or declarations, then the other side will have reason to believe that the leader really will carry them out if put in a position to do so. Thus, highly-resolved leaders can use public threats to "tie their hands" and convey to the other side that the threats will really be carried out if necessary. Less-resolved leaders are hesitant to tie their hands in this way, because they will have to pay a real cost if the other side calls their bluff. Thus, it is argued that, unlike with costless messages, public threats allow highly-resolved types to "separate" themselves from less-resolved types.[4]

Fearon (1994) hypothesizes that democratic leaders usually face higher domestic audience

[3]More recently, a literature has arisen that examines how, if war breaks out due to asymmetric information, this asymmetric information can be resolved *after* war-outbreak by events on the battlefield and bargaining behavior during war (Filson and Werner 2002; Powell 2004; Slantchev 2003; Smith and Stam 2004; Wagner 2000; Wittman 1979). These works usually *do* use bargaining models, in contrast to the works that examine how states can credibly overcome informational asymmetries *prior* to conflict breaking out.

[4]Explanations for why a leader would pay an audience cost for backing down from a public threat or commitment focus on (i) violating the national honor (Fearon 1994), (ii) signaling incompetence to voters (Fearon 1994, Smith 1998), (iii) losing international credibility (Guisinger and Smith 2002; Sartori 2002), and (iv) voters using the punishment mechanism to allow their leader to generate international bargaining leverage (Leventoğlu and Tarar 2005). For further discussions about the microfoundations of audience costs, see Gartzke and Gleditsch (2004), Gowa (1999), Schultz (1999), and Slantchev (2006). For experimental/survey evidence that audience costs exist, see Tomz (2007). For indirect empirical evidence that audience costs exist, see Eyerman and Hart (1996), Gelpi and Griesdorf (2001), Partell and Palmer (1999), and Prins (2003).

costs for backing down from public threats than autocratic leaders, because it is easier for domestic actors to punish the former than the latter. He thus argues that highly-resolved democratic leaders will be especially able to credibly convey their resolve in international crises. Because of this, a pair of democratic leaders will generally be better able to reach a negotiated settlement rather than go to war, compared to other types of dyads. Fearon thus posits that audience costs may help resolve the "security dilemma" (e.g., Herz 1950; Jervis 1978) between democratic states and may be at least partially responsible for the "democratic peace" empirical finding that there has been virtually no war between democracies in the modern era (e.g., Maoz and Russett 1993; also see Guisinger and Smith 2002 and Lipson 2003 for how audience costs help explain the democratic peace).[5]

Thus, previous research on audience costs generally concludes that they have a beneficial effect: by allowing for credible information transmission in incomplete-information crisis bargaining, they allow states to overcome informational asymmetries that can lead to war. And to the extent that this mechanism is especially available to democratic leaders, audience costs are theorized to improve the quality of relations between democracies.[6]

However, Tarar and Leventoğlu (2009) point out that previous analyses of audience costs have only focused on their signaling role in incomplete-information crisis bargaining over an indivisible good. In contrast, they analyze a model in which (i) there is complete information,

[5] Others (e.g., Gowa 1999) have noted that although democratic leaders may face a higher *likelihood* of being punished for backing down from a public threat, the *payoff* for the punishment outcome is more severe for autocratic leaders (perhaps imprisonment or death), and hence it is not clear which type of regime generally faces greater audience costs. More recently, Weeks (2008) theorizes and presents statistical evidence that certain types of autocracies, such as those where opposition groups have overcome their collective action problem of challenging the leader (e.g., Weingast 1997), face the same level of audience costs as democracies. We do not take a strong position on this issue here, but do discuss the implications of our results for the idea that audience costs provide a signaling explanation for the democratic peace.

[6] It has also been recognized that the use of audience costs to signal resolve can paradoxically *increase* the probability of war (through the "lock-in" effect; e.g., Fearon 1997) — indeed, this is one of the reasons why audience costs can act as a *credible* signal of resolve, as opposed to a bluff. However, the literature also suggests that the information-revealing role of audience costs can at least allow some negotiated settlements to be reached that otherwise would not (and hence there is some point in generating audience costs to signal resolve). For example, Schultz (1999, 233) writes: "Scholars in this tradition have argued that democratic institutions help reveal information about the government's political incentives in a crisis by increasing the transparency of the political process and/or by improving a government's ability to send credible signals. According to this logic, democracy facilitates peaceful conflict resolution by overcoming informational asymmetries that can cause bargaining to break down."

(ii) the good is completely divisible and offers and counteroffers can be made (and hence full-fledged bargaining is allowed), and (iii) the leaders can endogenously choose how much (if any) of the disputed good to publicly commit to obtaining, and hence the size of the audience cost is determined endogenously rather than exogenously fixed. In this setting, they show that public commitments can be used coercively as a source of *bargaining leverage*. In particular, by creating costs for accepting a small share of the disputed good, public commitments can be used to increase the minimal share of the good that one needs to avoid war (i.e., increase one's "reservation value" for war), thus shrinking the size of the preferred-to-war bargaining range in one's favor and forcing the other side to offer a bigger share of the disputed good than it otherwise would.

Thus, one set of works shows that audience costs can be used to credibly signal resolve in incomplete-information crisis bargaining over an indivisible good, whereas another work shows that public commitments can be used to coercively generate bargaining leverage in complete-information crisis bargaining over a divisible good. In this paper, we examine the natural question of how the bargaining-leverage and signaling roles of public commitments *interact* with each other in a model that can accommodate *both* effects. In particular, we add incomplete information to Tarar and Leventoğlu's (2009) divisible-good model of public commitments. Because the disputed good is divisible, public commitments have a potential bargaining-leverage role, and because there is private information about resolve, they have a potential signaling role.

We show that in this setting, the bargaining-leverage role predominates and prevents public commitments from credibly signaling information in a way that reduces the probability of war or that allows negotiated settlements to be reached that otherwise would not, which is the very purpose of credible signaling.[7] In particular, we consider a "risk-return tradeoff"

[7]As noted earlier, previous work on audience costs shows that the use of audience costs to signal resolve can paradoxically *increase* the probability of war (through the "lock-in" effect). However, this literature also suggests that the information-revealing role of audience costs can at least allow some negotiated settlements to be reached that otherwise would not (and hence there is some point in generating audience costs to signal resolve). Our results suggest that in a divisible-good setting, not only can audience costs not signal information in a way that reduces the probability of war (which is not terribly inconsistent with previous

scenario (Powell 1999) in which an uninformed satisfied state makes an initial offer to a dissatisfied state that has private information about its resolve for war, which is either high or low. If the satisfied state's initial belief puts sufficient weight on the dissatisfied state being the low-resolve type, then the satisfied state makes a low initial offer, which only the low-resolve type accepts. The high-resolve type rejects it and goes to war instead. In this risk-return tradeoff scenario, in which there is a positive probability of war and in which Fearon (1995) shows that costless messages have no effect in equilibrium, we allow the dissatisfied leader to make an endogenously-chosen public commitment (that it would be costly to back down from) once it realizes its type, and just before the satisfied state makes its initial offer.

We show that there exist separating equilibria in which the two types make different commitment levels and in which public commitments therefore allow for credible information transmission (unlike costless messages), but in all of these equilibria, to separate itself, the highly-resolved type has to publicly commit to so much that the preferred-to-war bargaining range is eliminated (i.e., the minimal amount that the highly-resolved type now needs to avoid war exceeds the maximum offer that the satisfied state is willing to make), and hence war occurs anyway (when the dissatisfied state is the highly-resolved type), although now it is under complete information. If the highly-resolved type does *not* commit to so high an amount that the preferred-to-war bargaining range is eliminated, then the low-resolve type has an incentive to mimic the high-resolve type's commitment in order to get a large offer. In a divisible-good setting in which public commitments can generate bargaining leverage, the incentive to bluff that is well-known for costless messages (e.g., Fearon 1995) kicks in and forces the high-resolve type to commit to an extreme amount if it wants to separate itself, and hence war occurs anyway.

We then show that under certain conditions there *do* exist equilibria in which the use of

results), but also not in a way that allows agreements to be reached that otherwise would not. That is, our results suggest that in a divisible-good setting, audience costs have no beneficial information-revealing role *at all*.

public commitments causes the probability of war to go down and causes negotiated settlements to be reached that otherwise would not, but this is not because of credible information transmission. Instead, if the two types pool on a *moderate* public commitment that lies between the two types' payoffs (reservation values) for war, this causes the "small" offer that the satisfied state might make (if she is sufficiently confident that she faces the low-resolve type) to increase (because the public commitment exceeds the low-resolve type's payoff for war, and hence she cannot just offer this payoff as the small offer; she has to compromise above what she would normally offer), but the "large" offer (if she is confident that she faces the high-resolve type) remains the same as before (because the public commitment is less than the high-resolve type's payoff for war, and hence she can continue to just offer this payoff as the large offer). This makes making the "small" offer relatively less tempting (because it is no longer much smaller than the "large" offer), and this has the effect of lowering the belief-threshold (that she faces the high-resolve type) above which she chooses to make the large offer. This can lead to her prior belief (which does not change, as the commitment levels are pooling) to now exceed the new threshold (and hence she makes the large offer and avoids war with certainty), in a situation where her prior belief is *below* the threshold *without* the public commitment tactic (and hence she makes the small offer and accepts a positive probability of war). Therefore, when public commitments lower the probability of war and cause agreements to be reached that otherwise would not, it is not because of an information-revealing effect (in fact, these equilibria are pooling), but because of the coercive (bargaining-leverage) effect of a moderate public commitment that forces the satisfied state to make a bigger offer to the less-resolved type (and *only* to the less-resolved type), which makes it more willing to make the large offer that satisfies *all* types.

Overall, then, the results suggest that the public commitment tactic is a tool of coercion and of *generating* resolve, and not a tool of *revealing pre-existing* resolve (unless the disputed good is for some reason considered to be indivisible, in which case the results of earlier models might apply). To the extent that this tactic is more available to democratic than autocratic leaders, the results suggest that democratic leaders may be better able to coerce their opponents into making concessions, but are not better able to signal private information (at least in a way that actually has a beneficial effect such as reducing the probability of war or allowing agreements to be reached that otherwise would not). Thus, it is not clear that audience costs provide a signaling explanation for the democratic peace.[8]

This analysis also has potential implications for the other credible signaling mechanisms that have been analyzed in the international relations literature. The basic idea behind our analysis is that the earlier audience cost literature, by using indivisible-good models which suppress the bargaining-leverage role of public commitments, have overstated the signaling value of audience costs. In a divisible-good setting, we show that the incentive to bluff kicks in and prevents public commitments from signaling information in a way that reduces the probability of war or that allows negotiated settlements to be reached that otherwise would not. As discussed earlier, the works in international relations that examine other credible signaling mechanisms (besides audience costs) also generally use indivisible-good models. The same logic that holds for public commitments in a divisible-good setting may (or may not) hold for those other signaling mechanisms, and examining this rigorously is a promising area for future research.

The rest of the paper is organized as follows. In the next section, we first describe the baseline crisis bargaining model that we use, and then supplement the model by allowing the dissatisfied leader to make a public commitment before the crisis bargaining begins, a commitment that it would be costly to back down from. Next, we present the complete-information results, and then the incomplete-information results. Finally, we offer some concluding remarks and briefly illustrate the results in the context of the 1962 Cuban Missile Crisis and the 1898 Fashoda Crisis.

[8]Schultz (1998) provides an alternative explanation, focusing on domestic opposition groups, for why democratic leaders may be better able to signal private information.

