Assurance and Self-Assurance under Power Imbalance*

Comments welcome.

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Abstract

How could power imbalance lead to war? How could power imbalance allow for mutual optimism? I analyze these questions using a formal model of incomplete information, where two parties bargain over two periods. I argue that power imbalance causes war because the strong party wishes to crush its weaker opponent, obviating the need for future concessions. This dynamic also explains how the two countries could be mutually optimistic about their path to victory, under two-sided incomplete information on capabilities and resolve. The strong country hopes that its enemy lacks the capabilities to survive the initial battle. The weak country hopes that its enemy lacks the resolve to continue the fight. I illustrate this argument by reevaluating the dynamics of the Pacific War of 1941-1945.

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1 Introduction

In February 2022, most analysts predicted that Russia would achieve a quick victory in its invasion of Ukraine.[1] The balance of forces was overwhelmingly in its favor. According to the widely used Correlates of War dataset, Russia had about 5 times the material capabilities of Ukraine.[2] Moscow would quickly capture Kyiv, and the Ukrainian army would collapse. Russian President Vladimir Putin was confident in his compatriots' "invincible force" (Putin N.d.). Yet Ukraine was determined to resist the Russian invasion. Ukrainian President Volodymyr Zelensky responded that Putin would have to contend with "the strength of the Ukrainian people." In his words, Ukrainians are "indomitable" (Hopkins 2022). The attack on Kyiv was unsuccessful. The war entered a stalemate and continued to rage two years later.

This episode is indicative of a more widespread phenomenon, where two rival states with very different capabilities fail to resolve their differences peacefully. The Soviet Union and Finland (1939), the United States and Japan (1941), the United States and Iraq (1990, 2003). In these dyads, the most powerful states had at least 3 times the capabilities of the weakest state, and in one occasion as much as 77 times the capabilities of the weakest state.[3] These are just a few examples where conflict erupts even if there is no

[1]See, e.g., Harris et al. (2022); Posen (2022).

[2]Singer, Bremer and Stuckey (1972), version 6.0. Figures are taken from 2016, the last year of availability.

[3]Singer, Bremer and Stuckey (1972), version 6.0.

ambiguity about the militarily preponderant states. Why would diplomacy break down under power asymmetries? How could two states believe that they have a path to victory, despite their power imbalance?

One approach is to assume that states behave irrationally. Mutual optimism is often seen as a symptom of irrationality.[4] There was much concern early in the war about Putin's mental state.[5] Surely, he must have erred in believing that he would prevail. Yet, as already mentioned, most Western analysts agreed with this assessment at the outset of the conflict, given the disparity in resources. It would be good to know if there are any structural reasons to explain the outbreak of war and any causal effects of mutual optimism, assuming that states are rational.

There are no complete answers to the above questions. The canonical bargaining model sees power shifts, rather than power imbalances, as a source of bargaining breakdown (Fearon 1995; Powell 2006). Uncertainty may cause war under any balance of power, but it is unclear if there is any specific dangers related to power asymmetries. Uncertainty may also open the way for mutual optimism, but scholars have long debated the role of mutual optimism as a cause of conflict.[6]

Recent work offers some partial answers to these questions. Power im-

[4]See, e.g., Johnson (2009).

[5]See, e.g., Krepinevich (2022); Moore (2022).

[6]See, e.g., Blainey (1988); Fearon (1995); Fey and Ramsay (2007); Slantchev and Tarar (2011).

balance could cause war because the strong party's promises of future generosity - technically, its assurances - lack credibility (see, e.g., Monteiro and Debs 2020; Pauly 2019; Sechser 2010). Anticipating that it cannot trust its stronger adversary, the weaker party fights, so as to establish a reputation for toughness, as argued in a prominent piece by Sechser (2010).

While the argument is plausible, the link between power imbalance and conflict is tenuous. A priori, *any* state would carefully monitor its adversary's resolve to revise its future bargaining stance. Sechser (2010, 641-645) concludes that power imbalance causes war by assuming that the two states disagree about the likelihood of future interactions, with the weak state believing future interactions to be more likely (Sechser 2010, 641-645). These assumptions depart from the canonical bargaining model, where states share common priors about the likelihood of future interactions (Fearon 1995). If anything, standard models of reputation assume that the *stronger* party worries more establishing a reputation, given its extended commitments.[7] Such a concern was articulated in the domino theory during the Cold War, where the fall of one country to Communism could jeopardize other U.S. allies.

Similarly, we understand that rational belligerents could be mutually optimistic about the balance of power when there are multiple sources of un-

[7]See, e.g., Alt, Calvert and Humes (1988). In the original chain-store paradox, a long-lived monopolist faces a succession of small, short-lived competitors (Kreps and Wilson 1982; Selten 1978).

certainty, complicating each party's inferences about its enemy's intentions (Debs 2022). Yet this argument uses a sparse setup - a one-shot game with binary choices. It does not explain how bargaining could break down and how states could be mutually optimistic about their path to victory.

This paper addresses these questions. It presents a two-period model of fighting and bargaining. Two countries, A and B, bargain over a pie of size 1 in each period. A makes an offer to B. If B rejects it, war ensues. War could be decisive, ending the game, with the victor securing the pie in both periods. If B accepts it or if a war is indecisive, countries earn their first-period payoff and enter a second period, where the above timing is repeated. A makes an offer to B, which B can accept or reject. Each country knows its type, determined by its fighting capabilities and its level of resolve, and may be uncertain about its enemy's type. Capabilities and resolve each take one of two values. Fighting capabilities affect the probability of victory and the probability that any round of fighting is decisive. Greater capabilities increase the probability of victory, if fighting is decisive. A greater disparity of capabilities increases the probability that fighting is decisive. The level of resolve is inversely related to the cost of fighting, a private value.

In a baseline model, incomplete information is one sided. The type of country A, the proposer, is common knowledge, while the type of country B, the receiver, is its private information. I consider in turn the model where uncertainty is solely on country B's capabilities or solely on its resolve. I analyze a game where, in period 1, country A cannot commit to honoring its current offer in period 2. I say that, in this case, country A's assurances are not credible; it could choose to revise the terms of peace based on the information revealed in period 1. I compare the outcome of this game to that of a one-shot game and that of a two-period game where, in period 1, country A can commit to honoring its current offer in period 2.

The first result is that, contrary to the conventional wisdom, non-credible assurances are not a compelling explanation for war. If the proposer cannot commit to future terms, then the receiver simply sets higher demands in period 1, anticipating that the proposer will ratchet up its demands in period 2 if the receiver reveals any weakness in period 1. Power imbalance does in a way cause conflict in this dynamic setting. If the proposer is strong, then it believes that any war is likely to be decisive and it is likely to prevail, obviating the need for any concessions in period 2.

Then the paper shows that this temptation for the strong country to obtain the weak country's capitulation opens the way for belligerents to be mutually optimistic about their path to victory. Assume that country A is stronger than country B and each country is uncertain about its enemy's capabilities and resolve. Also assume that capabilities have a greater effect than resolve on war payoffs for a weak country and that the opposite is true for a strong country. These conditions sustain an equilibrium with some separation, on capabilities for the weak state and resolve for the strong state. Country A pools in making an aggressive offer, accepted only if country B has weak capabilities and weak resolve. If war occurs and country B survives, then country A makes a generous offer if it has a low resolve and a more aggressive offer if it has a high resolve.

In this equilibrium, countries may have incompatible beliefs about their path to victory. The strong country makes an aggressive offer, hoping that the enemy has low capabilities, it will collapse, and future concessions will be unnecessary. The weak country rejects the aggressive offer, hoping that it will survive the engagement and the enemy has low resolve and it will tire of the conflict, offering greater concessions in the future.

Such a logic, I argue, captures key strategic dynamics in asymmetric wars, such as the Pacific War of 1941-1945.[8]

The paper proceeds as follows. Section 2 reviews the relevant literature. Section 3 presents the game-theoretic model. Section 4 reflects on the lessons of the model, both theoretically and empirically, using the case study of the Pacific War. Section 5 concludes. Proof of the results is included in the Appendix.

2 Power Imbalance, Assurance, and Mutual Optimism

How could power imbalance lead to conflict? How could two states perceive a path to victory under stark power asymmetries? Existing work offers

[8]See, e.g., Mack (1975).

some partial answers to these questions, but we still lack a comprehensive framework to understand these problems.

The deterrence literature has recently suggested that power imbalance could lead to conflict by undermining the credibility of the stronger party's assurances (see, e.g., Monteiro 2009, Chapter 2; Pauly 2019; Cebul, Dafoe and Monteiro 2021). As Thomas Schelling clearly articulated, coercion succeeds when a state can convey threats and assurances credibly (Schelling 1966, Chapter 2). Noncompliance would be punished (a threat) and compliance would be rewarded (an assurance). If war would be disastrous for the state imposing the punishment, then the credibility of threats is questioned. If war appears like an affordable and expedient way to eliminate an adversary, then the credibility of assurances may be in doubt.

Overall, deterrence theory has mainly focused on the credibility of threats, taking assurances for granted (see, e.g., Powell 1990; Schelling 1966). More recently, the literature has turned its attention to the credibility of assurances (see also Kydd and McManus 2017). Geopolitical conditions are in part responsible for this shift. Deterrence theory was initially articulated during the Cold War, when the two nuclear superpowers stared down the possibility of mutually assured destruction, and threats were not clearly credible. Since the Cold War, the United States has typically faced weaker adversaries, fearful that Washington would be undeterred by the cost of war.

For example, consider two key crises in the Cold War and post-Cold War era (for a graphical illustration, see Figures 1 and 2).

– Figures 1 and 2 here –

In the Cuban Missile Crisis, the United States worried about its ability to coerce the Soviet Union from placing and keeping missiles on Cuba. Threats of an attack if Moscow did not comply lacked credibility.[9] By contrast, in the 1990s and early 2000s, Washington struggled to obtain Saddam's full cooperation with inspections. Assurances that it would not attack if the Iraqi leader complied lacked credibility.[10]

Non-credible assurances have bedeviled U.S. foreign policy since the Cold War. After the U.S. invasion of Iraq in 2003, Muammar Gaddafi agreed to abandon Libya's fledgling nuclear-weapons program to reintegrate the international community, but he was deposed and killed in 2011 by NATO-backed

[9] In Figure 1, if launching a war creates a loss $L_i < 0$, then the Soviet Union anticipates no attack, no matter what it chooses. The unique subgame-perfect Nash Equilibrium is for the Soviet Union to keep its missiles in Cuba and for the US not to attack. The United States fails to keep the missiles out of Cuba peacefully.

[10] If launching a war creates a gain $G_2 > 0$, then Iraq anticipates that the United States will attack, no matter what it chooses. There is a subgame-perfect Nash Equilibrium where Iraq obstructs inspectors and the United States attack. The United States fails to obtain full inspections peacefully. For some perspectives on the war, see, e.g., Coe (2018); Debs and Monteiro (2014); Lake (2010/11).

rebels. This cast doubt on the credibility of U.S. assurances, with long-lasting consequences. When U.S. national security adviser John Bolton argued in 2018 that Washington should consider the "Libya model" to convince North Korea to abandon its nuclear arsenal, Kim Jong Un had reasons to be skeptical.[11]

More generally, the credibility of threats and assurances can depend on the balance of power. As Nuno Monteiro put it: "In situations of power balance, the credibility of threats is the main issue for states engaging in deterrence. If power is unbalanced, however, the importance of credible assurances comes to the fore" (Monteiro 2009, 3).

The idea that non-credible assurances lead to conflict, and power undermines the credibility of assurances, is simple and compelling. Yet the set of interactions in this argument is sparse: a state complies or not, another offers a punishment or a reward.[12] Once we allow for diplomatic negotiations over the terms of peace (Fearon 1995; Powell 2006), it is unclear whether non-credible assurances cause war, and whether assurances are problematic when they are offered by a stronger party.

The canonical bargaining model offers some insights (Fearon 1995). Greater power makes war more attractive and encourages a more aggressive bargain-

[11] CNN (2018).

[12] In line with this reasoning, the formal literature on deterrence typically assumes that states do not negotiate over the terms of a resolution Fearon (2002); Powell (1990, 2015). For exceptions, see Debs (N.d.); Sechser (2018).

ing stance, heightening the risk of war (see, e.g., Banks 1990; Debs N.d.; Sechser 2018). Consider a one-shot ultimatum game, where the proposer is strong or weak, and chooses an offer, uncertain of the receiver's resolve. A stronger proposer fares better in war and chooses a more aggressive and hence riskier offer. While useful, this insight is based on a one-shot interaction, and it is thus silent on the effect of assurances.

Now allow states to interact over multiple periods. We may then conclude that power imbalance leads to conflict. Yet we may also conclude that war is caused by the *weaker* party's non-credible assurances and, therefore, that greater power *reduces* the risk generated by non-credible assurances.