2 The Model

2.1 The Baseline Crisis Bargaining Model

To model how public commitments can be used to influence crisis bargaining over a divisible good, we use the bargaining approach to war used by many formal models of crisis bargaining. Figure 1, drawn from Fearon (1995) and Powell (1996a, 1996b, 1999), graphically illustrates this approach. Two countries (labeled D, henceforth a "he," and S, henceforth a "she") are involved in a dispute over a divisible good (e.g., territory) whose value to both sides is normalized to 1. The two sides can either peacefully reach an agreement on a division of the good, or they can go to war, in which case the side that wins obtains the entire good and the side that loses receives none of it. Moreover, war is costly, with side D and S's cost of war being $c_D, c_S > 0$, respectively. Assume that if war occurs, side D wins with probability $1 > p > 0$ and side S wins with probability $1 - p$ (thus, p measures the extent to which the military balance favors D). Then, country D's expected utility from war is $EU_D(war) = (p)(1) + (1-p)(0) - c_D = p - c_D$. Similarly, country S's expected utility from war is $EU_S(war) = (p)(0) + (1-p)(1) - c_S = 1 - p - c_S = 1 - (p + c_S)$. Thus, as seen in Figure 1, the costliness of war opens up a bargaining range of agreements $[p - c_D, p + c_S]$ such that for all agreements in this range, both sides prefer the agreement to war (and both sides *strictly* prefer any agreement in the interior of this range).[9]

There is some status quo division of the disputed good, $(q, 1-q)$, where $1 \geq q \geq 0$ is D's share and $1 - q$ is S's share. Powell (1999) calls a state "satisfied" if the current (i.e., status quo) division of the good provides it with at least as much utility as going to war. In contrast, a state is "dissatisfied" if it strictly prefers to go to war rather than live with the status quo. Thus, D is satisfied if $q \geq p - c_D$ and dissatisfied if $q < p - c_D$ (this is the case shown in Figure 1). S is satisfied if $1 - q \geq 1 - p - c_S$, or $q \leq p + c_S$. S is dissatisfied if

[9] As Powell (2002) points out, the interpretation that the war is total and the victorious side wins everything while the losing side gains nothing is not necessary for this argument. Simply interpret p to be the expected division of the good resulting from war.

$q > p + c_S$. Both sides are satisfied if $p + c_S \geq q \geq p - c_D$ (i.e., if the status quo lies within the preferred-to-war bargaining range). Only D is dissatisfied if $q < p - c_D$, and only S is dissatisfied if $q > p + c_S$. If the two sides agree on the probability that each prevails in war, then at most one state can be dissatisfied.

Now suppose that one side, say D, is dissatisfied (i.e., $q < p - c_D$), and hence the status quo has to be revised in its favor if war is to be avoided. To determine the new agreement (if any) that will be reached, we use the crisis bargaining model of Leventoğlu and Tarar (2008), which is shown graphically in Figure 2 (the figure shows only three periods of the model, but this is actually an infinite-horizon model).[10] The two sides take turns making offers and counteroffers (the figure shows D making the first offer, but this is not necessary) until an agreement is reached or one side opts for war. In general, if an agreement is reached on some division of the good $(z, 1-z)$ in period t ($t = 0, 1, 2, \ldots$), where z is D's share and $1-z$ is S's share, then D's payoff is $\sum_{i=0}^{t-1} \delta^i q + \sum_{i=t}^{\infty} \delta^i z$ and S's payoff is $\sum_{i=0}^{t-1} \delta^i (1-q) + \sum_{i=t}^{\infty} \delta^i (1-z)$ (recall that $(q, 1-q)$ is the status quo division of the good, from which the players get utility until an agreement is reached or war occurs), where $0 < \delta < 1$ is the common discount factor. If they go to war in some period t ($t = 0, 1, 2, \ldots$), then D's payoff is $\sum_{i=0}^{t-1} \delta^i q + \sum_{i=t}^{\infty} \delta^i (p - c_D)$ and S's payoff is $\sum_{i=0}^{t-1} \delta^i (1-q) + \sum_{i=t}^{\infty} \delta^i (1 - p - c_S)$.

Figure 3 shows the equilibrium proposals (which are accepted; hence war is avoided) that D and S make for D, x^* and y^*, respectively, as a function of the discount factor δ, when D is dissatisfied. When the discount factor is low, then each side just offers the other its utility from war (i.e., D proposes $x^* = p + c_S$ for himself, and S proposes $y^* = p - c_D$ for D). Thus, whoever gets to make the first proposal gets all of the gains from avoiding war (i.e., gets its most preferred outcome within the preferred-to-war bargaining range). When the discount factor gets in the medium range, then S starts compromising when making a proposal, i.e.,

[10] This model modifies the one in Powell (1996a, 1996b, 1999). As Leventoğlu and Tarar (2008) point out, Powell's model gives an odd result that in equilibrium, the dissatisfied state D proposes for itself an agreement that is worse than its utility from war. However, this does not make much substantive sense, because D would rather go to war instead. The modified model allows states to go to war in any period, and as a result, all agreements that are reached in equilibrium lie within the preferred-to-war bargaining range, which makes more substantive sense. More details are given in Leventoğlu and Tarar (2008).

her proposal y^* for D starts increasing. When the discount factor becomes high, then both sides' proposals for D start decreasing.[11]

2.2 Allowing for Public Commitments

In this paper, we want to investigate the impact that public commitments have on crisis bargaining over a divisible good, when the leader can endogenously choose how much (if any) of the disputed good to publicly commit to obtaining. Therefore, we suppose that before the baseline crisis bargaining game (described above) begins, the dissatisfied leader D can publicly commit to obtaining a certain amount of the disputed good.[12] That is, D publicly commits to some $\tau_D \in [0, 1]$ before the crisis bargaining subgame begins, where τ_D is endogenously chosen ($\tau_D = 0$ amounts to making no commitment at all, whereas $\tau_D = 1$ amounts to committing to obtaining the *entire* good; anything in between is also allowed). In any period in which country D's share of the pie (say, z) for that period is at least τ_D, then leader D's personal payoff for that period is simply z. However, in any period in which country D's share of the pie for that period is strictly less than τ_D (i.e., $z < \tau_D$), then leader D's personal payoff for that period is $z - a_D(\tau_D - z)$ rather than z, where $a_D > 0$ is leader D's "audience cost coefficient," which measures the extent to which violating a public commitment by a given amount is costly.[13] The bigger the deficit between leader D's public commitment and what he actually obtains (i.e., the bigger the difference $\tau_D - z$ is), the bigger the audience cost that he pays (e.g., perhaps he is less likely to be reelected). Moreover, the

[11] Leventoğlu and Tarar (2008) provide a detailed analysis of this model under complete and incomplete information, as well as the intuition behind the trend just described. As is shown there, when δ is high, there is a broad range of agreements that can be supported in non-stationary SPE, and Figure 3 just shows the stationary SPE proposals.

[12] Tarar and Leventoğlu (2009) analyze the complete-information results when (a) only D can make a public commitment, (b) only S can make a public commitment, and (c) both sides can make public commitments (either simultaneously or sequentially). In this paper, we are primarily interested in the incomplete-information results, and hence we just present the simplest complete-information results (namely, when only D can make a public commitment) that are needed to get to the incomplete-information results. More details are given later.

[13] This is the same cost structure used by Leventoğlu and Tarar (2005) and Muthoo (1999) to investigate how public commitments can affect *non-crisis* bargaining over a divisible good, i.e., bargaining where there is no outside option of war.

bigger the audience cost coefficient a_D, the more costly it is to violate a public commitment by a given amount. Under Fearon's (1994) hypothesis that democratic leaders usually pay greater audience costs than autocratic leaders, we would expect democratic leaders to have higher values of a_D than autocratic leaders, on average. Note that in this model, and in contrast to most previous formal models of audience costs, the magnitude of the audience cost (if any) is determined endogenously, by the amount that the leader publicly commits to as well as the amount that he ends up accepting in the bargaining subgame (both of which are endogenous). The only part of the audience cost that is exogenous is a_D.

We assume that the audience cost applies to the status quo payoff and any agreement reached, but not to the war payoff. That is, if a leader publicly commits to more than his war payoff but war occurs, the leader does not pay an audience cost in that case, since he is not backing down from a public commitment by accepting an agreement that is less than what he committed to.

3 Complete-Information Results

Tarar and Leventoğlu (2009) present the complete-information results for this model when both sides have a positive probability of making the first proposal and (a) only D can make a public commitment, (b) only S can make a public commitment, and (c) both sides can make public commitments (either simultaneously or sequentially). In this paper, we are interested in the impact of the public commitment tactic on *incomplete-information* crisis bargaining over a divisible good, particularly in the risk-return tradeoff scenario (with a positive probability of war) where an uninformed satisfied leader makes the first offer to a dissatisfied leader with private information about its payoff (resolve) for war.

In order to develop an intuition for the incomplete-information results, we therefore begin by briefly presenting the complete-information results for the scenario where S makes the first offer (with certainty) and only D can make a public commitment. Recall from Figure 3 that in the baseline crisis bargaining model (without public commitments), when the discount factor δ is relatively low, then whoever gets to make the first proposal gets all of the gains from avoiding war, i.e., D proposes $x^* = p + c_S$ for himself, and S proposes $y^* = p - c_D$ for D. Therefore, if S gets to make the first proposal with certainty, then agreement is reached immediately on $y^* = p - c_D$.

Now suppose that D can make a public commitment $\tau_D \in [0, 1]$ before S makes her initial offer. Figure 4 shows the "partial equilibrium" results, i.e., it shows leader D's share of the pie and personal payoff (share of the pie minus any audience cost paid) in the SPE of the bargaining *subgame*, as a function of D's public commitment $\tau_D \in [0, 1]$ (which is taken as *given* in the partial equilibrium analysis; later, we will consider what comprises equilibrium commitment levels of the *entire* game). When D commits to no more than his utility from war ($\tau_D \leq p - c_D$), the commitment has no effect on the bargaining subgame, because the normal proposal that S makes, $y^* = p - c_D$, satisfies D's (low) public commitment, and hence it is as if no commitment at all was made. Therefore, leader D's share of the pie and personal payoff remain at $p - c_D$.

When D starts committing to more than his utility from war, $\tau_D > p - c_D$, then D starts paying an audience cost in S's usual proposal $y^* = p - c_D$, and hence leader D's personal payoff for accepting this proposal is less than his utility from war. Therefore, S has to start compromising when making a proposal if she wants to avoid war (which she does, until D's commitment becomes too high), i.e., y^* starts increasing. Thus, D's share of the pie (which is simply y^*) starts increasing in τ_D — the more he commits to, the more S has to compromise when making a proposal, in order to avoid war.

An interesting thing to note in this range is that, although country D's share of the pie is increasing, leader D's personal payoff is not. The reason is that S compromises in just such a minimal way so as to leave leader D indifferent between accepting that agreement (with audience costs) and going to war. That is, suppose D commits to some τ_D a little larger than $p - c_D$. If S actually proposes $y^* = \tau_D$, i.e., the amount that D actually committed to, then leader D's personal payoff for accepting this agreement is τ_D, which is greater than his war payoff $(p - c_D)$ by a discrete amount. However, all S needs to offer D in order to avoid war is an agreement that, with audience costs, gives leader D a personal utility of just $p - c_D$ (his utility from war). Thus, instead of proposing $y^* = \tau_D$, S proposes $\tau_D > y^* = \frac{p-c_D+a_D\tau_D}{1+a_D} > p - c_D$, where y^* is the agreement such that leader D's personal utility for accepting this agreement (with audience costs) is just $p - c_D$. That is, S compromises, but in just such a minimal way so as to leave leader D with no personal gains. Thus, although his share of the pie is increasing, his personal payoff is not.