To see this, note that in the canonical model, commitment problems cause war by inducing the declining state to strike preventively (Fearon 1995; Powell 2006). In this set-up, an assurance is a promise of future generosity made by the rising state. It is not credible if it does not reflect the future balance of power. The standard interpretation is that the larger is the power shift, the greater are the odds of war, since the declining state has more to lose in condoning the weaker party's rise (Powell 2006, 182-3). An alternative interpretation is that the weaker is the rising state initially, then the more likely is war, as it is more attractive for the declining state, making any power shift less tolerable.[13] In short, the canonical model produces the right result - power imbalance causes war - but the wrong mechanism - assurances

[13]Technically, war obtains when the bargaining range does not overlap with the set of feasible offers. The bargaining range is anchored around the

are made by the weak state, and greater power improves the credibility of assurances.

To understand why assurances are problematic when offered by a stronger

initial power balance. The weaker is the rising state initially, the more likely is any power shift to move the bargaining range outside the set of feasible offers. Consider an infinitely-repeated game where country 1 is rising and country 2 is declining between periods t and $t+1$ (Powell 2006, 182). War occurs if $\delta M_1(t+1) - M_1(t) > B - [M_1(t) + M_2(t)]$, where δ is the common discount factor, $M_i(t)$ is i's minmax payoff at time t, i.e. the payoff that it could secure by unilaterally going to war, and B is the present value of the flow of pies. Powell (2006, 182-3) interprets the left-hand side as the per-period shift in the distribution of power: "Thus the inability to commit leads to inefficient outcomes when the per-period shift in the distribution of power is larger than the bargaining surplus." Yet the left-hand combines the per-period shift in power from period $t+1$ onward, if it does occur, and the minmax payoff of country 1 in period t. Rewrite the condition as $\delta[M_1(t+1) - M_1(t)] > (1-\delta)M_1(t) + (B - [M_1(t) + M_2(t)])$. War is inevitable when the per-period shift from next period onward is greater than the maximum value that country 2 could obtain peacefully in the current period, i.e. holding country 1 at its minmax payoff and extracting the full bargaining surplus. Holding fixed the power shift ($\delta[M_1(t+1) - M_1(t)]$) and the bargaining surplus ($B - [M_1(t) + M_2(t)]$), this is condition is more likely to hold as country 1 is initially weaker, i.e. as $M_1(t)$ decreases.

party, we may turn to a reputational framework. Compliance in an early interaction could signal weakness or lack of resolve, which the enemy could exploit in future interactions, a phenomenon called the "ratchet effect" in Economics (Laffont and Tirole 1988). If assurances of future generosity are not credible, would war obtain, especially if assurances are offered by strong states?

Fey, Meirowitz and Ramsay (2013) are skeptical that non-credible assurances cause conflict. Going further, they claim that a proposer would *not* change its offer after learning that the receiver is weak. The logic is as follows. Two states divide a pie. The proposer is uncertain about the receiver's cost of war, which takes a binary value in the baseline model, and it may rescind its offer after it is accepted but before it is implemented. In equilibrium, if the proposer makes an aggressive offer, which only the high-cost receiver accepts, then it does not increase its demands after it is accepted. The reason is that the aggressive offer is the reservation value of the high-cost receiver. The proposer is already extracting all the surplus of an agreement with this type; no other offer would be strictly better.

While the claim is thought provoking, it appears to depend on the fact that the states divide a single pie and the game ends after an agreement is implemented. If states bargain over a flow of payoffs, and the proposer can commit to honoring any current offers but not any future offers, then it will make a more aggressive offer after learning that the receiver is weak. This is a feature of existing models on the ratchet effect; it is also a feature of the model below.[14] The question is whether non-credible assurances cause conflict.

The most prominent argument that non-credible assurances cause conflict, especially if they come from strong states, may be by Todd Sechser, who describes the phenomenon as "Goliath's curse" (Sechser 2010). In this game, two states play the ultimatum bargaining game twice. In any period, the challenger demands a share of the issue from the target, who may accept or reject. The balance of power is known and the challenger is uncertain about the target's resolve, or its cost of fighting. The two states disagree over the likelihood that the game will continue to a second period. The weaker state believes that a future interaction is more likely. The greater is the power imbalance, the greater is the disagreement about the likelihood of a future interaction, and the greater is the likelihood that bargaining breaks down (Sechser 2010, 641-645).

The model does provide an answer to the above questions, in line with the informal argument in the deterrence literature, but the link between power imbalance and conflict is tenuous. It is not clear why revising a bargaining stance based on prior information is the purview of strong countries, or why

[14] See the two-period game of Laffont and Tirole (1988), the finite-horizon "rental model" of Hart and Tirole (1988, 514-516), with short-term commitment but no long-term commitment, and the "no-commitment" infinite-horizon model of Fearon and Jin (2021, 29-35).

the weak state should believe future interactions to be more likely.[15]

The literature on fighting and bargaining can provide some additional insights (Baliga and Sjöström 2023; Fearon and Jin 2021; Powell 2004*a*). Admittedly, this literature is focused on explaining the duration of conflict, by relaxing the standard assumption that war is a game-ending move. As a baseline, it assumes away the problem of non-credible assurances considered here, by assuming that any offer, once accepted, is implemented, ending the game. Fearon and Jin (2021, 29-35) is a prominent exception. Their model implies that non-credible assurances cause war when uncertainty centers on capabilities but not when uncertainty centers on resolve.[16]

The logic is complex but may be summarized as follows. In repeated interactions, the proposer competes with future versions of itself. It would like to commit to aggressive terms, but doing so may mean forgoing a surplus with some types. In this case, not only is the assurance problem assumed away, but it may be turned on its head. The proposer, competing with future versions of itself, could in equilibrium cede all the surplus instantaneously.[17]

[15]See, e.g., Alt, Calvert and Humes (1988); Kreps and Wilson (1982); Selten (1978).

[16]On uncertainty on capabilities being more dangerous than uncertainty on resolve, see, e.g., Fey and Ramsay (2011).

[17]Ronald Coase conjectured that a monopolist would cede all the surplus in a durable-goods market, an idea now known as the "Coase conjecture" (Coase 1972; Gul, Sonnenschein and Wilson 1986; Hart and Tirole 1988).

If uncertainty is over private values (as when uncertainty centers on resolve - i's cost of war does not affect j's cost of war), then the proposer earns a surplus with all types of the receiver, and it will want to offer more generous terms over time to earn additional surpluses. As the time between offers goes to zero, the proposer is forced to make the most generous offer arbitrarily quickly, and peace becomes instantaneous on terms most generous to the receiver. This result holds whether or not the proposer can commit to future offers.

If uncertainty is over interdependent values (as when uncertainty centers on capabilities - i's capabilities affect the probability that i wins and j loses), then the proposer may not earn a surplus with all types of the receiver; it may experience ex post regret. If the proposer can commit to future offers, then war duration is bounded away from zero (Baliga and Sjöström 2023; Deneckere and Liang 2006; Fearon and Jin 2021). The proposer balances surpluses and losses against different types and there is a limit on the speed at which it offers the most generous offer. If the proposer cannot commit to future offers, then the receiver never accepts a screening offer, and war is even longer (Fearon and Jin 2021, 29-35). The proposer begins with a series of non-serious offers. As the receiver proves its mettle on the battlefield, it convinces the proposer of its high capabilities, extracting a generous offer.

These are powerful results, but they are silent on the effect of non-credible assurances away from the limit case of frictionless bargaining. Uncertainty on resolve could cause war. Proposers could make a screening and ratchet up their demands after any sign of irresolution. Uncertainty on capabilities does not necessarily produce ex post regret.

I show in a set of simple one- and two-period games that non-credible assurances do not cause conflict, whether uncertainty centers on resolve or capabilities. If non-credible assurances allow the proposer to ratchet up its demands in period 2 after learning of its enemy's weakness, then a rational receiver simply demands some compensation in period 1 for revealing its type. Non-credible assurances shift the bargaining range but do not affect the proposer's risk-return tradeoff or the probability of war.

One consequential difference between resolve and capabilities is the latter's dynamic implications. Resolve only affects payoffs obtained during conflict. Capabilities also affect payoffs after conflict, by influencing the probability of a decisive victory and the probability of a stalemate.[18] A decisive victory lets a state impose its favorite outcome in the future. A stalemate lets a state extract future concessions. As such, when uncertainty centers on capabilities, dynamic considerations increase the return of an aggressive offer. The weaker receiver is willing to accept less favorable terms, worrying about its ability to prevail, and worrying too about its ability to produce a stalemate, if the balance of power favors the proposer. Herein lies a compelling mechanism whereby power imbalance produces conflict. A powerful proposer is tempted to run the risk of war, exploiting the weak receiver's fear of a collapse, which would obviate the need for future concessions.

[18]See, e.g., Powell (2004*b*, 346); Fearon and Jin (2021, 6-10).

This dynamic also explains how states may be mutually optimistic about their path to victory. Whether mutual optimism stands as a compelling rationalist explanation for war has been contested. Fey and Ramsay (2007) showed that if a factor causes war if and only if it is necessary and sufficient for war, then mutual optimism and war cannot both occur in equilibrium. Others disputed the claim (see, e.g., Slantchev and Tarar 2011). Debs (2022) proposed relaxing the criterion for causality. No other accepted cause of war, such as information and commitment problems, is necessary and sufficient for war. If a factor instead causes war if and only if it increases its probability, then mutual optimism may cause war and mutual optimism and war can both occur in equilibrium. Some states fight because they truly believe that they will win. Others fight because they are resolved, even if they are not very sanguine about their ability to prevail. Given this complex inference problem, rational states may each receive a favorable signal about the balance of power and believe that they can win, even as their enemy professes confidence in victory.

While complex sources of uncertainty explains how rational countries may be mutually optimistic about the balance of power, it does not characterize the different paths to victory pursued by the opposing states, since war is a game-ending move. I address this issue by considering a two-period game.

I show that if capabilities have a greater effect on war payoffs than resolve for weak states, and the reverse is true for strong states, then there is equilibrium where states are mutually optimistic about their path to victory.

The strong proposer pools on an aggressive offer in period 1, hoping that the receiver lacks capabilities to survive an initial encounter. The receiver rejects the offer if it has high resolve or high capabilities, hoping that the proposer lacks the resolve to continue the fight, and will sue for peace after an initial stalemate with a generous offer. I spell out the analysis in the next section.

3 Game-Theoretic Model

Consider a game between two countries, A and B, who interact for one or two periods, dividing a pie of size 1 in each period. Country A first proposes a division of the pie, where country i keeps x_i, $x_A + x_B = 1$. If country B accepts the offer, it is implemented and the play proceeds to any future period. If country B rejects, fighting ensues. Countries discount future payoffs by factor $\delta \in (0, 1)$.

Fighting is costly, imposing cost c_i to country i. With probability d, fighting is decisive and the winner of the conflict obtains the current and any future pie. With probability $1 - d$, fighting is indecisive and the game proceeds to any future period. If fighting is decisive, country i prevails with probability p_i, where $p_A + p_B = 1$.

Countries differ in their resolve and in their capabilities. Write a country's type as $t_i = (r_i, \kappa_i)$. Country i's resolve, r_i, takes one of two values, $r_i \in \{\underline{r_i}, \overline{r_i}\}$, where $\underline{r_i} < \overline{r_i}$. Greater resolve means a greater willingness to make the necessary sacrifices to fight for the issue, or a lower cost of war,

$c_i(r_i)$ is decreasing in r_i. Country i's capabilities, κ_i, take one of two values, $\kappa_i \in \{\underline{\kappa_i}, \overline{\kappa_i}\}$, where $\underline{\kappa_i} < \overline{\kappa_i}$. Greater capabilities increase the probability of victory, should fighting be decisive. In turn, the probability that fighting is decisive is increasing in the disparity of capabilities. Formally, $p_i(\kappa_A, \kappa_B)$ is increasing in country i's own capabilities (κ_i) and decreasing in its enemy's capabilities (κ_j, $j \neq i$). $d(\kappa_A, \kappa_B)$ is increasing in κ_A and decreasing in κ_B if $\kappa_A > \kappa_B$ (and, conversely, decreasing in κ_A and increasing in κ_B if $\kappa_A < \kappa_B$). Also, greater capabilities unambiguously increase a country's war payoff, i.e. $p_i(\kappa_A, \kappa_B)d(\kappa_A, \kappa_B)$ is increasing in κ_i for any κ_j, for any i, $j \neq i$. Finally, I assume that all (static) war payoffs are positive, i.e. $p_i(\kappa_A, \kappa_B)d(\kappa_A, \kappa_B) - c_i(r_i) > 0$ for any κ_A, κ_B, r_i, for any i.

In the full model, there is two-sided incomplete information on both dimensions. Country i knows its own type t_i and is uncertain about its enemy's type t_j, $i \neq j$. Let country i's prior be that country j's resolve takes the high value $\overline{r_j}$ with probability μ_{j0}, updated to probability μ_{jt} at the end of period t. Let country i's prior be that country j's capabilities take the high value $\overline{\kappa_j}$ with probability θ_{j0}, updated to probability θ_{jt}, at the end of period t. I enrich the informational environment gradually. As a baseline, I assume that country A's type is common knowledge. I consider the case where country A is uncertain about country B's resolve and then about its capabilities. Finally, I consider the full model, where both countries are uncertain about each other's resolve and capabilities.

I solve this game for a weak sequential equilibrium, where strategies are optimal given beliefs, and beliefs are consistent with Bayes' rule along the equilibrium path (Osborne 2004, 328). Write σ_i for a strategy for player i and σ for a strategy vector for both players $\sigma = (\sigma_A, \sigma_B)$. Use * to label equilibrium strategies. I solve for an equilibrium where country A plays a pure strategy and country B plays a cut-off strategy after any history, accepting if and only if the offer is greater than some minimum demand $\underline{x_{Bt}}$, as a function of country B's type and of the history of the game. I further assume that country B is indifferent about accepting and rejecting its minimum demand $\underline{x_{Bt}}$, and that beliefs at all minimum demands are consistent with Bayes' rule, whether or not they are offered in equilibrium.[19]

I ask whether non-credible assurances may cause conflict, especially when they come from the stronger party. In the repeated version of this bargaining game, an *assurance* is a promise in period 1 to honor the current offer in period 2, if the receiver accepts the offer in period 1. Assurances may not be credible. If the receiver's decision to accept an offer suggests that it is relatively weak or irresolute, the proposer may want to make a more aggressive offer in period 2, in what is typically called a "ratchet effect" (see, e.g., Fearon and Jin 2021; Hart and Tirole 1988; Laffont and Tirole 1988).

[19]These assumptions pin down a unique value for each minimum demand after any history. We may need to specify beliefs that are not consistent with equilibrium strategies away from the minimum demands, to ensure that country B plays a cut-off strategy. See footnote 45.

To trace the effect of non-credible assurances, I compare three versions of this game. First, the players interact for only one period. There is no shadow of the future and no assurances to be offered. Second, the players interact for two periods, and the proposer can commit to the current offer in period 2. If the receiver accepts in period 1, then the game ends and the two players get a share of the pie in each period equal to the terms agreed upon in period 1.[20] There is now a shadow of the future and assurances are credible. Third, players interact for two periods, and the proposer cannot commit to honoring the current offer in period 2. If the receiver accepts in period 1, then they receive their share of that pie and proceed to period 2, where the proposer offers a new division of that pie, which the receiver can accept or reject. There is here a shadow of the future and assurances are not credible.

Non-credible assurances cause conflict if and only if the set of parameters where war occurs in the first period of the repeated game, where assurances are non-credible (the third version described above), is strictly wider than

[20]This is the standard way to model commitment (see, e.g., Fearon and Jin 2021, 6,12). We could consider two slight modifications to the model. In one, the proposer commits to the current offer in period 2, and the receiver chooses in period 2 whether to accept or reject that offer. In another, the proposer proposes a division of the pie in period 1 and commits to a generous offer in period 2, which the receiver could accept and reject then. The results would remain unchanged.

the set of parameters where war occurs in the first period of the repeated game, where assurances are credible (the second version described above). *Dynamic considerations cause conflict* if and only if the set of parameters where war occurs in the first period of the repeated game, whether or not assurances are credible (the second and third versions described above), is strictly wider than the set of parameters where war occurs in the one-shot game (the first version described above).

I also evaluate the effect of the power preponderance on conflict. *Power preponderance causes conflict by undermining assurances* if the causal effect of non-credible assurances, described above, is greater when the proposer is stronger than the receiver than if the roles are reversed, everything else equal. *Power preponderance causes conflict through dynamic considerations* if the causal effect of dynamic considerations, described above, is greater when the proposer is stronger than the receiver than if the roles were reversed, everything else equal.

I also ask whether belligerents are mutually optimistic at the war's onset. Scholars have adopted different definitions of mutual optimism.[21] They have typically done so in the context of one-shot games. In this context, we may ask whether countries have incompatible beliefs about the balance of power, which determines whether they win or lose a war. The dynamic game

[21] See, e.g., Debs (2022); Fey and Ramsay (2007); Slantchev and Tarar (2011).

analyzed here allows for a richer set of outcomes. An initial engagement may be indecisive and lead to an improved compromise in the future.

Formally, I say that belligerents are *mutually optimistic about the balance of power* if they hold incompatible beliefs about the probability that they win in period 1, should the initial engagement be decisive, i.e. $E_{A1}[p_A(\kappa_A, \kappa_B)|I_{A1}] + E_{B1}[p_B(\kappa_A, \kappa_B)|I_{B1}] > 1$, where $E_{it}[x|I_{it}]$ is the expected value of the variable x for country i in period t, given its information I_{it} in period t. I also define a *path to victory* as a sequence of actions and outcomes, following the outbreak of war in period 1, which leads either to victory in war or to eventual peace under the most favorable peaceful terms allowed in equilibrium. Let h_i be a path to victory for player i. I wish to characterize such a path to victory. I say that belligerents are *mutually optimistic about their path to victory* if they hold incompatible beliefs about such histories, i.e. $E_{A1}[h_A|I_{A1}] + E_{B1}[h_B|I_{B1}] > 1$. I assume that rational players understand that war is an endogenous outcome and, as such, they use not just their private information but also their understanding of equilibrium strategies in evaluating their beliefs, i.e. $I_{it} = \{t_i, \sigma^*\}\ \forall i$.[22]

[22]See Holmström and Myerson (1983). This version is what Debs (2022); Fearon (N.d.*b*) call "interim 2" mutual optimism.

3.1 One-Sided Incomplete Information. Uncertainty on Resolve.

Assume that the proposer's type is common knowledge, the receiver's type is its private information, and there is only uncertainty about the receiver's resolve. For simplicity, write the variables that are known and fixed as constants, p_A, p_B, d, c_A.

First consider a one-shot game. The equilibrium takes a familiar form:

Lemma 1 *Assume that there is one-sided incomplete information, uncertainty about resolve, and players interact over one period. In any equilibrium, country A offers*

$$x^*_{B1} = \begin{cases} \underline{x_{B1}}(\overline{r_B}) & \text{if } \mu_{B0} \geq \mu'_B \\ \underline{x_{B1}}(\underline{r_B}) & \text{if } \mu_{B0} < \mu'_B \end{cases} \tag{1}$$

Country B accepts if and only if $x_{B1} \geq \underline{x_{B1}}(r_B)$, where

$$\underline{x_{B1}}(r_B) = p_B d - c_B(r_B) \tag{2}$$

$$\frac{\mu'_B}{1-\mu'_B} = \frac{c_B(\underline{r_B}) - c_B(\overline{r_B})}{1 - d + c_A + c_B(\overline{r_B})} \tag{3}$$

In a one-shot game, country B's minimum demand is its (static) war payoff. Country A runs a risk-return tradeoff when choosing between the two minimum demands. The more aggressive offer produces better peaceful terms, gaining the difference in costs if country B has a low resolve (a return of $c_B(\underline{r_B}) - c_B(\overline{r_B})$), at the risk of losing the bargaining surplus if country B has a high resolve $(1 - d + c_A + c_B(\overline{r_B}))$. Country A is more tempted to make the aggressive offer and run the risk of war if, everything else equal, the difference between the two minimum demands is large and the bargaining surplus if country B has a high resolve is small.

Now assume that players interact over two periods and player A can commit to implementing the current offer in period 2. I conclude:

Lemma 2 *Assume that there is one-sided incomplete information, uncertainty about resolve, players interact over two periods, and country A can commit to implementing the current offer in period 2. The following forms an equilibrium of the game. In period 1, country A offers*

$$x^*_{B1} = \begin{cases} \underline{x_{B1}}(\overline{r_B}) & \text{if } \mu_{B0} \geq \mu'_B \\ \underline{x_{B1}}(\underline{r_B}) & \text{if } \mu_{B0} < \mu'_B \end{cases} \tag{4}$$

Country B accepts if and only if $x_{B1} \geq \underline{x_{B1}}(r_B)$, where

$$\underline{x_{B1}}(r_B) = p_B d - \frac{c_B(r_B)}{1+\delta} + \frac{\delta}{1+\delta}(1-d)[p_B d - c_B(\overline{r_B})] \tag{5}$$

In period 2, if war occurred in period 1 and reached a stalemate, country A believes that $\mu_{B1} = 1$ and offers $x^*_{B2} = p_B d - c_B(\overline{r_B})$. Country B accepts if and only if $x_{B2} \geq p_B d - c_B(r_B)$.

This Lemma shows that the condition for war is the same in the first period of a two-period game with commitment as it was in the one-shot game. The logic is as follows. For a graphical illustration, see the top two panels of Figure 3.

– Figure 3 here –

The minimum demand of each type is anchored around its static war payoff, now taking into account that the offer is received over two periods while the cost of war would be paid once ($c_B(r_B)$ is divided by $1+\delta$). Country B also demands compensation for the dynamic consequences of peace (the last term of equation (5)). If country B declares war, then it could convince country A that it has a high resolve, and receive a generous offer in period 2 ($p_B d - c_B(\overline{r_B})$) if war reaches a stalemate (with probability $1-d$). This compensation is the same for each type. As such, the proposer's risk-return tradeoff is unchanged. The return for the aggressive offer is the same, equal to the difference in the costs of war (the difference $\frac{c_B(r_B)-c_B(\overline{r_B})}{1+\delta}$ is obtained in each of two periods, and thus multiplied by $1+\delta$). The risk of the aggressive offer is the same, equal to the size of the bargaining range when there is war with the resolved type. Therefore, the conditions for war remain the same.

Now assume that players interact over two periods and country A cannot commit to any offer in period 2. I conclude:

Lemma 3 *Assume that there is one-sided incomplete information, uncertainty about resolve, players interact over two periods, and country A cannot commit to implementing the current offer in period 2. The following forms* *an equilibrium of the game. In period 1, country A offers*

$$x^*_{B1} = \begin{cases} \underline{x_{B1}}(\overline{r_B}) & \text{if } \mu_{B0} \geq \mu'_B \\ \underline{x_{B1}}(\underline{r_B}) & \text{if } \mu_{B0} < \mu'_B \end{cases} \tag{6}$$

Country B accepts if and only if $x_{B1} \geq \underline{x_{B1}}(r_B)$*, where*

$$\underline{x_{B1}}(r_B) = p_B d - (1-\delta)c_B(r_B) + \delta(1-d)[p_B d - c_B(\overline{r_B})] \tag{7}$$

In period 2, play proceeds as in Lemma 1 *where country A's beliefs are updated to* μ_{B1}*, as specified in the Appendix.*

This Lemma states that the condition for war is the same in any dynamic game, whether or not the proposer's assurances are credible. The fact that the proposer cannot commit to generous terms in period 2 does not affect the odds of war. It simply shifts the bargaining range in period 1. The logic is as follows. For a graphical illustration, see the bottom two panels of Figure 3.

As in the game with commitment, the compensation for the dynamic consequences of peace (the last term of equation (7)) is the same for both types, the ability to convince the proposer that the receiver has a high resolve, leading to a generous offer in period 2 after a stalemate. This means that, again, the proposer's risk-return tradeoff is unchanged. The return for the aggressive offer is equal to the difference in the costs of war (the proposer gets $(1-\delta)(c_B(\underline{r_B}) - c_B(\overline{r_B}))$ in the current period and $c_B(\underline{r_B}) - c_B(\overline{r_B})$ next period, which it discounts by factor δ). The risk of an aggressive offer is again the size of the bargaining range in a war with the resolved type.

Put differently, the conditions for war remain the same because country B's reservation value for war in period 1 is pinned down by the period-1 balance of power. Country B's minimum demand leaves it indifferent between war and peace in period 1. If country B expects country A to ratchet up its demand in period 2, then it demands some compensation in period 1. The current value of the flow of payoffs obtained by country B in peace remains the same, and so does the flow of payoffs obtained by country A, leaving its risk-return tradeoff unchanged.

Taking stock, I conclude:

Result 1 *Assume that there is one-sided incomplete information and uncertainty about resolve. Non-credible assurances, dynamic considerations, and power imbalance have no causal effect on conflict.*

3.2 One-Sided Incomplete Information. Uncertainty on Capabilities.

Now assume that there is only uncertainty about the receiver's capabilities. For simplicity, write the variables that are known and fixed as constants, c_A, c_B, and write the probability of each country prevailing, should fighting be decisive, and the probability of a decisive fight, as solely a function of country B's type, $p_A(\kappa_B)$, $p_B(\kappa_B)$, $d(\kappa_B)$.