Note that the effect of the public commitment is essentially to reduce the size of the preferred-to-war bargaining range in D's favor from $[p - c_D, p + c_S]$ to $[y^*, p + c_S]$. That is, the public commitment increases the minimal amount that D needs to avoid war (thus increasing his "reservation value"), and in a sense thus increases his resolve for war (but without actually increasing his *payoff* from war).

When D's commitment reaches a threshold that we denote by $\tau_{D_{war}}$ (the "war threshold", and which is about 0.95 in Figure 4), then D is committing to so much that the preferred-to-war bargaining range has shrunk to the point $p + c_S$. If D commits to any more than this, then the range disappears entirely and S would rather allow war to occur than satisfy D's minimal demand (i.e., for τ_D higher than $\tau_{D_{war}}$, the minimal amount that D needs to avoid war is greater than $p + c_S$, which is as far as S is willing to compromise to avoid war). Thus, such an extreme public commitment by D leads to war in the bargaining subgame.[14]

This completes the description of the "partial equilibrium" results. We are now in a position to determine what comprises subgame-perfect equilibria (SPE) of the *entire* game, i.e., including the commitment stage. As seen from Figure 4, any commitment level from 0 to 1 is a SPE commitment level. Each of these commitment levels gives leader D the same personal utility, and hence these are all SPE commitment levels.

The model has multiple SPE, in which leader D commits to anything from 0 to 1. This is because, as seen in Figure 4, the leader's personal payoff is the same for all of these

[14] In the appendix, we show that $\tau_{D_{war}} = \frac{(p+c_S)(1+a_D)-p+c_D}{a_D}$.

commitment levels. However, as can also be seen in the figure, the country's share of the pie, which can be thought of as the payoff of the citizens, is *not* the same for all of these commitment levels: it is maximized at $\tau_D = \tau_{D_{war}}$. This suggests a natural equilibrium selection criterion. If the leader is indifferent (in personal utility terms) among a variety of commitment levels, a reasonable argument can be made that he will choose the one that makes his citizens the happiest. To capture this idea, we introduce a refinement that we call a "pie-maximizing" SPE, which is defined as a SPE in which, given the other side's strategy, among all of his best responses (i.e., those that maximize his personal payoff), the leader chooses the one that maximizes his country's share of the pie. Although the model has a continuum of SPE, it has a *unique* pie-maximizing SPE, in which leader D commits to $\tau_D = \tau_{D_{war}}$. Any SPE that is not pie-maximizing is weakly unstable in the sense that the leader can increase his country's share of the pie without decreasing his personal payoff by choosing a different commitment level, and hence the leader has at least a weak incentive to adopt such a deviation. Note that this refinement has no bearing for the incomplete-information results; we merely introduce it as a plausible equilibrium selection criterion for the complete-information results.

4 Incomplete-Information Results

The results thus show that in complete-information crisis bargaining over a divisible good, endogenously-chosen public commitments can be used to generate bargaining leverage by forcing the other side to make more concessions than it otherwise would. Fearon (1994) shows that in incomplete-information crisis bargaining over an indivisible good, audience costs allow leaders to *credibly* reveal their private information (as opposed to costless messages), and suggests that audience costs may thus provide an explanation for the democratic peace. We now want to examine how the bargaining leverage role of public commitments interacts with their signaling role. For this, we need a model in which the disputed good is divisible (so that the bargaining leverage role can potentially emerge), and there is incomplete information (so that the signaling role can potentially emerge). Therefore, we simply add incomplete information to the previous analysis.

We consider a case of one-sided uncertainty, in which S is uncertain about D's cost of war c_D (this means that S is uncertain about D's payoff for war, or resolve). We assume that D's cost of war takes on one of two possible values, i.e., there are two possible types of D. S believes that D's cost is c_{D_l} with probability $1 > s > 0$ and c_{D_h} with probability $1 - s$, with $c_{D_l} < c_{D_h}$, i.e., c_{D_l} is the more resolved (low-cost) type, because its expected utility from war is higher (see Figure 5). We assume that both types of D are dissatisfied, i.e., assume that $q < p - c_{D_h}$.

First suppose that public commitments are not allowed. That is, we are back in the baseline crisis bargaining model, but in the first move of the game, "nature" chooses D's type (with the above probabilities), a move that D observes but S does not, and then S makes its initial offer. The following proposition describes a "risk-return tradeoff" equilibrium in which war occurs if S's initial belief causes her to make a small initial offer, and D ends up being the high-resolve type (the risk-return tradeoff is the mechanism by which war typically occurs in incomplete-information crisis bargaining models; for an extensive discussion, see Leventoğlu and Tarar 2008).[15]

Proposition 1 *If $\delta_D \leq \frac{(p-c_{D_h})-q}{(p+c_S)-q}$, there is a perfect Bayesian equilibrium (PBE) in which, in the first period, type c_{D_l} accepts all offers $(y, 1-y)$ such that $y \geq p - c_{D_l}$ and goes to war for any lower offer, and type c_{D_h} accepts all offers $(y, 1-y)$ such that $y \geq p - c_{D_h}$ and goes to war for any lower offer. If $s \geq s^*$, where $s^* = \frac{c_{D_h} - c_{D_l}}{c_{D_h} + c_S}$, then S makes the large initial offer $y^* = p - c_{D_l}$, which both types accept, and war is avoided. If $s \leq s^*$, then S makes the small initial offer $y^* = p - c_{D_h}$, which only type c_{D_h} accepts. Type c_{D_l} rejects it and goes to war instead. If the second period is reached in this equilibrium (this is off-the-equilibrium-path behavior), agreement would be reached on $x^* = p + c_S$.*

In this equilibrium, if $s \leq s^*$, i.e., S is sufficiently confident that she faces the low-resolve

[15] The following is Proposition 5 in Leventoğlu and Tarar (2008).

type, then S makes a small offer and war occurs if D ends up being the high-resolve (low-cost) type. Hence, if $s \leq s^*$, then the ex ante equilibrium probability of war is s, which is simply the probability that D ends up being the high-resolve type.

In this risk-return setting, Fearon (1995) shows that if D can send a costless ("cheap talk") message upon realizing its type, then in any PBE, S does not condition its offer on the message received (i.e., the message is essentially ignored), and the ex ante probability of war is the same as in the model without messages (namely, s). Because of the incentive to bluff to get a better deal, costless messages do not allow for credible information transmission.[16] However, in an indivisible-good model, Fearon (1994) shows that audience costs can allow for credible information transmission. We want to examine whether this is also true in a divisible-good setting in which public commitments have a bargaining leverage role as well.

More particularly, there are three questions that we are interested in. First, do public commitments allow for credible information transmission? Second, if public commitments *do* allow for credible information transmission, does the probability of war go down (relative to the model without public commitments)? Finally, even if the probability of war does not go down, does the information-revealing role of public commitments at least allow some agreements to be reached that otherwise would not (in which case the information-revealing role of audience costs would be at least somewhat worthwhile, as the existing literature suggests)?

To answer these questions, we suppose that, once D realizes its type, it can choose any public commitment from 0 to 1. S gets to observe this commitment, and then makes its offer.

[16] The foundational work on cheap talk is Crawford and Sobel (1982), and for an important application to bargaining, see Farrell and Gibbons (1989).

4.1 Separating Equilibria

A major question of interest is, do there exist separating equilibria, i.e., equilibria in which type c_{D_l} commits to some τ_{D_l}, and type c_{D_h} commits to some τ_{D_h}, and $\tau_{D_l} \neq \tau_{D_h}$.[17] In a separating equilibrium, perfect information transmission is achieved. Therefore, if there exists such an equilibrium, S knows exactly which type it is facing upon the commitment being made, and therefore plays the complete information game (whose results we know from above) with that type.

Suppose that there exists a separating equilibrium in which type c_{D_l} commits to some $\tau_{D_l} \leq p - c_{D_l}$ (Figure 5 is useful in following this argument). Upon observing this commitment, S (knowing that it faces type c_{D_l}) proposes $p - c_{D_l}$. Regardless of what type c_{D_h} is committing to, his personal payoff is $p - c_{D_h}$ (either because S makes an acceptable offer, if $\tau_{D_h} \leq \tau_{D_{war}}(c_{D_h})$, or because war occurs, if $\tau_{D_h} > \tau_{D_{war}}(c_{D_h})$).[18] Thus, type c_{D_h} can profitably deviate by committing to τ_{D_l}, and hence such a separating equilibrium cannot exist.

Now suppose that there exists a separating equilibrium in which type c_{D_l} commits to some $\tau_{D_{war}}(c_{D_l}) \geq \tau_{D_l} > p - c_{D_l}$ (note that this implies that $\tau_{D_{war}}(c_{D_h}) > \tau_{D_l}$). Upon observing this commitment, S (knowing that it faces type c_{D_l}) proposes $y^*(c_{D_l}) = \frac{p - c_{D_l} + a_D \tau_{D_l}}{1 + a_D}$ ($\in (p - c_{D_l}, p + c_S]$), which is the compromise agreement that leaves leader D's (either type) personal payoff for accepting it to be $p - c_{D_l}$. As before, regardless of what c_{D_h} is committing to, his personal payoff is $p - c_{D_h}$ (either because S makes an acceptable offer, if $\tau_{D_h} \leq \tau_{D_{war}}(c_{D_h})$, or because war occurs, if $\tau_{D_h} > \tau_{D_{war}}(c_{D_h})$). Thus, c_{D_h} can profitably deviate by committing to τ_{D_l} (in which case his personal payoff is $p - c_{D_l}$), and hence such a separating equilibrium cannot exist.

[17] Below, we discuss the case of mixed strategies, where the players can probabilistically choose among commitment levels.

[18] Note that $\tau_{D_{war}}(c_{D_h})$ denotes type c_{D_h}'s war threshold (as defined in the complete-information results, i.e., it is the commitment threshold above which the preferred-to-war bargaining range is eliminated), and $\tau_{D_{war}}(c_{D_l})$ denotes type c_{D_l}'s war threshold. Also note that $\tau_{D_{war}} = \frac{(p+c_S)(1+a_D) - p + c_D}{a_D}$ is increasing in c_D, and hence $\tau_{D_{war}}(c_{D_h}) > \tau_{D_{war}}(c_{D_l})$.

We have thus established that there exists no separating equilibrium in which $\tau_{D_l} \leq \tau_{D_{war}}(c_{D_l})$.[19] The only remaining possibility for a separating equilibrium is one in which $\tau_{D_l} > \tau_{D_{war}}(c_{D_l})$ (and in the appendix we show that it is indeed possible to construct a PBE like this). However, note that in any separating equilibrium like this, type c_{D_l} is committing to more than his war threshold, and hence war occurs if D ends up being type c_{D_l} (just like in the risk-return tradeoff equilibrium in the model without public commitments). Thus, although there exist separating equilibria in which public commitments allow for credible information transmission (unlike with costless messages), in all of these equilibria, (i) *the probability of war is at least* s (depending on whether or not type c_{D_h} is choosing a commitment level that exceeds its war threshold; either case is possible, as shown in the appendix), which is the same as in the model without public commitments, and (ii) *no agreements are reached that otherwise would not be reached* (more particularly, with or without the public commitment option, war occurs if D ends up being type c_{D_l}).