First consider a one-shot game. The equilibrium takes a familiar form:

Lemma 4 *Assume that there is one-sided incomplete information, uncertainty about capabilities, and players interact over one period. In any equilibrium, country A offers*

$$x^*_{B2} = \begin{cases} \underline{x_{B2}}(\overline{\kappa_B}) & \text{if } \theta_{B1} \geq \theta'_B \\ \underline{x_{B2}}(\underline{\kappa_B}) & \text{if } \theta_{B1} < \theta'_B \end{cases} \tag{8}$$

Country B accepts if and only if $x_{B2} \geq \underline{x_{B2}}(\kappa_B)$*, where*

$$\underline{x_{B2}}(\kappa_B) = p_B(\kappa_B)d(\kappa_B) - c_B \tag{9}$$

$$\frac{\theta'_B}{1-\theta'_B} = \frac{p_B(\overline{\kappa_B})d(\overline{\kappa_B}) - p_B(\underline{\kappa_B})d(\underline{\kappa_B})}{1 - d(\overline{\kappa_B}) + c_A + c_B} \tag{10}$$

In a one-shot game, country B's minimum demand is its (static) war payoff. The risk-return tradeoff balances the more favorable peaceful terms from targeting the type with low capabilities $(p_B(\overline{\kappa_B})d(\overline{\kappa_B}) - p_B(\underline{\kappa_B})d(\underline{\kappa_B}))$ with the cost of losing the bargaining surplus in a war against the type with high capabilities $(1 - d(\overline{\kappa_B}) + c_A + c_B)$.

Now assume that players interact over two periods and country A can commit to implementing the current offer in period 2. I conclude:

Lemma 5 *Assume that there is one-sided incomplete information, uncertainty about capabilities, players interact over two periods, and country A can commit to implementing the current offer in period 2. The following forms an equilibrium of the game. In period 1, country A offers*

$$x^*_{B1} = \begin{cases} \underline{x_{B1}}(\overline{\kappa_B}) & \text{if } \theta_{B0} \geq \hat{\theta}_B \\ \underline{x_{B1}}(\underline{\kappa_B}) & \text{if } \theta_{B0} < \hat{\theta}_B \end{cases} \tag{11}$$

Country B accepts if and only if $x_{B1} \geq \underline{x_{B1}}(\kappa_B)$*, where*

$$\underline{x_{B1}}(\kappa_B) = p_B(\kappa_B)d(\kappa_B) - \frac{c_B}{1+\delta} + \frac{\delta}{1+\delta}(1 - d(\kappa_B))[p_B(\overline{\kappa_B})d(\overline{\kappa_B}) - c_B] \tag{12}$$

$$\frac{\hat{\theta}_B}{1-\hat{\theta}_B} = \frac{(1+\delta)[p_B(\overline{\kappa_B})d(\overline{\kappa_B}) - p_B(\underline{\kappa_B})d(\underline{\kappa_B})] + \delta[d(\underline{k_B}) - d(\overline{k_B})][p_B(\overline{\kappa_B})d(\overline{\kappa_B}) - c_B]}{1 - d(\overline{\kappa_B}) + c_A + c_B} \tag{13}$$

In period 2, after any history, country A offers $x^*_{B2} = p_B(\overline{\kappa_B})d(\overline{\kappa_B}) - c_B$*. Country B accepts if and only if* $x_{B2} \geq p_B(\kappa_B)d(\kappa_B) - c_B$ *(beliefs are specified in the Appendix).*

This Lemma suggests that dynamic considerations cause war by making the aggressive offer optimal for a wider set of parameters ($\hat{\theta}_B > \theta'_B$). The logic is as follows. For a graphical illustration, see the top two panels of Figure 4.

– Figure 4 here –

The minimum demand of each type is anchored around its static war payoff, now taking into account that the offer is received over two periods while the cost of war would be paid once ($c_B(r_B)$ is divided by $1+\delta$). Country B also demands compensation for the dynamic consequences of peace (the last term of equation (12)). If country B declares war, then it could convince country A that it has strong capabilities and receive a generous offer in period 2 ($p_B(\overline{\kappa})d(\overline{\kappa}) - c_B$) if war reaches a stalemate (with probability $1 - d(\overline{\kappa})$).

Here, a player's type affects its ability to win decisively and to impose a stalemate. The returns of an aggressive offer increase for any balance of power. The proposer can exploit any advantage of targeting the weaker type for an additional pie ($p_B(\overline{\kappa_B})d(\overline{\kappa_B}) - p_B(\underline{\kappa_B})d(\underline{\kappa_B})$ is multiplied by $1 + \delta$). The returns of an aggressive offer further increase when the balance of power favors the proposer. When this is the case, the weaker type is especially concerned about its ability to impose a stalemate and extract concessions in the second period, and it is willing to sue for peace on less favorable terms ($d(\underline{k_B}) - d(\overline{k_B})$ is positive).

Now assume that players interact over two periods and player A cannot commit to implementing the current offer in period 2. I conclude:

Lemma 6 *Assume that there is one-sided incomplete information, uncertainty about capabilities, players interact over two periods, and country A cannot commit to implementing the current offer in period 2. The following* *forms an equilibrium of the game. In period 1, country A offers*

$$x^*_{B1} = \begin{cases} \underline{x_{B1}}(\overline{\kappa_B}) & \text{if } \theta_{B0} \geq \hat{\theta}_B \\ \underline{x_{B1}}(\underline{\kappa_B}) & \text{if } \theta_{B0} < \hat{\theta}_B \end{cases} \tag{14}$$

Country B accepts if and only if $x_{B1} \geq \underline{x_{B1}}(\kappa_B)$, where

$$\underline{x_{B1}}(\kappa_B) = p_B(\kappa_B)d(\kappa_B) - (1-\delta)c_B + \delta(1 - d(\kappa_B))[p_B(\overline{\kappa_B})d(\overline{\kappa_B}) - c_B] \tag{15}$$

and $\hat{\theta}_B$ is as given in equation (13). In period 2, play proceeds as in Lemma 4 where country A's beliefs are updated to θ_{B1}, as specified in the Appendix.

This Lemma implies that non-credible assurances do not cause war when uncertainty centers on capabilities. For a graphical illustration, see the bottom two panels of Figure 4.

Again, country B's minimum demand leaves it indifferent between war and peace, under the balance of power in period 1. If country A can ratchet up its demand in period 2, then country B demands some compensation in period 1. The current value of the flow of payoffs obtained by country B in peace remains the same, and so does the flow of payoffs obtained by country A, and its risk-return tradeoff is unaffected.

Since non-credible assurances do not cause war, the effect of power imbalance remains the same. If country A is stronger than country B, it is more tempted to target the type with low capabilities, exploiting the latter's fear that it could not produce a stalemate.

Result 2 *Assume that there is one-sided incomplete information and uncertainty about capabilities. Non-credible assurances do not cause conflict, dynamic considerations do. Power preponderance causes conflict through dynamic considerations, holding fixed the bargaining surplus (*$1 - d(\overline{\kappa_B}) + c_A + c_B$*), the effect of type on capabilities (*$p_B(\overline{\kappa_B})d(\overline{\kappa_B}) - p_B(\underline{\kappa_B})d(\underline{\kappa_B})$*), and the payoff of the type with high capabilities (*$p_B(\overline{\kappa_B})d(\overline{\kappa_B}) - c_B$*).*

3.3 Two-Sided Incomplete Information Two Sources of Uncertainty

Now consider a model of two-sided incomplete information where each country is uncertain about its enemy's resolve and capabilities, and country A is stronger than country B. Assume that capabilities have a larger effect than resolve on the war payoffs of a weak state, with the reverse being true for a strong state. These sustain an equilibrium with some separation, on capabilities for the weak state and resolve for the strong state. The proposer targets the receiver with weak capabilities (and weak resolve), hoping that it will collapse after an initial fight, and if the receiver survives the initial fight, the proposer sues for peace with a generous offer if it has a low resolve. The receiver rejects the offer if it has strong capabilities or strong resolve, hoping that it can survive the initial encounter and the proposer has a low resolve and will make a generous offer after the initial stalemate. For a graphical illustration, see Figure 5.

Lemma 7 *Assume that country A is stronger than country B and the following conditions hold:*

$$p_A(\overline{\kappa_A}, \kappa_B)d(\overline{\kappa_A}, \kappa_B) - p_A(\underline{\kappa_A}, \kappa_B)d(\underline{\kappa_A}, \kappa_B) < c_A(\underline{r_A}) - c_A(\overline{r_A}) \quad \forall \kappa_B \quad (16)$$

$$p_B(\kappa_A, \overline{\kappa_B})d(\kappa_A, \overline{\kappa_B}) - p_B(\kappa_A, \underline{\kappa_B})d(\kappa_A, \underline{\kappa_B}) > c_B(\underline{r_B}) - c_B(\overline{r_B}) \quad \forall \kappa_A \quad (17)$$

Under the above conditions, and others specified in the appendix, there is an equilibrium where the following occurs along the equilibrium path. In the first period, all types of country A pool in making an offer $x^*_{B1} = \underline{x_{B1}}(\underline{r_B}, \underline{\kappa_B})$*, accepted by country B if and only if* $(r_B, \kappa_B) = (\underline{r_B}, \underline{\kappa_B})$*. In the second period, play proceeds as follows. If offer* x^*_{B1} *was accepted, then country A makes an offer* $x^{*'}_{B2}$ *accepted if and only if* $(r_B, \kappa_B) = (\underline{r_B}, \underline{\kappa_B})$*. If offer* x^*_{B1} *was rejected, then country A makes one of two offers,* $x^{*''}_{B2}$ *or* $x^{*'''}_{B2}$*. Offer* $x^{*''}_{B2} = \underline{x_{B2}}(\overline{r_B}, \overline{\kappa_B})$ *is made if and only if* $r_A = \underline{r_A}$*. It is accepted by any type of country B. Offer* $x^{*'''}_{B2} = \underline{x_{B2}}(\underline{r_B}, \overline{\kappa_B})$ *is made if and only if* $r_A = \overline{r_A}$*. It is accepted by country B if and only if* $(r_B, \kappa_B) \neq (\overline{r_B}, \overline{\kappa_B})$*.*

– Figure 5 here –

In this equilibrium, the following holds:

Result 3 *Assume that countries A and B have high capabilities. (i) Countries A and B are mutually optimistic about the balance of power. (ii) Countries A and B may be mutually optimistic about their path to victory, under* *additional circumstances specified in the appendix, where a path to victory for country A involves the defeat of country B in period 1, and a path to victory for country B involves either the defeat of country A in period 1 or a stalemate in period 1 and a generous offer* $x_{B2}^{*''}$ *in period 2 or, if country B has a high resolve, a stalemate in period 1, an aggressive offer* $x_{B2}^{*'''}$ *in period 2 and the defeat of country A in period 2.*

This result states that countries may be mutually optimistic about the balance of power, given the multidimensional nature of uncertainty (i) (Debs 2022). Assume that each country has high capabilities. An aggressive offer by country A reveals no information about its capabilities, since it pools in making the aggressive offer. A decision for war by country B does not reveal that it has high capabilities; it could have opted for war because of a high resolve. Thus, each country knows that it has high capabilities and remains uncertain about whether its enemy does. Countries hold incompatible beliefs about the balance of power, each believing that they have an edge in the upcoming fight.

Second, countries may be mutually optimistic about their path to victory given the nature of uncertainty and the effect of capabilities and resolve on their payoffs (ii). Assume that country B is a priori likely to have low capabilities and that such a type is likely to collapse, and that each country has high capabilities. Country A believes that country B will collapse in the first encounter. Country B believes that it would either defeat country A

or that it can survive the initial encounter, obtaining a generous offer from country A in period 2 if the latter has low resolve.

4 Discussion

I discuss here two of the model's main results: non-credible assurances in bargaining do not necessarily cause war; and rational states could be mutually optimistic about the balance of power and their path to victory, with the strong hoping that the weak collapses, and the weak hoping that the strong tires of the conflict.

4.1 On Assurances

The first result - that non-credible assurances in bargaining do not cause war - qualifies some claims in the literature (see, e.g., Monteiro 2009; Pauly 2019; Sechser 2010), but it is actually consistent with the canonical bargaining model (Fearon 1995; Powell 2006). In such a model, the inability of a rising state to commit not to use its increased power to ratchet up its future bargaining demands does not per se cause conflict. It simply shifts the bargaining range. Only when the power shift is large do commitment problems cause war.

Essentially, commitment problems cause bargaining breakdown when they allow each party to access incompatible war payoffs in quick succession. As such, they operate under a similar logic as first-strike advantages. By definition, first-strike advantages allow each party to access higher war payoffs by striking first. If such advantages are large, they eliminate the bargaining range, making war inevitable (Fearon 1995, 402-404).[23]

Standard treatments of commitment problems add a dynamic element to the interaction, but they follow the same logic. When power shifts are exogenous, commitment problems cause war only when power shifts are large (Fearon 1995; Powell 2006). When power shifts are endogenous and result from the common assent of both parties, they generally do not cause conflict, unless the mapping from capabilities to power is discontinuous or there are other irregularities (see, e.g., Fearon 1996, 14-15; Chadefaux 2011, 240). In all these cases, war obtains because large shifts, discontinuities, and irregularities allow each party to access incompatible war payoffs in quick succession.

When power shifts result from unilateral actions, each party may be able to access different war payoffs (see, e.g., Bas and Coe 2010; Debs and Monteiro 2014; Spaniel 2019). If shifts in the balance of power result from costly investments with delayed returns, then war may be inevitable, even in an infinite-horizon game, if information about an attempt to change the balance of power is imperfect (Debs and Monteiro 2014, 13-15). Only then can

[23]For a skeptical view of first-strike advantages, see Powell (1990, Chapter 5). More recent treatments include Baliga and Sjöström (2004); Debs (N.d.); Fearon (N.d.*a*).

a state militarize, evade its enemy's detection, and produce a fait accompli.[24]

If we allow states to invest in economic growth, then commitment problems may cause war, though again they do so most convincingly when there is a link between economic growth and military power or when, put differently, states can unilaterally impose different war payoffs (Monteiro and Debs

[24]Coe and Vaynman (2020, 348) argue instead that "asymmetric information in itself is not enough to cause arming or war." These obtain only if there is a transparency-security tradeoff, where greater transparency allows the monitoring side to exploit information for its advantage. Yet in Debs and Monteiro (2014, 13-15), there is no transparency-security tradeoff, and arming and war may nevertheless be inevitable. The difference comes from the fact that in Coe and Vaynman (2020), militarization attempts succeed or fail before the enemy can react, and intelligence services provide information about past failed attempts. (Intelligence can then trigger a punishment subgame and not be perfect to deter investments and secure peace.) If intelligence services instead inform states about ongoing militarization attempts, then imperfect information may cause bargaining breakdown, even if there is no transparency-security tradeoff. Imperfect information allows a state to present its enemy with a fait accompli, and access a significantly improved war payoff. Imperfect information, in turn, could derive from many reasons, including the transparency-security tradeoff (Coe and Vaynman 2020) or private information about the quality of the signal (Jelnov, Tauman and Zeckhauser 2017; Ma and Biran 2023).

2020). Indeed, if the pie divided between the two sides is endogenous, and an economically powerful state can use its influence on the international political economy to steal some of the surplus created by its counterpart, then a hold-up problem emerges, making peace costly and potentially making war inevitable in a finite-horizon game (Monteiro and Debs 2020, 259). [25]Yet even this temptation to steal can be disciplined in an infinite-horizon game, unless there is a link between economic growth and military power (Monteiro and Debs 2020, 260). If military power does not depend on economic output, then the two states should agree on efficient investment, with each state receiving a share of the pie commensurate with its military power. If military power does depend on economic output, however, efficient investment could allow the rising state to secure a larger share of the pie. The economically powerful state is tempted to steal some of the pie to constrain its enemy's rise. Only then does war become inevitable, by allowing each state to impose different war payoffs in quick succession.

4.2 On Competing Paths to Victory: An Illustration

I now turn to the empirical claim, that given mutual uncertainty about capabilities and resolve, rational belligerents could each see a path to victory, where the strong hopes to crush the weak, obviating the need for future concessions, and the weak hopes to exhaust the strong, who will not sue for

[25]See also Carnegie (2014).

peace to avoid the costs of war. I turn to a prominent case, the Pacific War, and argue that this description captures the strategic interaction.

The Pacific war featured a large imbalance in capabilities. By 1940, the United States's economy was 4.3 times the size of the Japanese economy and its military capabilities were around 4 times those of Japan.[26] Given this imbalance, some scholars argue that Japan's decision to initiate war escapes a rationalist framework, and derived from its excessive optimism (Snyder 1991, chapter 4; Taliaferro 2004, chapter 4; Record 2009, 1-5).

Others have stayed closer to a rationalist framework. They point out that Japanese decisionmakers opted for war, in full recognition of the long odds they faced, because they feared that inaction would lead to long-term decline under the economic influence of the United States (Copeland 2015; Monteiro and Debs 2020; Russett 1967; Sagan 1988). Put differently, any assurances that the United States would tolerate Japanese's economic and military rise was non-credible, making peace costly and war inevitable.

This account does not explain how rational decisionmakers could each see a path to victory.[27] The above model proposes a way to straddle the two competing perspectives. Rational belligerents could each see a path to victory because of fundamental uncertainty about resolve and capabilities. The United States hoped to destroy Japan's war-making potential and prevent

[26] Bolt and van Zanden (2014); Singer, Bremer and Stuckey (1972), version 6.0.

[27] Previous work on this question includes Reiter (2009); Weisiger (2013).

any resurgence of its aggressive foreign policy. Japan hoped to impose sufficient costs on the United States that it would sue for peace. The war ended when it became clear that Japan could not extract any additional concessions from the United States. Any costly invasion of the Japanese homeland became unnecessary, after the atomic attacks on Hiroshima and Nagasaki and the Soviet entry into the war.

Indeed, at the Casablanca conference of January 1943, President Roosevelt declared his intention of "ending any Japanese attempt in the future to dominate the Far East [...] not only in China but in the whole of the Pacific area." In his view, "peace can come to the world only by the total elimination of German and Japanese war power." As such, he was looking for the "unconditional surrender" of Germany, Italy, and Japan (Roosevelt 1958, 727). In October 1944, upon the landing of U.S. troops in the Philippines, President Roosevelt reiterated that the U.S.'s objective was to "strangle the Black Dragon of Japanese militarism forever" (Roosevelt 1944).

For their part, Japanese decisionmakers understood the severe power imbalance they faced, but they still saw a possible path to victory, predicated on imposing high costs of war on the United States. Ahead of the Imperial Conference of September 6, 1941, Japanese officials surmised that "it would be well-nigh impossible to expect the surrender of the United States. However, we cannot exclude the possibility that the war may end because of a great change in American public opinion, which may result from such factors as the remarkable success of our military operations in the South or the surrender of Great Britain" (Ike 1967, 153).[28]

Japan did enjoy some remarkable success in the first few months of the war, but the tides of the war turned with the battle of Midway of June 1942 and the Guadalcanal campaign of August to February 1943. Soon thereafter, Japan's strategy shifted from "attrition to one of inflicting a decisive defeat on the advancing foe" (Patalano 2015, 182). Still, the guiding principle remained the same: to impose sufficient costs on the enemy that it would sue for peace. In the summer of 1944, the military leadership wrote that the "only course left is for Japan's one hundred million people to sacrifice their lives by charging the enemy to make them lose the will to fight" (quoted in Irokawa 1995, 92). On January 20, 1945, the emperor accepted a new directive whereby the homeland would be the theater of the "final decisive battle" (Frank 1999, 84). In April, the government of new prime minister Kantaro Suzuki adopted a new master plan for the defense of the homeland, *Ketsu-Go*, or "Decisive" Operation (Frank 1999, 85). Japan capitulated before it could fully implement its new master plan.

Japan's strategic situation indeed deteriorated quickly. After Washington announced the capture of Okinawa on June 22nd, the emperor urged his cabinet to pursue "*concrete plans* to end the war," intensifying efforts to obtain Moscow's mediation in the conflict.[29] These efforts were unsuccessful.

[28]See also Agawa (1979, 232, 243-244); Wohlstetter (1962, 351).

[29]Quoted in Asada (1998, 500). See also Feis (1961, 174); Frank (1999, 221); Hasegawa (2005, 97).

On July 26th, the United States, the United Kingdom, and China issued an ultimatum in the Potsdam Declaration, calling for the "unconditional surrender of all the Japanese armed forces," demanding "convincing proof that Japan's war-making power is destroyed." Turning to Japan's governing institutions, the Allies insisted that "[t]here must be eliminated for all time the authority and influence of those who have deceived and misled the people of Japan into embarking on world conquest." Allied forces would occupy Japan until these objectives are met and "there has been established in accordance with the freely expressed will of the Japanese people a peacefully inclined and responsible government." Ominously, they declared that if their terms were rejected, "[t]he alternative for Japan is prompt and utter destruction" (Dougall 1960, doc. 1382).

In a press conference two days later, Prime Minister Suzuki declared that its government would just "ignore" it [*mokusatsu*] (quoted in Frank 1999, 234). On August 6th and 9th, the United States dropped atomic bombs on Hiroshima and Nagasaki, and Russia declared war on Japan on August 8th. The Japanese government accepted the Potsdam Declaration on August 10th, as long as it did not "comprise any demand which prejudices the Emperor's prerogatives as a sovereign ruler" (quoted in Gallicchio 2020, 148). The United States agreed that the emperor could remain under "the authority of the Supreme Commander of the Allied Powers," insisting that Japan's eventual government should express the free will of its people (quoted in Gallicchio 2020, 149). Japan officially accepted U.S. terms on August 15th, and the acts of surrender were signed on September 2nd (Gallicchio 2020, 161-162, 168-169).

The causes of Japan's surrender, and the role that the atomic attacks played in such a development, are a matter of controversy. Were the atomic attacks necessary to obtain Japan's surrender?

U.S. officials believed that the atomic bomb was instrumental in obtaining Japan's surrender, thus saving many lives in what would have been a costly invasion. Secretary of War Henry Stimson declared in 1947: "My chief purpose was to end the war in victory with the least possible cost in the lives of the men in the armies which I had helped to raise." After the Japanese decision to surrender, "[o]ur great objective was thus achieved, and all the evidence I have seen indicates that the controlling factor in the final Japanese decision to accept our terms of surrender was the atomic bomb" (Stimson 1947, 105-106). President Truman stated succinctly: "The dropping of the bombs stopped the war, saved millions of lives" (Truman 1960, 67).

Historians initially concurred (see, e.g., Feis 1961, 179). Revisionist historians, led by Gar Alperovitz, objected, arguing that the bomb was not necessary to obtain Tokyo's capitulation. Truman misunderstood Suzuki's response to the Potsdam Declaration: *mokusatsu* should not have been understood as "ignoring" or "rejecting" the ultimatum but instead as "withholding comment at this time," while the Cabinet debated how best to respond (Alperovitz 1965, 185). Ultimately, "the decision to use the weapon did not derive from overriding military considerations" (Alperovitz 1965, 237). Japan was already defeated militarily and willing to surrender, as shown by its outreach to the Soviet Union. U.S. officials knew that "either a Russian declaration of war or a change in the surrender terms was likely to bring capitulation" (Alperovitz 1965, 110). Instead, they used the bomb for two "political reasons": "the desire to end the Japanese war quickly" and the desire "to convince the Russians to accept the American plan for a stable peace" (Alperovitz 1965, 240).[30]

Disagreements on the importance of the atomic bomb lingered. Freedman and Dockrill (1994, 193) described the revisionist account as "now largely discredited among Western historians," but Alperovitz and Sherwin maintained their position (Alperovitz 1995*a*,*b*; Sherwin 1995, 2003). Others, such as Tsuyoshi Hasegawa, agree that the atomic attacks played a smaller role in obtaining Japan's capitulation than the Soviet entry into the war (see, e.g., Hasegawa 2005, 3, 140, 156, 183). Yet the bulk of the recent scholarship, based on some newly available evidence, does reject the revisionist interpretation (Asada 1998; Frank 1999; Heinrichs and Gallicchio 2019; Kuehn 2015; Miscamble 2011; Patalano 2015). Even Hasegawa agrees that the Japanese cabinet was seeking to obtain additional concessions from the Americans: "Soviet entry into the war shocked the Japanese even more than the atomic bombs because it meant the end of any hope of achieving a settlement short

[30]Sherwin (1975, 198-199) similarly contrasts Stimson's "*chief* purpose" with the two "other purposes" mentioned by Alperovitz (1965, 240).

of unconditional surrender" (Hasegawa 2005, 3).

Herein lies a crucial limitation of the revisionist case. It is impossible to distinguish the "military" and the "political" dimensions of Japan's surrender. Japan's military plan was to impose significant casualties on the Americans so as to extract additional political concessions. Even if it was clear that Japan would eventually be defeated, it could still hope to extract concessions from the United States for laying down its arms, if bringing about this defeat took time and a costly invasion of the home islands. And Japanese decisionmakers *were* hoping to extract more concessions from the United States until the very end. This fact was well known to U.S. officials at the time, as they intercepted and decoded diplomatic cables, and it is now well known to scholars as well. In short, it is possible to understand the U.S. decision to drop the bomb without any reference to any coercive benefits for future relations with the Soviet Union.

When the Imperial cabinet agreed on June 22nd to reach out to the Soviet Union to mediate the conflict, it could not agree on the terms of a possible peace. Three military representatives on the Big Six council, Army Minister Korechika Anami, Chief of the Army General Staff Yoshijiro Umezu, and Chief of the Naval General Staff Soemu Toyoda, argued that the war was not yet lost and that a costly U.S. invasion would allow to obtain better terms (Asada 1998, 500).

Foreign Minister Shigenori Togo first instructed Japanese ambassador to the Soviet Union Naotake Sato on June 30th to propose "firm and lasting relations of friendship" with the Soviet Union in exchange for the following concessions: neutralization of Manchuria, renunciation of fishery rights (in exchange for Soviet oil), and an open-ended invitation to discuss "any matter which the Russians would like to bring up."[31] Soviet foreign minister Vyacheslav Molotov remained evasive. In a series of cables on July 11th-12th, Togo then asked Sato to "sound him [Molotov] out on the extent to which it is possible to make use of Russia in ending the war." There would be no occupation of Japan and, in exchange, Japan would withdraw from all occupied territories and offer territorial concessions to Russia, renouncing on its rights under the Portsmouth Treaty, offering the Kurils and Karafuto as well as concessions in Manchuria (Frank 1999, 221-223). U.S. officials who intercepted and analyzed the cable concluded that this was not a serious effort but instead an effort to exploit "war weariness in the United States."[32] Sato himself told Togo that they could not enlist the Soviet Union with "pretty little phrases devoid of all connection with reality." We "must first of all make up our own minds to terminate the war" and, if so, we should expect only "virtually [the] equivalent to unconditional surrender," assuming of course "an exception of the question of preserving our national structure [i.e., the Imperial system]"[33] Togo rejected Sato's entreaties, writing on July

[31]Quoted in Frank (1999, 221).