Thus, in a divisible-good bargaining setting, our results suggest that public commitments have no useful information-revealing role at all. Previous work has suggested that although audience costs may have the paradoxical effect of causing the probability of war to increase (through the "lock-in" effect; e.g., Fearon 1997), they at least allow (though information-transmission) some agreements to be reached that otherwise would not, and hence they can serve a useful signaling purpose (and may even help explain the democratic peace). Our results show that in a divisible-good bargaining setting, to separate itself, the high-resolve type has to commit to so much that the bargaining range is eliminated and hence war occurs anyway, although now it is under complete information (since perfect information transmission has been achieved). In a divisible-good setting, the incentive of the low-resolve

[19]A similar argument establishes that, more generally, there exists no fully separating equilibrium (in pure or mixed strategies) in which the support of type c_{D_l}'s mixed strategy contains some element $\tau_{D_l} \leq \tau_{D_{war}}(c_{D_l})$. Upon observing this element, S (knowing that it faces type c_{D_l}) makes an offer that leaves D's personal payoff for accepting it to be $p - c_{D_l}$, whereas type c_{D_h}'s personal payoff for any commitment that it makes is $p - c_{D_h}$ (recall that this hypothetical equilibrium is a separating one), and hence c_{D_h} can profitably deviate by committing to τ_{D_l} instead. This establishes that, if there exists a fully separating equilibrium, it must be such that every commitment level that c_{D_l} chooses with positive probability has to strictly exceed $\tau_{D_{war}}(c_{D_l})$.

type to bluff to get a better deal and that is well-known for costless messages (e.g., Fearon 1995), kicks in and causes the high-resolve type to have to make an extreme commitment to separate itself, and hence war occurs anyway. If the high-resolve type makes a limited commitment that does *not* eliminate the bargaining range, then the low-resolve type has an incentive to make the same commitment in order to get a big offer. The bargaining-leverage role of public commitments mitigates their signaling role to the extent of making the latter role useless for achieving any worthwhile purpose (either reducing the probability of war or allowing agreements to be reached that otherwise would not). The results thus suggest that public commitments are primarily a tool of coercion and bargaining-leverage, rather than a tool of information-revelation.

4.2 Pooling and Semi-Separating Equilibria

We now show that under certain circumstances there *do* exist equilibria in which the use of public commitments causes the probability of war to drop from s to 0 and which allows agreements to be reached which otherwise would not (in particular with the high-resolve type), but this is not because of information transmission. Instead, moderate public commitments lower the threshold for S's belief (that D is the high-resolve type) above which S chooses to make the big offer (that all types accept), and this can have the effect of making S more likely to make the big offer, thereby eliminating the chance of war and allowing an agreement to be reached even with the high-resolve type.

Recall that in the risk-return tradeoff equilibrium in the model without public commitments, S chooses to make the big offer of $p - c_{D_l}$ (which both types accept) if $s \geq s^* = \frac{c_{D_h} - c_{D_l}}{c_{D_h} + c_S}$, where s is the prior probability that D is the high-resolve type. How is this threshold s^* determined? If S makes the big offer of $p - c_{D_l}$, it is accepted for sure, and hence S's payoff is $1 - (p - c_{D_l})$. If she makes the small offer of $p - c_{D_h}$ instead, only the low-resolve type accepts it; the high-resolve type rejects it and goes to war, and hence S's expected payoff for making the small offer is $s(1 - p - c_S) + (1 - s)(1 - (p - c_{D_h}))$. Therefore, the threshold s^*

is determined by solving the inequality $1 - (p - c_{D_l}) \geq s(1 - p - c_S) + (1 - s)(1 - (p - c_{D_h}))$ for s. In particular, it is determined by the payoff that S gets if the small offer is accepted, relative to what S gets by making the big offer. The bigger the relative gain from making the small offer (if it is accepted) over making the large offer, the more willing S is to make the small offer, i.e., the threshold $s_{critical}$ (above which S prefers to make the big offer) becomes larger. In contrast, if the relative gain for making the small offer becomes smaller, then the threshold $s_{critical}$ decreases.

Now suppose that both types of D make the same commitment level τ_D, where $p - c_{D_h} < \tau_D \leq p - c_{D_l}$. Now what are S's possible best responses? If she is sufficiently confident that she faces the high-resolve type (note that her posterior belief remains at her prior s, because the two types of D are pooling on their commitment levels), then she optimally offers $p - c_{D_l}$ (which both types accept). On the other hand, if she is confident that she faces the low-resolve type, then she optimally offers $y^*(c_{D_h}) = \frac{p - c_{D_h} + a_D \tau_D}{1 + a_D}$, which is greater than $p - c_{D_h}$ (and less than $p - c_{D_l}$), but which leaves D's personal payoff for accepting it to be just $p - c_{D_h}$. Because the "low offer" has become larger, i.e., $y^*(c_{D_h}) > p - c_{D_h}$, whereas the large offer stays the same (because of the *moderate* public commitment, which causes her to just have to compromise with the low-resolve type), the threshold $s_{critical}$ decreases, and S is now more willing to make the big offer than it was without the public commitment tactic.

More generally, Figure 6 (whose derivation is given in the appendix) shows how $s_{critical}$ varies as a function of τ_D (where both types of D pool on committing to τ_D), as τ_D ranges from 0 to $\tau_{D_{war}}(c_{D_l})$, which in Figure 6 is 0.75. (For any bigger τ_D, $s_{critical}$ is undefined, because S never prefers to make the big offer that satisfies all types; this is established in the appendix.) Because $s_{critical}$ drops below the no-commitment level (s^*) for an intermediate range of commitment levels, this allows the existence of pooling equilibria (for certain values of the prior s) in which the probability of war drops from s to 0. For example, for s a little smaller than s^*, the probability of war in the no-commitment model is s (because S makes the small offer). However, suppose both types of D choose a pooling commitment level in the intermediate range, such that $s_{critical}$ for that commitment level is less than s (an example from Figure 6 would be if $s = 0.3$ and $\tau_D = 0.3$, at which $s_{critical} \approx 0.17$). S's belief remains at s (since this is a pooling equilibrium in which both types of D choose the same commitment level), which now exceeds the critical threshold for making the big offer, and so now S makes the big offer and war is avoided with certainty.[20]

However, in this pooling equilibrium, war is avoided not because information has been credibly conveyed. Instead, because a moderate public commitment raises the small offer relative to the big offer, the big offer becomes less unattractive in relative terms, and hence the belief-threshold for making the big offer drops, and hence S's belief (which has not changed) can now exceed the new threshold, and hence the big offer is made. Note that in a sense, this can be thought of as an extension of the coercive (bargaining leverage) role of public commitments to the incomplete information setting — by making a moderate commitment, this forces S to compromise with the low-resolve type, thus lowering the threshold for making the big offer, thus causing S to make the big offer. A coercive aspect of public commitments can reduce the probability of war and allow agreements to be reached that otherwise would not, not an information-revealing aspect.[21]

Also note that we can construct semi-separating equilibria as well, in which the probability of war goes from s to 0. For example, in the pooling equilibrium described above, specify that the high-resolve type makes an alternative commitment level (some $\tau_D' \leq \tau_{D_{war}}(c_{D_l})$) with some very small probability $\epsilon > 0$. S's prior belief s will go down slightly upon the common (pooling) commitment level being observed, but will still (for ϵ small enough) exceed the threshold at that commitment level, and hence S will still make the big offer upon observing the common (pooling) commitment level. Thus, the low-resolve type will not

[20]We also have to specify that if S observes some commitment level other than the (pooling) equilibrium level, her off-the-equilibrium-path beliefs are such that she optimally makes a small enough offer to make it not-worthwhile for either type to deviate to that commitment level. We provide such beliefs (and the resulting offer that S makes) in the appendix.

[21]Note that if S's prior belief s is extremely low, i.e., if S is *very* confident that she faces the low-resolve type, then a war-reducing pooling equilibrium like this cannot exist. For example, for the parameter values of Figure 6, $s_{critical}$ reaches a minimum of about 0.17, and if s is below this, there cannot exist a war-reducing equilibrium like we have described.

have an incentive to deviate to τ'_D. Note that in this equilibrium, information is credibly conveyed if S observes the commitment level that only the high-resolve type makes (τ'_D) — however, this is not the reason the probability of war drops from s to 0. The only reason the low-resolve type does not have an incentive to deviate is because S is already making the big offer (upon observing the common commitment level), and this is because of the threshold-lowering effect. If the threshold was not being lowered, the low-resolve type would have an incentive to deviate to τ'_D (because S would make the small offer upon observing the pooling commitment level), and hence information could not be credibly conveyed in a way that actually reduces the probability of war or which allows agreements to be reached that otherwise would not (i.e., we would be back in the situation where the high-resolve type has to eliminate the bargaining range to separate itself). When public commitments lower the probability of war or allow agreements to be reached that otherwise would not, it is because of a coercive threshold-lowering effect of a moderate commitment, not because of credible information transmission.

5 Conclusion

How leaders can credibly signal their private information in international crises, thereby avoiding costly war, is a core topic in the study of international conflict. Game theory, with its ability to rigorously analyze the effects of informational asymmetries, has proven to be a very useful tool for examining this issue, and a large number of game-theoretic works examine how leaders can credibly signal their private information. However, these works generally use models in which the disputed good is indivisible, despite the fact that most issues over which states have disputes, e.g., territory, are in principle divisible. In this paper, we examine how one of the most prominent signaling mechanisms, namely public commitments, operate in a setting in which the disputed good is fully divisible. In this setting, we show that endogenously-chosen public commitments acquire a coercive (bargaining leverage) role that greatly mitigates their signaling role. In fact, in a divisible-good setting, public commitments cannot credibly convey information in a way that reduces the probability of war or that allows agreements to be reached that otherwise would not, which is the very purpose of credible signaling. Overall, our results suggest that public commitments are primarily a tool of coercion and of *generating* resolve, rather than *revealing pre-existing* resolve.

How can we empirically evaluate this theoretical claim? Although a systematic empirical test is beyond the scope of this paper, it does seem that in many international crises, when one side makes strong public statements about its intentions, the other side feels coerced rather than informed. For example, according to US attorney general Robert Kennedy's memoir of the 1962 Cuban Missile Crisis, during the course of internal administration deliberations, US president John Kennedy wondered what the Soviet reaction would be to a US attack on Cuba, including airstrikes and/or a US invasion. When Air Force Chief of Staff General Curtis LeMay responded that there would be no Soviet response, Kennedy was skeptical, stating that "They, no more than we, can let these things go by without doing something. They can't, *after all their statements*, permit us to take out their missiles, kill a lot of Russians, and then do nothing. If they don't take action in Cuba, they certainly will in Berlin" (Kennedy 1999, 28-9; emphasis added). This statement does not convey any sense that the Soviet posturing over Cuba *transmitted information* about pre-existing Soviet resolve — instead, the Soviet statements created a situation where they *had* to respond to a US attack on Cuba (or face significant domestic and/or international audience costs), *regardless of what their initial level of resolve was.* This forced the US to be more conciliatory in its policy choice (Kennedy opted for a blockade rather than airstrikes). In other words, Soviet public commitments seemed to *coerce* (perhaps unintentionally) the US rather than convey information. Robert Kennedy writes of the president: "What guided all his deliberations was an effort not to disgrace Khrushchev, not to humiliate the Soviet Union... This was why he was so reluctant to stop and search a Russian ship; this was why he was so opposed to attacking the missile sites. The Russians, he felt, would have to react militarily to such actions on our part. Thus the initial decision to impose a quarantine rather than to attack;

our decision to permit the *Bucharest* to pass; our decision to board a non-Russian vessel first; all these and many more were taken with a view to putting pressure on the Soviet Union but not causing a public humiliation. . . During our crisis talks, he kept stressing the fact that we would indeed have war if we placed the Soviet Union in a position she believed would adversely affect her national security or cause such public humiliation that she lost the respect of her own people and countries around the globe. . . 'I am not going to push the Russians an inch beyond what is necessary' " (Kennedy 1999, 95-8).

Similarly, in the 1898 Fashoda Crisis between Britain and France, British leaders generated large (potential) audience costs by publicly releasing the dispatches between the two countries and belligerently stating in public that they would not compromise at all on the issue, and the only choice facing France was to entirely withdraw its troops from Fashoda or face war. The French ambassador in London, Baron de Courcel, stated to his superiors, "It seems that, with this haughty language, the English government will cut itself off from all retreat, and that it will be impossible for it to back down from demands made in such a manner. . . Lord Salisbury has entrenched himself in English public opinion thereby preventing his government from negotiating as long as French forces occupy Fashoda" (Schultz 2001, 41-2). Again, there is little to indicate information transmission here — instead, French leaders felt that they were being *coerced* by the British public statements into withdrawing their forces from Fashoda (which indeed they did). Although these cases are more suggestive than conclusive, they do at least indicate the plausibility of our argument that public commitments are primarily a tool of coercion rather than information-transmission.

Finally, this analysis suggests that the other credible signaling mechanisms that have been analyzed in the international relations literature should also be analyzed in a divisible-good setting, to see if their bargaining-leverage role mitigates their signaling efficacy. More work is needed to better understand the extremely important issue of how leaders can credibly signal their private information in international crises, thereby avoiding costly war.

6 Appendix

In many of the following proofs, we use the "one-stage-deviation principle," henceforth OSDP, for infinite horizon games with discounting of future payoffs (Fudenberg and Tirole 1991, 108-110). This principle states that, to verify that a profile of strategies comprises a SPE, one just has to verify that, given the other players' strategies, no player can improve her payoff at any history at which it is her turn to move by deviating from her equilibrium strategy at that history and then reverting to her equilibrium strategy afterwards.

6.1 No Public Commitment Allowed (The Baseline Crisis Bargaining Model, Complete Information)

The baseline crisis bargaining model is analyzed in detail in Leventoğlu and Tarar (2008). However, for the sake of completeness, we begin here by presenting the result when D is dissatisfied (i.e., $q < p - c_D$) and D's discount factor δ_D is relatively low (Proposition 1 of Leventoğlu and Tarar 2008), and then build on this result to see what happens when public commitments are allowed.

Proposition 2 *If* $\delta_D \leq \frac{(p-c_D)-q}{(p+c_S)-q}$, *then the following are SPE in the baseline crisis bargaining model:*
(a) D always proposes $(x^*, 1-x^*)$, *where* $x^* = p + c_S$. *He always accepts any offer* $(y, 1-y)$ *such that* $y \geq p - c_D$. *In any period in which he gets a lower offer than this, he fights (does not say no). In any period in which S rejects his offer, he fights rather than passes.*
(b) S always proposes $(y^*, 1-y^*)$, *where* $y^* = p - c_D$. *She always accepts any offer* $(x, 1-x)$ *such that* $x \leq p + c_S$. *In any period in which she gets a worse offer, she is indifferent between fighting and saying no (since in the latter case D fights anyway), and hence can be choosing either (or mixing). In any period in which D rejects her offer, she passes rather than fights.*

Proof: (i) Given S's acceptance rule, D's proposal of $x^* = p + c_S$ clearly satisfies the OSDP. (If D proposes some $x < x^*$, S accepts it, but D is worse off. If D proposes some $x > x^*$, S rejects it and war occurs, which is worse for D than x^*.)

(ii) If D says no to S's offer, S's decision to pass rather than fight satisfies the OSDP, because her payoff for fighting is $\frac{1-p-c_S}{1-\delta_S}$, and her payoff for passing (assuming she sticks to her equilibrium strategy) is $(1-q)+\frac{\delta_S(1-p-c_S)}{1-\delta_S}$, and the latter is strictly greater than the former.

(iii) Consider a period in which S makes an offer. If she makes a low offer and D chooses to fight, his payoff is $\frac{p-c_D}{1-\delta_D}$. If he chooses to say no instead, and then reverts to his equilibrium strategy, his payoff is $q+\frac{\delta_D(p+c_S)}{1-\delta_D}$. For the upper bound on δ_D in this proposition, the former payoff is greater than the latter one, and hence D cannot credibly reject any offer $(y, 1-y)$ such that $y \geq p-c_D$. Thus, D's acceptance rule satisfies the OSDP.

(iv) Given D's acceptance rule, S's proposal of $y^*=p-c_D$ clearly satisfies the OSDP.

(v) Suppose S has just said no to D's proposal. If D fights, his payoff is $\frac{p-c_D}{1-\delta_D}$, whereas if he passes and then reverts to his equilibrium strategy, his payoff is $q+\frac{\delta_D(p-c_D)}{1-\delta_D}$. The latter is strictly less than the former, and hence D's decision to fight rather than pass satisfies the OSDP.

(vi) Given that D is choosing to fight rather than pass if S says no to D's proposal, S cannot credibly be demanding more than her utility from war, and hence her acceptance rule satisfies the OSDP. Q.E.D.

6.2 D Can Make a Public Commitment (Complete Information)

We now present the "partial equilibrium" results, i.e., we present the SPE of the bargaining subgame when D makes a low, moderate, medium, large, or extreme public commitment. These results are also given in Tarar and Leventoğlu (2009), and we reproduce them here for the sake of completeness. For the case where S makes the first offer with certainty (Tarar and Leventoğlu 2009 discuss the results when both sides have a positive probability of making the first offer), these results are plotted in Figure 4, which allows us to determine the SPE of the *entire* game (i.e., including the commitment stage).

6.2.1 Low Public Commitment, $\tau_D \leq q$ $(< p-c_D)$

The above result still holds, and the exact same proof carries through, as no audience cost is paid in the SQ or in the agreements $y^*=p-c_D$ and $x^*=p+c_S$.

6.2.2 Moderate Public Commitment, $q < \tau_D \leq p - c_D$

Now D's SQ payoff becomes $q - a_D(\tau_D - q)$ rather than q, but no audience cost is paid in the agreement $y^* = p - c_D$ (or $x^* = p + c_S$), and so the above result still holds, but now the upper bound on δ_D is $\delta_D \leq \frac{a_D(\tau_D - q) + [(p - c_D) - q]}{a_D(\tau_D - q) + [(p + c_S) - q]}$ (note that this is a less restrictive upper bound on δ_D than is the usual (i.e., when public commitments are not allowed) condition that $\delta_D \leq \frac{(p - c_D) - q}{(p + c_S) - q}$).

Proof: (i) Given S's acceptance rule, D's proposal of $x^* = p + c_S$ clearly satisfies the OSDP.

(ii) If D says no to S's offer, S's decision to pass rather than fight satisfies the OSDP, because her payoff for fighting is $\frac{1 - p - c_S}{1 - \delta_S}$, and her payoff for passing (assuming she sticks to her equilibrium strategy) is $(1 - q) + \frac{\delta_S(1 - p - c_S)}{1 - \delta_S}$, and the latter is strictly greater than the former.

(iii) Consider a period in which S makes an offer. If she makes a low offer and D chooses to fight, his payoff is $\frac{p - c_D}{1 - \delta_D}$. If he chooses to say no instead, and then reverts to his equilibrium strategy, his payoff is $[q - a_D(\tau_D - q)] + \frac{\delta_D(p + c_S)}{1 - \delta_D}$. For $\delta_D \leq \frac{a_D(\tau_D - q) + [(p - c_D) - q]}{a_D(\tau_D - q) + [(p + c_S) - q]}$, which we have stipulated to hold, the former is greater than the latter, and hence D cannot credibly reject any offer $(y, 1 - y)$ such that $y \geq p - c_D$. Thus, D's acceptance rule satisfies the OSDP.

(iv) Given D's acceptance rule, S's proposal of $y^* = p - c_D$ clearly satisfies the OSDP.

(v) Suppose S has just said no to D's proposal. If D fights, his payoff is $\frac{p - c_D}{1 - \delta_D}$, whereas if he passes and then reverts to his equilibrium strategy, his payoff is $[q - a_D(\tau_D - q)] + \frac{\delta_D(p - c_D)}{1 - \delta_D}$. The latter is strictly less than the former, and hence D's decision to fight rather than pass satisfies the OSDP.

(vi) Given that D is choosing to fight rather than pass if S says no to D's proposal, S cannot credibly be demanding more than her utility from war, and hence her acceptance rule satisfies the OSDP. Q.E.D.

6.2.3 Medium/Large Public Commitment, $p - c_D < \tau_D \leq \frac{(p + c_S)(1 + a_D) - p + c_D}{a_D}$ $(> p + c_S)$

Now suppose that τ_D is large enough that D starts paying an audience cost in S's usual proposal $y^* = p - c_D$, so that D now prefers war over this agreement, and hence S has to start compromising in y^* in order to avoid war, but τ_D is not too large. (In particular, D's public commitment is small enough that S still prefers to compromise and appease D rather than let war break out. In the next section, we will show that when $\tau_D > \frac{(p+c_S)(1+a_D)-p+c_D}{a_D}$, war occurs. Hence, let us call this right-hand-side $\tau_{D_{war}} = \frac{(p+c_S)(1+a_D)-p+c_D}{a_D}$.)

It turns out that in this range for τ_D of $p - c_D < \tau_D \leq \tau_{D_{war}}$ there are actual two subranges to consider, when $p - c_D < \tau_D \leq p + c_S$ (so that no audience cost is paid in D's usual proposal $x^* = p + c_S$; we will call this a medium public commitment), and when $p + c_S < \tau_D \leq \tau_{D_{war}}$ (we will call this a large public commitment; D pays an audience cost in his usual proposal $x^* = p + c_S$).

Proposition 3 *If* $\delta_D \leq \frac{a_D(\tau_D-q)+[(p-c_D)-q]}{a_D(\tau_D-q)+[(p+c_S)-q]}$ *when* $p-c_D < \tau_D \leq p+c_S$ *or* $\delta_D \leq \frac{a_D(\tau_D-q)+[(p-c_D)-q]}{a_D[(p+c_S)-q]+[(p+c_S)-q]}$ *when* $\tau_{D_{war}} \geq \tau_D > p + c_S$*, then the following are SPE:*[22]
(a) D always proposes $(x^*, 1 - x^*)$*, where* $x^* = p + c_S$*. He always accepts any offer* $(y, 1 - y)$ *such that* $y \geq \frac{p-c_D+a_D\tau_D}{1+a_D}$ *(this is the audience-cost equivalent of demanding at least his payoff from war; this amount is bigger than* $p - c_D$*, but with audience costs makes his personal utility just* $p - c_D$*). In any period in which he gets a lower offer than this, he fights (does not say no). In any period in which S rejects his offer, he fights rather than passes.*
(b) S always proposes $(y^*, 1 - y^*)$*, where* $y^* = \frac{p-c_D+a_D\tau_D}{1+a_D}$*. She always accepts any offer* $(x, 1 - x)$ *such that* $x \leq p + c_S$*. In any period in which she gets a worse offer, she is indifferent between fighting and saying no (since in the latter case D fights anyway), and hence can be choosing either (or mixing). In any period in which D rejects her offer, she passes rather than fights.*

Proof: Below, in the main text we will consider the case where $p - c_D < \tau_D \leq p + c_S$, and in parentheses we will consider the case where $\tau_{D_{war}} \geq \tau_D > p + c_S$ (there are only two steps in the proof where this distinction matters, and hence where there is additional analysis in parentheses).