[32]Quoted in Frank (1999, 224-5).

[33]Quoted in Frank (1999, 225, 229).

21st: "With regard to unconditional surrender we are unable to consent to it under any circumstances whatever."[34] U.S. officials concluded on July 27th that Japan's "unwillingness to surrender stems primarily form the failure of her otherwise capable and all-powerful Army leaders to perceive that the defenses they are so assiduously fashioning actually are utterly inadequate."[35]

When the Potsdam Declaration reached Japan, Prime Minister Suzuki's response is best understood as a rejection. Announcing in a press conference that Japan would *mokusatsu* the Declaration, Suzuki added: "We will press forward resolutely to carry the war to a successful conclusion."[36] When leading Japanese businessmen pressed him two days later to accept the Declaration, Suzuki refused to do so. The simple fact that the United States discussed the terms of a possible peace showed its flagging resolve, which Japan could exploit to obtain better terms after continued fighting: "For the enemy to say something like that means circumstances have arisen that force them also to end the war. That is why they are talking about unconditional surrender. Precisely at a time like this, if we hold firm, they will yield before we do. Just because they have broadcast their Declaration, it is not necessary to stop fighting. You advisers may ask me to reconsider, but I don't think there is any need to stop [the war]."[37]

[34] Quoted in Frank (1999, 230).

[35] Quoted in Frank (1999, 232).

[36] Quoted in Frank (1999, 234). See Alperovitz's interpretation in Alperovitz (1995*b*, 407-409).

[37] Quoted in Bix (1995, 208).

The Imperial cabinet remained deadlocked on the terms of a possible peace, even after the atomic attack on Hiroshima and the Soviet entry into the war. On August 9th, Suzuki and Togo implored the cabinet to accept the Declaration, with guarantees for the position of the emperor (Asada 1998, 491). Toyoda demurred: "To be sure, the damage of the atomic bomb is extremely heavy, but it is questionable whether the United States will be able to use more bombs in rapid succession."[38] Anami wished to extract three additional conditions from the Allies: no military occupation of the homeland, letting Japanese armed forces to disarm and demobilize voluntarily, allowing the Japanese government to prosecute its own war criminal (Asada 1998, 493-494).

The atomic attack on Nagasaki undermined Toyoda's argument. Upon hearing the news of the attack, Suzuki began to fear that "the United States, instead of staging the invasion of Japan, will keep on dropping atomic bombs."[39] Yet Anami still refused to sue for peace. In his view, Japan could still strike a massive blow against the invading U.S. forces, producing such high casualties that Washington would agree on a compromise peace (Asada 1998, 494-495). The cabinet remained in a 3-3 tie. In the early hours of August 10th, the emperor insisted that the Declaration should be approved, with protections for the position of the emperor (Asada 1998, 495-496; Gal-

[38]Quoted in Asada (1998, 490-1).

[39]Quoted in Asada (1998, 491). See also Patalano (2015, 185); Patalano (2015, 185).

licchio 2020, 147).

In short, the atomic bomb and the entry of the Soviet Union negated Japan's war plan. It was no longer tenable to argue that Japan could keep fighting and impose high casualties on the Americans.

We may never know which of these two factors had a greater impact on Japan's decision.[40] We may never know whether the bomb could have impacted Japanese calculations through a technical demonstration. Yet a panel of U.S. experts commissioned to study the question in May and June 1945, the Interim Committee and the Scientific Panel, ruled out such a proposition because it could "propose no technical demonstration likely to bring an end to the war."[41] Considerations were in part technical in nature - the bomb might not explode or the Japanese could shoot down any delivery plane, for example (Alperovitz 1965, 115) - and political in nature. According to Karl Taylor Compton, member of the Interim Committee and president of

[40]Hasegawa (2005, 3) argues that the Soviet entry played a greater role. Asada argues that "[i]t is difficult to determine which factor was more important" (Asada 1998, 503), though he offers some evidence that Suzuki and the emperor each decided to sue for peace on August 8th, after the attack on Hiroshima and before the Soviet entry into the war (Asada 1998, 488, 489). Kuehn (2015, 454) and Patalano (2015, 186) both argue that what convinced Japanese decisionmakers of the futility of Ketsu-Go was the second atomic bomb on Nagasaki.

[41]Quoted in Sherwin (1975, 214).

MIT at the time, it was hard to believe that if a test were conducted on neutral ground the "determined and fanatical military men of Japan would be impressed."[42] In short, the best use of the bomb was a complete military mission, showing how it could be dropped and exploded on Japanese targets, making the strongest case that Japan's plan for its defense - imposing high casualties on invading U.S. forces - was utopian.

5 Conclusion

This paper argues that power imbalance may lead to war because of the strong party's aspiration to crush its weaker opponent, obviating the need for future concessions. In turn, this explains how countries could be mutually optimistic about their path to victory. The strong country hopes that its enemy lacks the capabilities to survive the initial battle. The weak country believes that the strong pursues such a strategy. It is confident that it can survive a fight and it hopes that its enemy lacks the resolve to continue fighting. This logic, I argue, captures key features of the strategic interaction between the United States and Japan in the Pacific War of 1941-1945.

The properties described here generalize to other cases. Consider again the current Russia-Ukraine war. Putin hoped that he could destroy Ukraine, quickly seize Kyiv and replace the Ukrainian government (see, e.g., Harris et al. 2022). Kyiv, in turn, hoped that Russia would not tolerate high casual-

[42]Quoted in Sherwin (1975, 208).

ties and offer concessions. After the counter-offensive of the summer of 2023 reached a stalemate, then-commander of Ukrainian forces, General Valery Zaluzhny admitted that it was his "mistake" to assume that Russia would sue for peace: "Russia has lost at least 150,000 dead. In any other country such casualties would have stopped the war."[43]

Looking ahead, there are many interesting extensions to be considered. I highlight two here. One extension would be to expand the strategic interaction beyond two players. In the Russia-Ukraine war, the United States and NATO have played an important role in supporting Ukraine. The United States and NATO arguably have greater capabilities but lower resolve than Russia in prosecuting the war. This produces an interesting dynamic where the balance of resolve and capabilities may flip as we consider additional parties to the conflict. How additional dimensions affect the form of mutual optimism on the paths to victory is an open question.

Another extension would be to endogenize the decision to negotiate. In the current model, the proposer is scheduled to make an offer in each period. What we observe in the empirical record is that the decision to make an offer, even with the harshest terms, is informative, and can be interpreted as a sign of weakness. Additional work on this dynamic would be welcome.[44]

[43]Quoted in n.d. (2023).

[44]Existing work includes Mastro (2019); Reich (2024).

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Appendix: Proof of the Formal Results

Proof. (Proof of Lemma 1). Omitted. This is the standard ultimatum-bargaining game with one-sided uncertainty (Fearon 1995). ■

Proof. (Proof of Lemma 2). Consider period 2. By assumption, the game proceeds to this point only if war obtained in period 1 and it was not decisive. Assume then that country A believes that $\mu_{B1} = 1$ and it offers $x_{B2} = p_B d - c_B(\overline{r_B})$, and country B accepts x_{B2} if and only if $x_{B2} \geq p_B d - c_B(r_B)$. The strategies are optimal given beliefs and beliefs are consistent with Bayes' rule and equilibrium strategies, if $\underline{x_{B1}}(\underline{r_B}) < \underline{x_{B1}}(\overline{r_B})$ and $x^*_{B1} \in \{\underline{x_{B1}}(\underline{r_B}), \underline{x_{B1}}(\overline{r_B})\}$, which we discuss below.[45]

[45]These beliefs are consistent with Bayes' rule and equilibrium strategies after $x_{B1} \in [\underline{x_{B1}}(\underline{r_B}), \underline{x_{B1}}(\overline{r_B}))$ is rejected. Consistency imposes no constraints after $x_{B1} \geq \underline{x_{B1}}(\overline{r_B})$ is rejected. Consistency would require that $\mu_{B1} = \mu_{B0}$ after $x_{B1} < \underline{x_{B1}}(\underline{r_B})$ is rejected, if such offers are made in equilibrium. Yet it is easy to establish that such offers would not be made in equilibrium. Also, such beliefs may not sustain a cut-off equilibrium for all prior beliefs. Indeed, if μ_{B0} sufficiently low, then country A would offer $\underline{x_{B2}}(\underline{r_B})$ in period 2, and the payoff of type $\underline{r_B}$ would be strictly lower for rejecting $x_{B1} < \underline{x_{B1}}(\underline{r_B})$ than it would be for rejecting $x_{B1} = \underline{x_{B1}}(\underline{r_B})$, and it would strictly prefer to accept some offers $x_{B1} \in (\underline{x_{B1}}(\underline{r_B}) - \epsilon, \underline{x_{B1}}(\underline{r_B}))$, for some $\epsilon > 0$ sufficiently small, contradicting the claim it plays a cut-off strategy. The above off-the-equilibrium-path beliefs avoid this problem for

Move up to period 1. Given period-2 strategies, country B's minimum demand satisfies

$$\underline{x_{B1}}(r_B)(1+\delta) = p_B d(1+\delta) - c_B(\overline{r_B}) + (1-d)\delta[p_B d - c_B(\overline{r_B})] \tag{18}$$

which simplifies to equation (5). Clearly, $\underline{x_{B1}}(\underline{r_B}) < \underline{x_{B1}}(\overline{r_B})$.

Next, consider country A's optimal offer. First, we can verify that there is a bargaining range between country A and each type of country B, that these bargaining ranges intersect with the set of feasible offers, and that country A's optimal offer is the minimum demand of one of the two types, i.e. $x^*_{B1} \in \{\underline{x_{B1}}(\underline{r_B}), \underline{x_{B1}}(\overline{r_B})\}$.

If country A offers $\underline{x_{B1}}(\underline{r_B})$, its expected payoff is $\mu_{B0}[p_A d(1+\delta) - c_A + \delta(1-d)[1-(p_B d - c_B(\overline{r_B}))]] + (1-\mu_{B0})[1-\underline{x_{B1}}(\underline{r_B})][1+\delta]$.

If country A offers $\underline{x_{B1}}(\overline{r_B})$, its expected payoff is $(1-\underline{x_{B1}}(\overline{r_B}))(1+\delta)$. Country A prefers $\underline{x_{B1}}(\overline{r_B})$ to $\underline{x_{B1}}(\underline{r_B})$ if and only if

$$\mu_{B0}[(1+\delta)(1-\underline{x_{B1}}(\overline{r_B})) - [p_A d(1+\delta) - c_A + \delta(1-d)[1-(p_B d - c_B(\overline{r_B})]] \geq (1-\mu_{B0})[\underline{x_{B1}}(\overline{r_B}) - \underline{x_{B1}}(\underline{r_B})](1+\delta) \tag{19}$$

This reduces to $\mu_{B0} \geq \mu'_B$ for μ'_B given in equation (3). ■

Proof. (Proof of Lemma 3). The second period of a two-period game follows the same structure as a one-shot game, where country A's beliefs are given

all prior beliefs.

by μ_{B1}. Assume that country A's beliefs are as follows: After any offer x_{B1} is rejected, country A believes $\mu_{B1} = 1$. After any offer $x_{B1} < \underline{x_{B1}}(\overline{r_B})$ is accepted, let $\mu_{B1} = 0$. After any offer $x_{B1} \geq \underline{x_{B1}}(\overline{r_B})$ is accepted, let $\mu_{B1} = \mu_{B0}$.[46]

Move up to period 1. I show that the minimum demands of each type are given in equation (7).

Begin with type $\overline{r_B}$. This type receives $p_B d - c_B(\overline{r_B})$ in period 2, for any history. Its minimum demand, $\underline{x_{B1}}(\overline{r_B})$, satisfies:

$$\underline{x_{B1}}(\overline{r_B}) + \delta[p_B d - c_B(\overline{r_B})] = p_B d(1+\delta) - c_B(\overline{r_B}) + \delta(1-d)[p_B d - c_B(\overline{r_B})] \quad (20)$$

which can be expressed by equation (7).

Now consider type $\underline{r_B}$. I establish first that $\underline{x_{B1}}(\underline{r_B}) < \underline{x_{B1}}(\overline{r_B})$. To see this, note that $\underline{x_{B1}}(\underline{r_B})$ satisfies:

$$\underline{x_{B1}}(\underline{r_B}) + \delta V_{B2}(\underline{r_B})^a = p_B d(1+\delta) - c_B(\underline{r_B}) + (1-d)\delta V_{B2}(\underline{r_B})^r \quad (21)$$

where $V_{B2}(\underline{r_B})^a$, $V_{B2}(\underline{r_B})^r$ are the value of the game in period 2 for country B of type $\underline{r_B}$ for accepting and rejecting offer $\underline{x_{B1}}(\underline{r_B})$, respectively. We have that

$$\underline{x_{B1}}(\underline{r_B}) \leq p_B d - c_B(\underline{r_B})(1-\delta) + \delta(1-d)[p_B d - c_B(\overline{r_B})] < \underline{x_{B1}}(\overline{r_B}) \quad (22)$$

[46] The observations of footnote 45 apply here as well.

where the weak inequality follows from $V_{B2}(\underline{r_B})^a \geq p_B d - c_B(\underline{r_B})$ and $V_{B2}(\underline{r_B})^r \leq p_B d - c_B(\overline{r_B})$ and the strict inequality from $c_B(\underline{r_B}) > c_B(\overline{r_B})$.

Given that $\underline{x_{B1}}(\underline{r_B}) < \underline{x_{B1}}(\overline{r_B})$, we must have that, after $\underline{x_{B1}}(\underline{r_B})$ is rejected, $\mu_{B1} = 1$, and strategies are as given above. Therefore, we have that $V_{B2}(\underline{r_B})^a = p_B d - c_B(\underline{r_B})$, $V_{B2}(\underline{r_B})^r = p_B d - c_B(\overline{r_B})$ and, replacing in equation (21), $\underline{x_{B1}}(\underline{r_B})$ can be given by equation (7).

Next, we can verify that country B's strategies are indeed cut-off strategies. For type $\overline{r_B}$, the result is straightforward, since its continuation value is unique. Consider type $\underline{r_B}$. This type accepts x_{B1} if and only if

$$x_{B1} + \delta V_{B2}(\underline{r_B})^a \geq p_B d(1+\delta) - c_B(\underline{r_B}) + (1-d)\delta[p_B d - c_B(\overline{r_B})] \qquad (23)$$

For $x_{B1} < \underline{x_{B1}}(\overline{r_B})$, $V_{B2}(\underline{r_B})^a = p_B d - c_B(\underline{r_B})$ and country B accepts if and only if $x_{B1} \geq \underline{x_{B1}}(\underline{r_B})$. For $x_{B1} \geq \underline{x_{B1}}(\overline{r_B})$, $V_{B2}(\underline{r_B})^a \geq p_B d - c_B(\underline{r_B})$ and country B strictly prefers to accept.

Next, consider country A's optimal offer. First, note that there is a bargaining range between country A and each type of country B, that these bargaining ranges intersect with the set of feasible offers, and that country A's optimal offer is the minimum demand of one of the two types, i.e. $x^*_{B1} \in \{\underline{x_{B1}}(\underline{r_B}), \underline{x_{B1}}(\overline{r_B})\}$.

If country A offers $\underline{x_{B1}}(\underline{r_B})$, its expected payoff is $\mu_{B0}[p_A d(1+\delta) - c_A + \delta(1-d)[1 - \underline{x_{B2}}(\overline{r_B})]] + (1-\mu_{B0})[1 - \underline{x_{B1}}(\underline{r_B}) + \delta[1 - \underline{x_{B2}}(\underline{r_B})]]$.

If country A offers $\underline{x_{B1}}(\overline{r_B})$, its expected payoff depends on its strategies in period 2, which in turn depends on whether $\mu_{B0} \geq \mu'_B$.

Assume first that $\mu_{B0} \geq \mu'_B$. If country A offers $\underline{x_{B1}}(\overline{r_B})$, it will offer $\underline{x_{B2}}(\overline{r_B})$ in period 2. Its expected payoff in period 1 from offering $\underline{x_{B1}}(\overline{r_B})$ is $1 - \underline{x_{B1}}(\overline{r_B}) + \delta[1 - \underline{x_{B2}}(\overline{r_B})]]$. Country A prefers $\underline{x_{B1}}(\overline{r_B})$ to $\underline{x_{B1}}(\underline{r_B})$ if and only if

$$\begin{aligned}\mu_{B0}[1 - \underline{x_{B1}}(\overline{r_B}) - (p_A d - c_A) + \delta d[1 - p_A - \underline{x_{B2}}(\overline{r_B})]] \geq \\ (1 - \mu_{B0})[\underline{x_{B1}}(\overline{r_B}) - \underline{x_{B1}}(\underline{r_B}) + \delta[\underline{x_{B2}}(\overline{r_B}) - \underline{x_{B2}}(\underline{r_B})]\end{aligned} \tag{24}$$

which reduces to $\mu_{B0} \geq \mu'_B$, which holds by assumption.

Assume that $\mu_{B0} < \mu'_B$. If country A offers $\underline{x_{B1}}(\overline{r_B})$, it will offer $\underline{x_{B2}}(\underline{r_B})$ in period 2. Its expected payoff in period 1 from offering $\underline{x_{B1}}(\overline{r_B})$ is $1 - \underline{x_{B1}}(\overline{r_B}) + \delta[\mu_{B0}(p_A d - c_A) + (1 - \mu_{B0})(1 - \underline{x_{B2}}(\underline{r_B}))]$. Country A prefers $\underline{x_{B1}}(\underline{r_B})$ to $\underline{x_{B1}}(\overline{r_B})$ if and only if

$$\mu_{B0}[1 - \underline{x_{B1}}(\overline{r_B}) - (p_A d - c_A) - \delta[c_A + (1-d)(1 - \underline{x_{B2}}(\underline{r_B}))]] < (1 - \mu_{B0})[\underline{x_{B1}}(\overline{r_B}) - \underline{x_{B1}}(\underline{r_B})] \tag{25}$$

which reduces to $\mu_{B0} < \mu'_B$, which holds by assumption. ■

Proof. (Proof of Result 1). Omitted. It follows directly from Lemmas 1 to 3 and the above discussion. ■

Proof. (Proof of Lemma 4). Omitted. This is the standard ultimatum-bargaining game with one-sided uncertainty (Fearon 1995). ■

Proof. (Proof of Lemma 5). Consider period 2. By assumption, the game proceeds to this point only if war obtained in period 1 and it was not decisive. Assume then that country A believes that $\theta_{B1} = 1$ and it offers $x_{B2} = p_B(\overline{\kappa_B})d(\overline{\kappa_B}) - c_B$, and country B accepts x_{B2} if and only if $x_{B2} \geq p_B(\kappa_B)d(\kappa_B) - c_B$. The strategies are optimal given beliefs and beliefs are consistent with Bayes' rule and equilibrium strategies, if $\underline{x_{B1}}(\underline{\kappa_B}) < \underline{x_{B1}}(\overline{\kappa_B})$ and $x^*_{B1} \in \{\underline{x_{B1}}(\underline{\kappa_B}), \underline{x_{B1}}(\overline{\kappa_B})\}$, which we discuss below.[47]

Move up to period 1. We can verify that the minimum demands of each type are given in equation (12), that country B's strategies are indeed cut-off strategies, that country A's optimal offer is the minimum demand of one of the two types, i.e. $x^*_{B1} \in \{\underline{x_{B1}}(\underline{\kappa_B}), \underline{x_{B1}}(\overline{\kappa_B})\}$. Next, we characterize the conditions under which country A offers $\underline{x_{B1}}(\underline{\kappa_B})$ rather than $\underline{x_{B1}}(\overline{\kappa_B})$.

If country A offers $\underline{x_{B1}}(\underline{\kappa_B})$, its expected payoff is $\theta_{B0}[p_A(\overline{\kappa_B})d(\overline{\kappa_B})(1 + \delta) - c_A + \delta(1 - d(\overline{\kappa_B}))[1 - (p_B(\overline{\kappa_B})d(\overline{\kappa_B}) - c_B)]] + (1 - \theta_{B0})[1 - \underline{x_{B1}}(\underline{\kappa_B}) + \delta[1 - (p_B(\overline{\kappa_B})d(\overline{\kappa_B}) - c_B)]]$.

If country A offers $\underline{x_{B1}}(\overline{\kappa_B})$, its expected payoff is $1 - \underline{x_{B1}}(\overline{\kappa_B}) + \delta[1 - (p_B(\overline{\kappa_B})d(\overline{\kappa_B}) - c_B)]]$. Country A prefers $\underline{x_{B1}}(\overline{\kappa_B})$ to $\underline{x_{B1}}(\underline{\kappa_B})$ if and only if

$$\theta_{B0}[1 - \underline{x_{B1}}(\overline{\kappa_B}) - (p_A(\overline{\kappa_B})d(\overline{\kappa_B})(1 + \delta) - c_A) + \delta d(\overline{\kappa_B})[1 - (p_B(\overline{\kappa_B})d(\overline{\kappa_B}) - c_B]] \geq (1 - \theta_{B0})[\underline{x_{B1}}(\overline{\kappa_B}) - \underline{x_{B1}}(\underline{\kappa_B})] \quad (26)$$

which reduces to $\theta_{B0} \geq \hat{\theta}_B$ for $\hat{\theta}_B$ given in equation (13). ■

[47] The observations of footnote 45 apply here as well.

Proof. (Proof of Lemma 6). The second period of a two-period game follows the same structure as a one-shot game, where country A's beliefs are given by θ_{B1}. Assume that country A's beliefs are as follows: After any offer x_{B1} is rejected, country A believes $\theta_{B1} = 1$. After any offer $x_{B1} < \underline{x_{B1}}(\overline{\kappa_B})$ is accepted, let $\theta_{B1} = 0$. After any offer $x_{B1} \geq \underline{x_{B1}}(\overline{\kappa_B})$ is accepted, let $\theta_{B1} = \theta_{B0}$.[48]

Move up to period 1. We use the same logic as in the proof of Lemma 3. To see that $\underline{x_{B1}}(\underline{\kappa_B}) < \underline{x_{B1}}(\overline{\kappa_B})$, note that $\underline{x_{B1}}(\underline{\kappa_B})$ satisfies:

$$\underline{x_{B1}}(\underline{\kappa_B})+\delta V_{B2}(\underline{\kappa_B})^a = p_B(\underline{\kappa_B})d(\underline{\kappa_B})(1+\delta)-c_B+(1-d(\underline{\kappa_B}))\delta V_{B2}(\underline{\kappa_B})^r \quad (27)$$

where $V_{B2}(\underline{\kappa_B})^a$, $V_{B2}(\underline{\kappa_B})^r$ are the value of the game in period 2 for country B of type $\underline{\kappa_B}$ for accepting and rejecting offer $\underline{x_{B1}}(\underline{\kappa_B})$, respectively, so that

$$\underline{x_{B1}}(\underline{\kappa_B}) \leq p_B(\underline{\kappa_B})d(\underline{\kappa_B})-c_B(1-\delta)+\delta(1-d(\underline{\kappa_B}))[p_B(\overline{\kappa_B})d(\overline{\kappa_B})-c_B] < \underline{x_{B1}}(\overline{\kappa_B}) \quad (28)$$

where the weak inequality follows from $V_{B2}(\underline{\kappa_B})^a \geq p_B(\underline{\kappa_B})d(\underline{\kappa_B})-c_B$, $V_{B2}(\underline{r_B})^a \leq p_B(\overline{\kappa_B})d(\overline{\kappa_B}) - c_B$. The strict inequality holds if

$$[d(\overline{\kappa_B}) - d(\underline{\kappa_B})][p_B(\overline{\kappa_B})d(\overline{\kappa_B}) - c_B] < p_B(\overline{\kappa_B})d(\overline{\kappa_B}) - p_B(\underline{\kappa_B})d(\underline{\kappa_B}) \quad (29)$$

To see that this inequality holds, consider two cases. If country A is

[48] The observations of footnote 45 apply here as well.

stronger than country B, then $d(\overline{\kappa_B}) < d(\underline{\kappa_B})$, the left-hand side of condition (29) is negative and the condition holds. If country A is weaker than country B, then $d(\overline{\kappa_B}) > d(\underline{\kappa_B})$, the left-hand side of condition (29) is smaller than $p_B(\overline{\kappa_B})d(\overline{\kappa_B}) - p_B(\overline{\kappa_B})d(\underline{\kappa_B})$, and the inequality holds since $p_B(\overline{\kappa_B}) > p_B(\underline{\kappa_B})$.

Next, we can show, using the same logic as in the proof of Lemma 3, that the minimum demands of each type are given in equation (15), that country B's strategies are indeed cut-off strategies, that country A's optimal offer is the minimum demand of one of the two types, i.e. $x^*_{B1} \in \{\underline{x_{B1}}(\underline{\kappa_B}), \underline{x_{B1}}(\overline{\kappa_B})\}$, and we can characterize the conditions under which country A offers $\underline{x_{B1}}(\underline{\kappa_B})$ rather than $\underline{x_{B1}}(\overline{\kappa_B})$.

If country A offers $\underline{x_{B1}}(\underline{\kappa_B})$, its expected payoff is $\theta_{B0}[p_A(\overline{k_B})d(\overline{k_B})(1+\delta) - c_A + \delta(1-d(\overline{k_B}))[1-\underline{x_{B2}}(\overline{\kappa_B})]] + (1-\theta_{B0})[1-\underline{x_{B1}}(\underline{\kappa_B}) + \delta[1-\underline{x_{B2}}(\underline{\kappa_B})]]$.