(i) Consider when S makes an offer. Suppose D finds it optimal to go to war if S's offer is too small, rather than say no. Then D cannot credibly reject any offer that gives him at least his utility from war. Suppose this offer (i.e., the one that makes him indifferent between accepting it and going to war) is y^* (note that the usual proposal $y^* = p - c_D$ will

[22]Note that these are less restrictive upper bounds on δ_D than is the usual (i.e., when public commitments are not allowed) condition that $\delta_D \leq \frac{(p-c_D)-q}{(p+c_S)-q}$.

not do, since $p - c_D < \tau_D$), and suppose that $y^* < \tau_D$, i.e., D's overall payoff from accepting y^* is actually $\frac{y^* - a_D(\tau_D - y^*)}{1-\delta_D}$. Then, to solve for y^*, we set $\frac{y^* - a_D(\tau_D - y^*)}{1-\delta_D} = \frac{p-c_D}{1-\delta_D}$, which gives $y^* = \frac{p-c_D+a_D\tau_D}{1+a_D}$. Setting this less than τ_D and simplifying, we get $\tau_D > p - c_D$, which we have stipulated to hold in this proposition. Therefore, if it is optimal for D to fight rather than say no if S's offer is too small, then D cannot credibly reject any offer $(y, 1-y)$ such that $y \geq \frac{p-c_D+a_D\tau_D}{1+a_D}$.

Is it optimal for D to fight rather than say no if S's offer is too small? In any period in which S makes an offer, if S's offer is too low, D prefers to fight rather than wait and get $x^* = p + c_S$ in the next period (we are using the OSDP here, i.e., we are supposing that D reverts to his equilibrium strategy in the future) as long as $\frac{p-c_D}{1-\delta_D} \geq [q - a_D(\tau_D - q)] + \frac{\delta_D(p+c_S)}{1-\delta_D}$, or $\delta_D \leq \frac{a_D(\tau_D-q)+[(p-c_D)-q]}{a_D(\tau_D-q)+[(p+c_S)-q]}$. (In the case where $p + c_S < \tau_D$, the condition becomes $\frac{p-c_D}{1-\delta_D} \geq [q - a_D(\tau_D - q)] + \frac{\delta_D[x^* - a_D(\tau_D - x^*)]}{1-\delta_D}$, or $\delta_D \leq \frac{a_D(\tau_D-q)+[(p-c_D)-q]}{a_D[(p+c_S)-q]+[(p+c_S)-q]}$.) Thus, as long as this condition on δ_D holds, we have verified that D's acceptance rule is optimal, or satisfies the OSDP.

(ii) Would S always find it optimal to propose y^*? Yes, as long as $\frac{1-y^*}{1-\delta_S} \geq \frac{1-p-c_S}{1-\delta_S}$, or $\tau_D \leq \tau_{D_{war}}$, which we have stipulated to hold in this proposition. That is, as long as D does not commit to too much, S would rather appease D than have war break out. So we have verified that S's proposal is optimal, or satisfies the OSDP.

(iii) To ensure that it is optimal for D to fight rather than pass if S rejects D's proposal, we need $\frac{p-c_D}{1-\delta_D} \geq [q - a_D(\tau_D - q)] + \frac{\delta_D[y^* - a_D(\tau_D - y^*)]}{1-\delta_D} = [q - a_D(\tau_D - q)] + \frac{\delta_D(p-c_D)}{1-\delta_D}$, which is indeed the case, in fact this inequality holds strictly. Thus, we have verified that D's decision to fight rather than pass satisfies the OSDP.

(iv) Given that D is choosing to fight rather than pass if S rejects D's offer, S cannot credibly be demanding more than her utility from war, and hence her acceptance rule satisfies the OSDP.

(v) Given S's acceptance rule, it is easy to see that D's proposal satisfies the OSDP. (In the case where $\tau_D > p + c_S = x^*$, it is needed that $\frac{x^* - a_D(\tau_D - x^*)}{1-\delta_D} \geq \frac{p-c_D}{1-\delta_D}$, or $\tau_D \leq \tau_{D_{war}}$, which we have stipulated to hold in this proposition.)

(vi) Finally, it is easy to see that if D says no to S's offer, S's decision to pass rather than fight satisfies the OSDP. This is because if she fights, her payoff is $\frac{1-p-c_S}{1-\delta_S}$, whereas if she passes, her payoff (assuming she sticks to her equilibrium strategy) is $(1-q)+\frac{\delta_S(1-p-c_S)}{1-\delta_S}$, and the latter is strictly greater than the former. Q.E.D.

6.2.4 Extreme Public Commitment, $\tau_D > \frac{(p+c_S)(1+a_D)-p+c_D}{a_D}$ $(> p+c_S)$

Proposition 4 *When D makes such a high public commitment, then the following are SPE (regardless of the value of δ_D) in which each side makes unacceptable offers and war occurs in the first period regardless of who makes the first offer:*
(a) Whenever D makes a proposal, he proposes some $(x, 1-x)$, where $x > p+c_S$. He always accepts any offer $(y, 1-y)$ such that $y \geq \frac{p-c_D+a_D\tau_D}{1+a_D}$ (this is the audience-cost equivalent of demanding at least his payoff from war; this amount is bigger than $p-c_D$, but with audience costs makes his personal utility just $p-c_D$). In any period in which he gets a lower offer than this, he fights (does not say no). In any period in which S rejects his offer, he fights rather than passes.
(b) Whenever S makes a proposal, she proposes some $(y, 1-y)$, where $y < \frac{p-c_D+a_D\tau_D}{1+a_D}$. She always accepts any offer $(x, 1-x)$ such that $x \leq p+c_S$. In any period in which she gets a worse offer, she is indifferent between fighting and saying no (since in the latter case D fights anyway), and hence can be choosing either (or mixing). In any period in which D rejects her offer, she passes rather than fights.

Proof: (i) Consider when S makes an offer. Suppose D goes to war if S's offer is too small, rather than says no. Then D cannot credibly reject any offer that gives him at least his utility from war. Suppose this offer (i.e., the one that makes him indifferent between accepting it and going to war) is y^*, and suppose that $y^* < \tau_D$, i.e., D's overall payoff from accepting y^* is actually $\frac{y^*-a_D(\tau_D-y^*)}{1-\delta_D}$. Then, to solve for y^*, we set $\frac{y^*-a_D(\tau_D-y^*)}{1-\delta_D} = \frac{p-c_D}{1-\delta_D}$, which gives $y^* = \frac{p-c_D+a_D\tau_D}{1+a_D}$. Setting this less than τ_D and simplifying, we get $\tau_D > p-c_D$, which is indeed the case since we have stipulated that $\tau_D > \frac{(p+c_S)(1+a_D)-p+c_D}{a_D}$ $(> p+c_S > p-c_D)$. Therefore, if it is optimal for D to fight rather than say no if S's offer is too small, then D cannot credibly reject any $y \geq \frac{p-c_D+a_D\tau_D}{1+a_D}$.

Is it optimal for D to fight rather than say no if S's offer is too small? Using the OSDP, i.e., supposing that D uses his equilibrium strategy in the future, if D says no to S's offer, then war occurs in the next period and so D's overall payoff is $[q-a_D(\tau_D-q)]+\frac{\delta_D(p-c_D)}{1-\delta_D}$, which is strictly less than his payoff of $\frac{p-c_D}{1-\delta_D}$ for fighting in the current period. Thus, we have verified that D's acceptance rule is optimal, or satisfies the OSDP.

(ii) Does S's choice of proposing some $y < \frac{p-c_D+a_D\tau_D}{1+a_D}$, which is rejected and which leads to war, satisfy the OSDP? If S wants to deviate and make some acceptable proposal, the best (for herself) acceptable proposal that she can make, given D's acceptance rule, is $y^* = \frac{p-c_D+a_D\tau_D}{1+a_D}$. Thus, S's proposal rule of proposing some $y < \frac{p-c_D+a_D\tau_D}{1+a_D}$ satisfies the OSDP as long as $\frac{1-y^*}{1-\delta_S} < \frac{1-p-c_S}{1-\delta_S}$, or $\tau_D > \frac{(p+c_S)(1+a_D)-p+c_D}{a_D}$, which we have stipulated to hold in this proposition. Thus, S's proposal rule satisfies the OSDP. (The intuition here is that, when D commits to too much, S would rather have break out than appease D, because D is now demanding an amount that leaves S with less than her utility from war.)

(iii) To ensure that it is optimal for D to fight rather than pass if S rejects D's proposal, we need $\frac{p-c_D}{1-\delta_D} \geq [q - a_D(\tau_D - q)] + \frac{\delta_D(p-c_D)}{1-\delta_D}$, which is indeed the case, in fact this inequality holds strictly. Thus, we have verified that D's decision to fight rather than pass satisfies the OSDP.

(iv) Given that D is choosing to fight rather than pass if S rejects D's offer, S cannot credibly be demanding more than her utility from war, and hence her acceptance rule satisfies the OSDP.

(v) Does D's choice of proposing some $x > p + c_S$, which is rejected and which leads to war, satisfy the OSDP? If D wants to deviate and make some acceptable proposal, the best (for himself) acceptable proposal that he can make, given S's acceptance rule, is $x^* = p + c_S$. Note that $\frac{(p+c_S)(1+a_D)-p+c_D}{a_D} > p + c_S$, which means that our stipulation in this proposition that $\tau_D > \frac{(p+c_S)(1+a_D)-p+c_D}{a_D}$ means that $\tau_D > p + c_S$, which means that D pays an audience cost in the agreement $x^* = p + c_S$. Thus, D's proposal rule of proposing some $x > p + c_S$ satisfies the OSDP as long as $\frac{x^*-a_D(\tau_D-x^*)}{1-\delta_D} < \frac{p-c_D}{1-\delta_D}$, or $\tau_D > \frac{(p+c_S)(1+a_D)-p+c_D}{a_D}$, which we have stipulated to hold in this proposition. Thus, D's proposal rule satisfies the OSDP. (The intuition here is that, when D commits to too much, even getting all of the gains from avoiding war is worse, with the audience costs that are paid as a result of this, than going to war.)

(vi) Finally, it is easy to see that if D says no to S's offer, S's decision to pass rather than fight satisfies the OSDP. This is because if she fights, her payoff is $\frac{1-p-c_S}{1-\delta_S}$, whereas if she passes, her payoff (assuming she sticks to her equilibrium strategy) is $(1-q) + \frac{\delta_S(1-p-c_S)}{1-\delta_S}$, and the latter is strictly greater than the former. Q.E.D.

6.3 Proof of Proposition 1 (Risk-Return Tradeoff Equilibrium in Baseline Crisis Bargaining Model with Incomplete Information)

Again, this proof is given in Leventoğlu and Tarar (2008), and we reproduce it here for the sake of completeness. We want to construct a PBE in which neither type of D rejects S's initial offer in order to make a counteroffer. Each type accepts all initial offers $(y, 1-y)$ such that y is at least as great as its expected utility from war, and fights (rather than says no) if it gets a lower offer. We also want that if the second period is reached (this is off-the-equilibrium path behavior), the strategies of the players are such that agreement is reached on $x^* = p + c_S$, i.e., D gets all of the gains from avoiding war.

(i) First note that if such an agreement were to be reached, then S would be strictly best off passing rather than fighting if D says no to S's initial offer, i.e., $\frac{1-p-c_S}{1-\delta_S} < (1-q) + \frac{\delta_S(1-x^*)}{1-\delta_S}$.

(ii) Then, for type c_{D_l} to be fighting rather than saying no if he gets a low initial offer, it must be that $\frac{p-c_{D_l}}{1-\delta_D} \geq q + \frac{\delta_D x^*}{1-\delta_D}$, or $\delta_D \leq \frac{(p-c_{D_l})-q}{(p+c_S)-q}$. This also ensures that type c_{D_l} cannot credibly reject any initial offer $(y, 1-y)$ such that $y \geq p - c_{D_l}$.

(iii) Similarly, for type c_{D_h}'s acceptance rule to be to accept any initial offer $(y, 1-y)$ such that $y \geq p - c_{D_h}$ and go to war (rather than say no) for a lower y, it must be that $\frac{p-c_{D_h}}{1-\delta_D} \geq q + \frac{\delta_D x^*}{1-\delta_D}$, or $\delta_D \leq \frac{(p-c_{D_h})-q}{(p+c_S)-q}$. Since $c_{D_h} > c_{D_l}$, the latter is the binding restriction on δ_D.

(iv) Now we need to construct a PBE of the subgame beginning in the second period, which is in never reached in equilibrium, in which agreement is reached on $x^* = p + c_S$. The simplest way to do this is to stipulate that if this subgame is reached, S believes that it is facing type c_{D_l} (the low-cost, or highly resolved, type) with certainty (and that this belief never changes later on), and that S and type c_{D_l} therefore use the complete information strategies of Proposition 2, which are best responses to each other (note that we could also stipulate that S believes she is facing type c_{D_h} with certainty, and this belief never changes; the argument below would require only minor modifications). This requires the binding condition of Proposition 2 to hold (when D's cost of war is c_{D_l}), namely that $\delta_D \leq \frac{(p-c_{D_l})-q}{(p+c_S)-q}$, which is already implied by our binding condition in the previous paragraph.

(v) Now we need to construct a strategy (in this subgame) for type c_{D_h} that is a best response to S's strategy (which is given by Proposition 2). (a) Given S's acceptance rule, type c_{D_h} is strictly best off proposing $x^* = p + c_S$ whenever he makes a proposal. (b) Now suppose S has just made a low offer to type c_{D_h}. We have just shown that if type c_{D_h} says no, his optimal continuation value is $q + \frac{\delta_D x^*}{1-\delta_D}$ (note that S's strategy is to pass rather than fight if D says no, and hence the next period will be reached). Given the upper bound on δ_D that we have derived earlier, namely that $\delta_D \leq \frac{(p-c_{D_h})-q}{(p+c_S)-q}$, type c_{D_h}'s payoff from war, $\frac{p-c_{D_h}}{1-\delta_D}$, is greater than this, and hence type c_{D_h}'s acceptance rule must be to always accept any offer $(y, 1-y)$ such that $y \geq p - c_{D_h}$, and fight if he gets a lower offer. (c) Finally, suppose S has said no to type c_{D_h}'s offer. Given S's proposal and the acceptance rule we have just derived for type c_{D_h}, the latter's continuation value for passing is $q + \frac{\delta_D(p-c_{D_l})}{1-\delta_D}$. Given the upper bound on δ_D that we have derived earlier, namely that $\delta_D \leq \frac{(p-c_{D_h})-q}{(p+c_S)-q}$, type c_{D_h}'s payoff from war, $\frac{p-c_{D_h}}{1-\delta_D}$, is strictly greater than this, and hence type c_{D_h} must always be choosing to fight rather than pass. This completes the description of type c_{D_h}'s best response to S's strategy.

(vi) All that remains is to specify the optimal offer that S makes in the first period of the game. Given the acceptance rules of types c_{D_l} and c_{D_h}, S's best response is either to make the big offer $y^* = p - c_{D_l}$, which both types accept (and so war is avoided with certainty), or to make the lower offer $y^* = p - c_{D_h}$, which only type c_{D_h} accepts. Type c_{D_l} rejects it and goes to war. It is easy to see that no other proposal can be a best response. If $0 < s < 1$ is the prior probability that D is of type c_{D_l}, then making the big offer is a best response if and only if $\frac{1-(p-c_{D_l})}{1-\delta_S} \geq s[\frac{1-p-c_S}{1-\delta_S}] + (1-s)[\frac{1-(p-c_{D_h})}{1-\delta_S}]$, or $s \geq \frac{c_{D_h}-c_{D_l}}{c_{D_h}+c_S} \in (0,1)$. Q.E.D.

6.4 Separating Equilibria in Public Commitment Model with Incomplete Information

A useful fact to note for the discussion below is that $\tau_{D_{war}} = \frac{(p+c_S)(1+a_D)-p+c_D}{a_D}$ is increasing in c_D. Therefore, $\tau_{D_{war}}(c_{D_h}) > \tau_{D_{war}}(c_{D_l})$, meaning that the high-cost type has a higher threshold for τ_D beyond which S prefers to go to war rather than satisfy D's minimal demand, than does the low-cost type.

In the main body of the text, we established that there exists no separating equilibrium in which type c_{D_l} commits to some $\tau_{D_l} \leq \tau_{D_{war}}(c_{D_l})$. We now construct separating equilibria in which $\tau_{D_l} > \tau_{D_{war}}(c_{D_l})$. In any separating equilibrium in which c_{D_l} makes such a public commitment, upon observing this commitment, S knows that she faces type c_{D_l}, and her set of best responses is to offer any $y < y^*(c_{D_l})$ ($> p+c_S$), which will be rejected by type c_{D_l}, who is demanding at least $y^*(c_{D_l})$. All we need to do is to specify that S makes a sufficiently small offer upon observing this commitment level, low enough that c_{D_h} does not have an incentive to mimic c_{D_l}'s commitment level (c_{D_h}'s personal payoff is $p - c_{D_h}$, since this is a separating equilibrium in which S knows that it faces type c_{D_h} upon observing τ_{D_h}). For example, specifying that S offers $y = 0$ upon observing τ_{D_l} will do. (We also have to specify that if S observes some commitment level other than τ_{D_l} or τ_{D_h}, her off-the-equilibrium-path beliefs are such that she optimally makes a small enough offer to not make it worthwhile for either type to deviate to that commitment level. The easiest way to do this is to specify that (i) if S observes some non-equilibrium $\tau_D > \tau_{D_{war}}(c_{D_l})$, she believes that she faces type c_{D_l} with certainty and offers $y = 0$, (ii) if S observes some non-equilibrium $p - c_{D_h} < \tau_D \leq \tau_{D_{war}}(c_{D_l})$, she believes that she faces type c_{D_h} with certainty and offers $y^*(c_{D_h})$, and (iii) if S observes some non-equilibrium $\tau_D \leq p - c_{D_h}$, she believes that she faces type c_{D_h} with certainty and offers $p - c_{D_h}$.) Note that these separating equilibria can involve the ex ante probability of war being s, if $\tau_{D_h} \leq \tau_{D_{war}}(c_{D_h})$ in equilibrium, or it can involve the ex ante probability of war being 1, if $\tau_{D_h} > \tau_{D_{war}}(c_{D_h})$ in equilibrium. (Either case is fine from c_{D_h}'s perspective, as his personal payoff is going to be $p - c_{D_h}$ regardless; however, if we assume pie-maximizing behavior, then c_{D_h} should commit to exactly $\tau_{D_{war}}(c_{D_h})$ in equilibrium,[23] and the ex ante probability of war will be s.) Also note that these separating equilibria can (but do not necessarily) involve the low-resolve type publicly committing to more than the high-resolve type, which is not what we would intuitively expect. For example, if c_{D_h} is committing to $\tau_{D_{war}}(c_{D_h})$, and c_{D_l} is committing to just a little over $\tau_{D_{war}}(c_{D_l})$.

6.5 Pooling and Semi-Separating Equilibria in the Public Commitment Model with Incomplete Information

We first provide S's off-the-equilibrium-path beliefs and offers in the pooling and semi-separating equilibria described in the main text, and then discuss the derivation of Figure

[23]Note that this shows that in a separating equilibrium, the low-resolve type can use the commitment tactic for bargaining leverage. The high-resolve type cannot, however, because in any separating equilibrium, it is eliminating the bargaining range and hence war occurs.

6. We require that if S observes some commitment level other than commitment levels that are made with positive probability in equilibrium, her off-the-equilibrium-path beliefs are such that she optimally makes a small enough offer to make it not-worthwhile for either type to deviate to that commitment level. The easiest way to do this is to use the same off-the-equilibrium-path beliefs and offers that we specified in the separating equilibria of the previous section, namely that (i) if S observes some non-equilibrium $\tau_D > \tau_{D_{war}}(c_{D_l})$, she believes that she faces type c_{D_l} with certainty and offers $y = 0$, (ii) if S observes some non-equilibrium $p - c_{D_h} < \tau_D \leq \tau_{D_{war}}(c_{D_l})$, she believes that she faces type c_{D_h} with certainty and offers $y^*(c_{D_h})$, and (iii) if S observes some non-equilibrium $\tau_D \leq p - c_{D_h}$, she believes that she faces type c_{D_h} with certainty and offers $p - c_{D_h}$.

To plot Figure 6, we analyze S's optimal offer when, upon observing a given commitment level τ_D, she is not sure which type she faces (i.e., when τ_D is not a commitment level that only one type chooses with positive probability).

Case 1: First suppose that $\tau_D \leq p - c_{D_h}$. Then, S's possible best responses are to either offer $p - c_{D_h}$, or to offer $p - c_{D_l}$. Therefore, the critical threshold for s is the same as in the model without public commitments, namely s^*. This is shown in Figure 6, which plots $s_{critical}$ as a function of τ_D.[24]

Case 2: Now suppose that $p - c_{D_h} < \tau_D \leq p - c_{D_l}$ (this is the case discussed in the main text). Now S's possible best responses are to make the big offer of $p - c_{D_l}$, or the smaller offer of $y^*(c_{D_h})$ ($\in (p - c_{D_h}, p - c_{D_l})$). Henceforth, we will simplify notation by denoting $y^*(c_{D_h})$ by y_h^* and $y^*(c_{D_l})$ by y_l^*. S prefers to make the small offer if $s(1 - p - c_S) + (1 - s)(1 - y_h^*) \geq 1 - p + c_{D_l}$, or $s \leq \frac{(p - c_{D_l}) - y_h^*}{(p + c_S) - y_h^*}$. Now the critical threshold has changed — because c_{D_h} is now demanding a bigger amount to avoid war, S's preference for offering the small amount (which is no longer as small as it used to be) over the big amount is not as strong, and hence the critical threshold for s has been lowered. This is shown in Figure 6.

Case 3: Now suppose that $p - c_{D_l} < \tau_D \leq \tau_{D_{war}}(c_{D_l})$. Now S's possible best responses are to make the big offer of y_l^*, or the smaller offer of y_h^*. S makes the small offer if $s(1 - p - c_S) + (1 - s)(1 - y_h^*) \geq 1 - y_l^*$, or $s \leq \frac{y_l^* - y_h^*}{(p + c_S) - y_h^*}$. Now the threshold starts increasing, because the big offer is increasing (in τ_D) at a faster rate than the small offer, and hence

[24] Figure 6 is drawn for $p = 0.5$, $c_{D_l} = 0.2$, $c_{D_h} = 0.4$, $c_S = 0.1$, and $a_D = 2$. It has the same overall shape for all values of these parameters.

making the big offer is becoming more unattractive relative to making the small offer. This is shown in Figure 6. As $\tau_D \to \tau_{D_{war}}(c_{D_l})$ (which in the figure is 0.75), $s_{critical} \to 1$.

Case 4: Now suppose that $\tau_{D_{war}}(c_{D_l}) < \tau_D \leq \tau_{D_{war}}(c_{D_h})$. Now the minimal amount that c_{D_l} needs, y_l^*, leaves S with less than her utility from war (i.e., $y_l^* > p + c_S$), and so S never wants to make an acceptable offer to this type. Therefore, regardless of the value of s (unless $s = 1$, in which case any $y < y_l^*$ is a best response), S's only best response is to offer the small amount of y_h^*. There is no critical value of s, because it is never optimal to make the big offer.

Case 5: Now suppose that $\tau_D > \tau_{D_{war}}(c_{D_h})$. Now even y_h^* leaves S with less than her utility from war (i.e., now $y_h^* > p + c_S$), and hence she does not want to make an acceptable offer to either type. Therefore, regardless of the value of s (unless $s = 1$, in which case her set of best responses are all $y < y_l^*$), her set of best responses are all $y < y_h^*$ (this is the set of offers that will be rejected by both types). There is no critical value of s.

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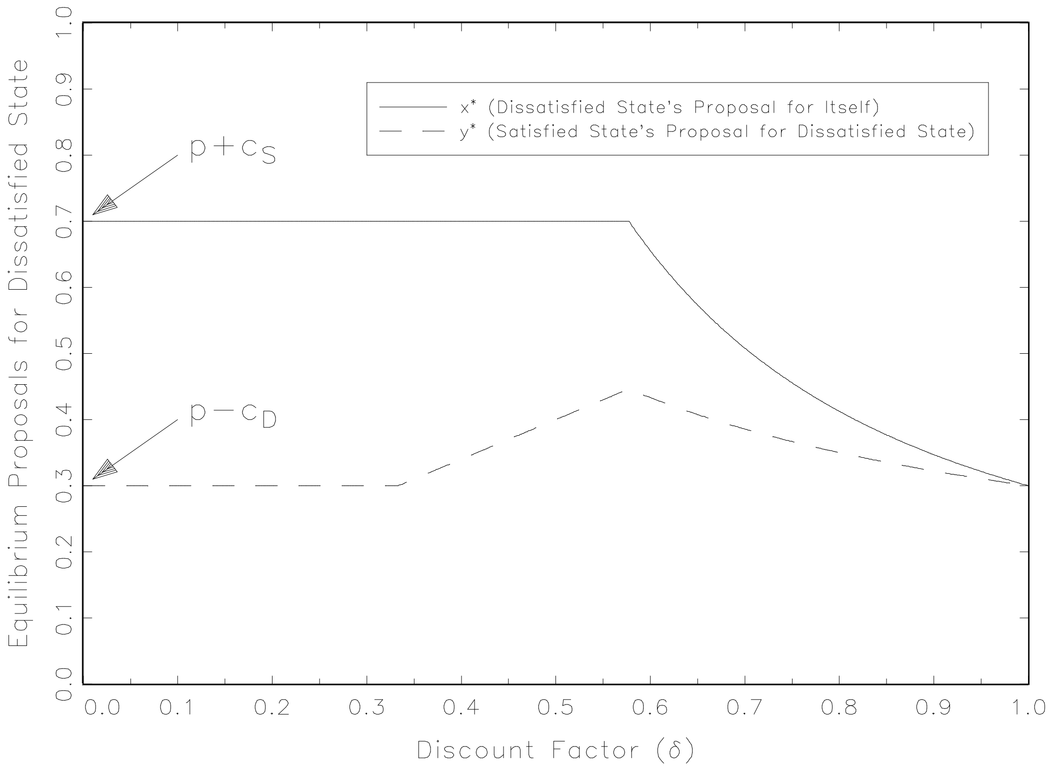

Figure 3: Stationary Equilibrium Proposals in the Baseline Crisis Bargaining Model

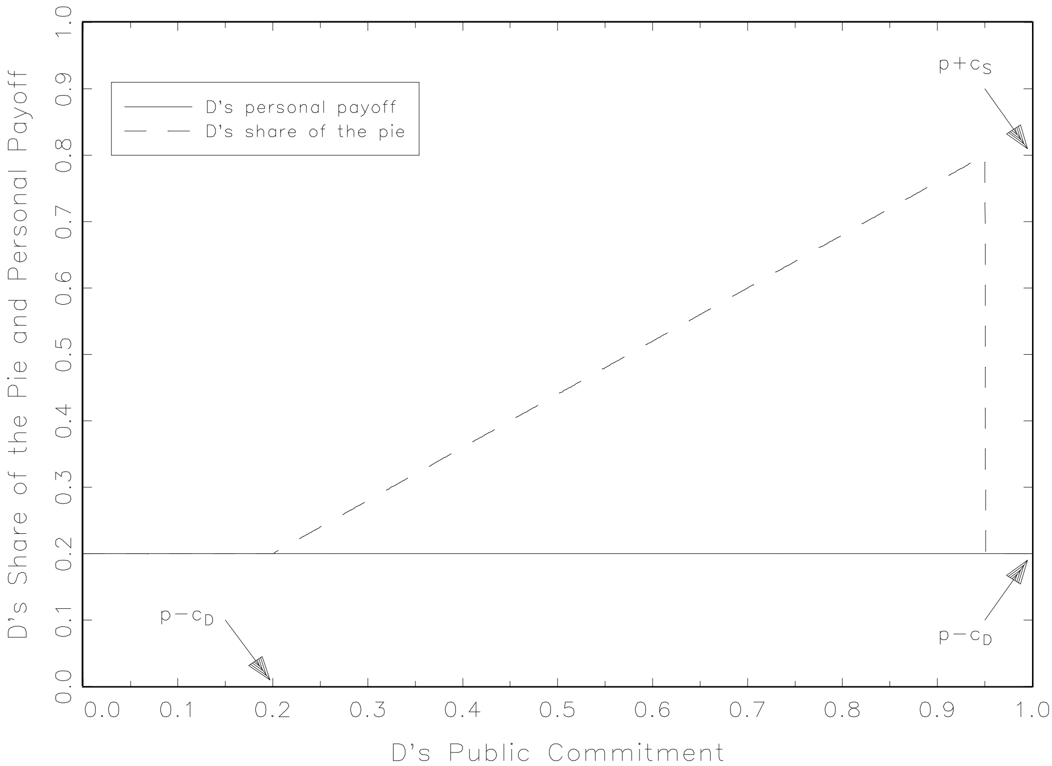

Figure 4: D's Share of the Pie and Personal Payoff as a Function of His Public Commitment $\tau_D \in [0, 1]$, when D is Dissatisfied and S Makes the First Offer

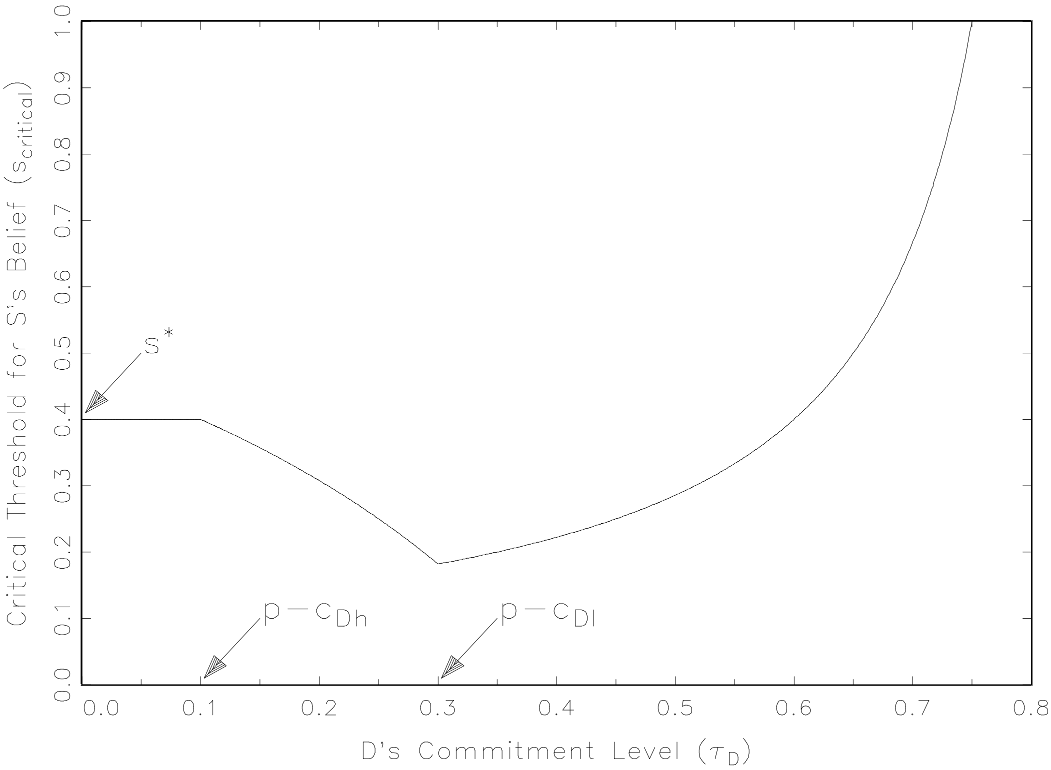

Figure 6: S's Critical Belief Threshold ($s_{critical}$) as a Function of D's Pooling Public Commitment Level (τ_D)

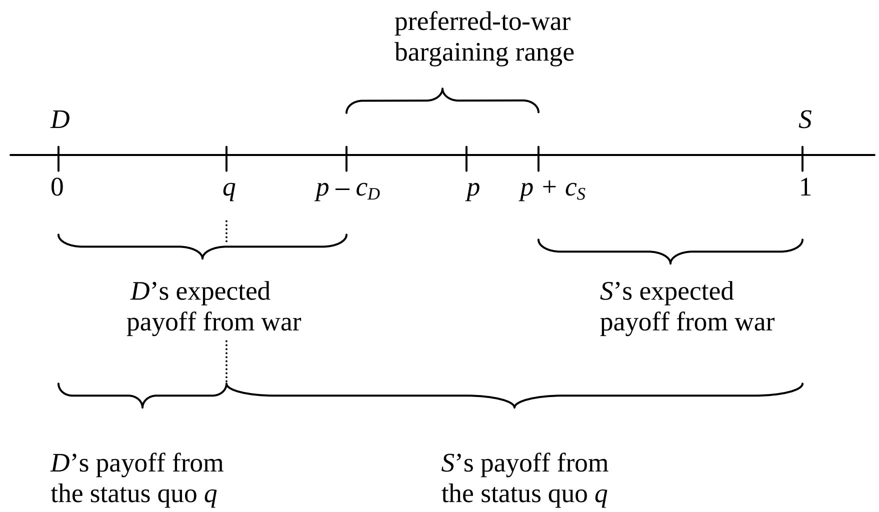

Figure 1: The Bargaining Approach to War

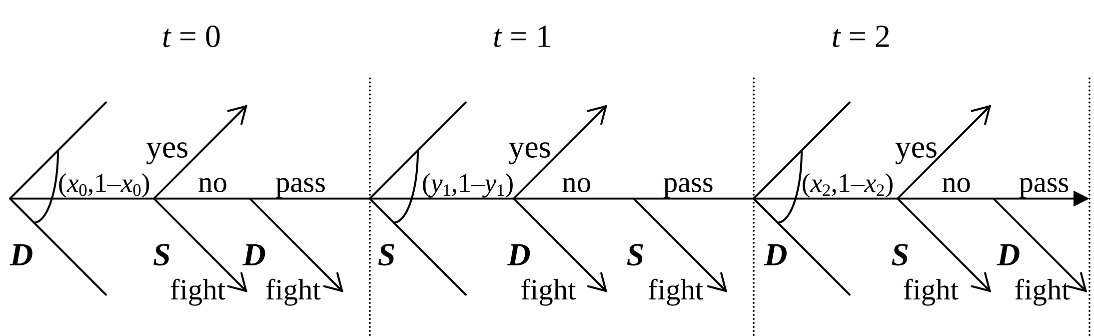

Figure 2: The Baseline Crisis Bargaining Model

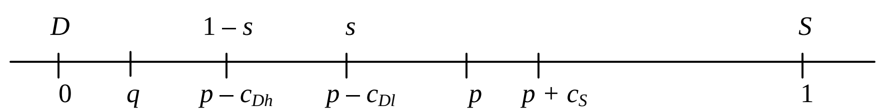

Figure 5: Uncertainty About *D*’s Cost of War