If country A offers $\underline{x_{B1}}(\overline{\kappa_B})$, its expected payoff depends on its strategies in period 2, which in turn depends on whether $\theta_{B0} \geq \theta'_B$.

Assume first that $\theta_{B0} \geq \theta'_B$. If country A offers $\underline{x_{B1}}(\overline{\kappa_B})$, it will offer $\underline{x_{B2}}(\overline{\kappa_B})$ in period 2. Its expected payoff in period 1 from offering $\underline{x_{B1}}(\overline{\kappa_B})$ is $1 - \underline{x_{B1}}(\overline{\kappa_B}) + \delta[1 - \underline{x_{B2}}(\overline{\kappa_B})]]$. Country A prefers $\underline{x_{B1}}(\overline{\kappa_B})$ to $\underline{x_{B1}}(\underline{\kappa_B})$ if and only if

$$\theta_{B0}[1 - \underline{x_{B1}}(\overline{\kappa_B}) - (p_A(\overline{\kappa_B})d(\overline{\kappa_B}) - c_A) + \delta d(\overline{\kappa_B})[1 - p_A(\overline{\kappa_B}) - \underline{x_{B2}}(\overline{\kappa_B})]] \geq (1-\theta_{B0})[\underline{x_{B1}}(\overline{\kappa_B}) - \underline{x_{B1}}(\underline{\kappa_B}) + \delta[\underline{x_{B2}}(\overline{\kappa_B}) - \underline{x_{B2}}(\underline{\kappa_B})] \tag{30}$$

which reduces to condition $\theta_{B0} \geq \hat{\theta}_B$.

We can show that $\hat{\theta}_B > \theta'_B$. If country A is stronger than country B, then $d(\underline{\kappa_B}) < d(\overline{\kappa_B})$, and the conclusion is immediate. If country A is weaker than country B, then $d(\underline{\kappa_B}) > d(\overline{\kappa_B})$. We have that $\lim_{\delta \to 0} \hat{\theta}_B = \theta'_B$ and $\frac{\partial \hat{\theta}_B}{\partial \delta} > 0$ since condition (29) holds. Thus, the conclusion follows. Therefore, we conclude that country A offers $\underline{x_{B1}}(\overline{\kappa_B})$ if $\theta_{B0} \in [\hat{\theta}_B, 1]$ and $\underline{x_{B1}}(\underline{\kappa_B})$ if $\theta_{B0} \in [\theta'_B, \hat{\theta}_B)$.

Assume that $\theta_{B0} < \theta'_B$. If country A offers $\underline{x_{B1}}(\overline{\kappa_B})$, it will offer $\underline{x_{B2}}(\underline{\kappa_B})$ in period 2. Its expected payoff in period 1 from offering $\underline{x_{B1}}(\overline{\kappa_B})$ is $1 - \underline{x_{B1}}(\overline{r_B}) + \delta[\theta_{B0}(p_A(\overline{\kappa_B})d(\overline{\kappa_B}) - c_A) + (1 - \theta_{B0})(1 - \underline{x_{B2}}(\underline{\kappa_B}))]$. Country A prefers $\underline{x_{B1}}(\underline{\kappa_B})$ to $\underline{x_{B1}}(\overline{\kappa_B})$ if and only if

$$\theta_{B0}[1 - \underline{x_{B1}}(\overline{\kappa_B}) - (p_A(\overline{\kappa_B})d(\overline{\kappa_B}) - c_A) - \delta[c_A + (1 - d(\overline{\kappa_B}))(1 - \underline{x_{B2}}(\underline{\kappa_B}))]]$$
$$< (1 - \theta_{B0})[\underline{x_{B1}}(\overline{\kappa_B}) - \underline{x_{B1}}(\underline{\kappa_B})] \quad (31)$$

which reduces to $\theta_{B0} < \tilde{\theta}_B$, where

$$\frac{\tilde{\theta}_B}{1 - \tilde{\theta}_B} = \frac{[p_B(\overline{\kappa_B})d(\overline{\kappa_B}) - p_B(\underline{\kappa_B})d(\underline{\kappa_B})] + \delta[d(\underline{k_B}) - d(\overline{k_B})][p_B(\overline{\kappa_B})d(\overline{\kappa_B}) - c_B]}{(1 - \delta)(1 - d(\overline{\kappa_B}) + c_A + c_B)} \quad (32)$$

We can show that $\tilde{\theta}_B > \theta'_B$. If country A is stronger than country B, then $d(\underline{\kappa_B}) < d(\overline{\kappa_B})$ and the conclusion is immediate. If country A is weaker than country B, then $d(\underline{\kappa_B}) > d(\overline{\kappa_B})$. We have that $\lim_{\delta \to 0} \tilde{\theta}_B = \theta'_B$ and $\frac{\partial \tilde{\theta}_B}{\partial \delta} > 0$ since condition (29) holds. Thus, the conclusion follows. Therefore, we conclude that country A offers $\underline{x_{B1}}(\overline{\kappa_B})$ for any $\theta_{B0} < \hat{\theta}_B$.

In sum, country A's strategy is summarized by equation (14). ■

Proof. (Proof of Result 2). Let i be stronger than j. Assume that $1 - d(\overline{\kappa_i}) + c_A + c_B = 1 - d(\overline{\kappa_j}) + c_A + c_B$, $p_i(\overline{\kappa_i})d(\overline{\kappa_i}) - p_i(\underline{\kappa_i})d(\underline{\kappa_i}) = p_j(\overline{\kappa_j})d(\overline{\kappa_j}) - p_j(\underline{\kappa_j})d(\underline{\kappa_j})$, and $p_i(\overline{\kappa_i})d(\overline{\kappa_i}) - c_i = p_j(\overline{\kappa_j})d(\overline{\kappa_j}) - c_j$.

First note that whether i or j serves as the proposer, θ'_B has the same value, and the range of parameters that would produce war in a one-shot game is the same.

Then note that the probability of war in the first period of the dynamic game increases with $d(\underline{\kappa_B}) - d(\overline{\kappa_B})$. If i is stronger than j, we have that $d(\underline{\kappa_i}) - d(\overline{\kappa_i}) < 0 < d(\underline{\kappa_i}) - d(\overline{\kappa_i})$. Therefore, the probability of war is lower if the strong party (i) is the receiver and the weak party (j) is the proposer, rather than if the roles are reversed.

The following numerical example holds fixed the above values and satisfies the other conditions of the model: Country i is stronger than country j. $d(\overline{k_i}) = d(\overline{k_j}) = \frac{2}{3}$, $d(\underline{k_i}) = \frac{1}{2}$, $d(\underline{k_j}) = 1$, $p_i(\overline{k_i}) = \frac{3}{4}$, $p_i(\underline{k_i}) = \frac{5}{8}$, $p_j(\overline{k_j}) = \frac{3}{8}$, $p_j(\underline{k_j}) = \frac{1}{16}$, $c_i = \frac{9}{32}$, $c_j = \frac{1}{32}$, $\delta = \frac{1}{2}$. When i serves as the proposer and j as the receiver ($j = B$), we have that $\theta'_j = \frac{9}{40}$ and $\hat{\theta}_j = \frac{61}{185}$. When j serves as the proposer and i as the receiver ($i = B$), we have that $\theta'_i = \frac{9}{40}$ and $\hat{\theta}_i = \frac{101}{349}$. Therefore, $\theta'_j = \theta'_i < \hat{\theta}_i < \hat{\theta}_j$. ■

Proof. (Proof of Lemma 7). Allowing for two-sided incomplete information on two dimensions significantly increases the number of parameters. To simplify the analysis, I impose some restrictions on their values. Specifically, I assume that there exists $\epsilon > 0$ arbitrarily small and values $d(\kappa_B)$ and $p_i(\kappa_B)$ such that the following hold:

$$|d(\kappa_A, \kappa_B) - d(\kappa_B)| < \epsilon \quad \forall \kappa_B \tag{33}$$

$$|p_i(\kappa_A, \kappa_B) - p_i(\kappa_B)| < \epsilon \quad \forall \kappa_B, i \tag{34}$$

$$d(\kappa_A, \underline{\kappa_B}) \in (1 - \epsilon, 1] \quad \forall \kappa_A \tag{35}$$

$$\theta_{B0} \in (0, \epsilon) \tag{36}$$

$$\frac{1 - d(\kappa_A, \underline{\kappa_B})}{\theta_{B0}} \in (0, \epsilon) \quad \forall \kappa_A \tag{37}$$

Conditions (33) and (34) states that the impact of the strong country's capabilities is small. Condition (35) states that war is very likely to be decisive when the weak country has low capabilities. Condition (36) states that the weak country is very likely to have low capabilities. Condition (37) states that war is very likely to be decisive when the weak country has low capabilities, relative to the prior probability that the weak country has low capabilities.

I show that an equilibrium exists as described in Lemma 7, under conditions (16) and (17), if the following conditions hold:

$$p_B(\overline{\kappa_B})d(\overline{\kappa_B}) - p_B(\underline{\kappa_B})d(\underline{\kappa_B}) > (1 - \delta)(c_B(\underline{r_B}) - c_B(\overline{r_B})) \tag{38}$$

$$\frac{\mu_{B0}}{1-\mu_{B0}} \in (\nu, min\{\nu', \nu''\}) \tag{39}$$

where

$$\nu = \frac{c_B(\underline{r_B}) - c_B(\overline{r_B})}{1 - d(\overline{\kappa_B}) + c_B(\overline{r_B}) + c_A(\underline{r_A})} \tag{40}$$

$$\nu' = \frac{c_B(\underline{r_B}) - c_B(\overline{r_B})}{c_B(\overline{r_B}) + c_A(\underline{r_A})} \tag{41}$$

$$\nu'' = \frac{c_B(\underline{r_B}) - c_B(\overline{r_B})}{1 - d(\overline{\kappa_B}) + c_B(\overline{r_B}) + c_A(\overline{r_A})} \tag{42}$$

Condition (38) strengthens condition (17) and states that for the weak country B, war payoffs are more affected by changes in capabilities than by changes in resolve. Conditions (39) to (42) assume that country A's prior beliefs about country B's resolve are intermediate, which ensures that country A is willing to pool on the most aggressive offer in period 1 and to separate in its offer in period 2.

To establish the equilibrium, I proceed by backward induction, starting with period 2. Equilibrium strategies depend on the history of the game and on beliefs, on and off the equilibrium path. I specify these beliefs first.

To begin with, assume that, consistent with condition (38), country B's minimum demands in period 1 can be ordered so that changes in capabilities have a greater impact than changes in resolve (we establish this claim below):

$$x_{B1}(\underline{r_B}, \underline{\kappa_B}) < x_{B1}(\overline{r_B}, \underline{\kappa_B}) < x_{B1}(\underline{r_B}, \overline{\kappa_B}) < x_{B1}(\overline{r_B}, \overline{\kappa_B}) \tag{43}$$

Consider country B's beliefs in period 2. Actually, off-the-equilibrium-path beliefs are inconsequential, under conditions (33) and (34), since these imply that country B's minimum demand $\underline{x_{B2}}(r_B, \kappa_B)$ is arbitrarily close to $p_B(\kappa_B)d(\kappa_B) - c_B(r_B)$, for any history and any beliefs. For completeness, assume that country B's beliefs after observing an offer x_{B1} are as follows: there is a value $\hat{x}_{B1} \in (\underline{x_{B1}}(\overline{r_B}, \underline{\kappa_B}), \underline{x_{B1}}(\underline{r_B}, \overline{\kappa_B}))$ such that if $x_{B1} < \hat{x}_{B1}$, then country B's beliefs are equal to its priors. If $x_{B1} \geq \hat{x}_{B1}$, then country B believes that $r_A = \underline{r_A}$ and its beliefs about κ_A are equal to its priors.

Consider country A's beliefs in period 2. After the equilibrium offer x^*_{B1}, its beliefs are given by Bayes' rule and equilibrium strategies. Country A's beliefs after an offer $x_{B1} \neq x^*_{B1}$ need to be specified. Assume that after offer $x_{B1} \in [\underline{x_{B1}}(\underline{r_B}, \underline{\kappa_B}), \underline{x_{B1}}(\overline{r_B}, \overline{\kappa_B})]$, country A's beliefs are given by Bayes' rule and country B's strategy. After offer $x_{B1} > \underline{x_{B1}}(\overline{r_B}, \overline{\kappa_B})$ is accepted, country A's beliefs are given by Bayes' rule and country B's strategy. After offer $x_{B1} > \underline{x_{B1}}(\overline{r_B}, \overline{\kappa_B})$ is rejected, country A believes that $(r_B, \kappa_B) = (\overline{r_B}, \overline{\kappa_B})$. After offer $x_{B1} < \underline{x_{B1}}(\underline{r_B}, \underline{\kappa_B})$ is accepted, country A believes that $(r_B, \kappa_B) = (\underline{r_B}, \underline{\kappa_B})$. After offer $x_{B1} < \underline{x_{B1}}(\underline{r_B}, \underline{\kappa_B})$ is rejected, country A believes that $(r_B, \kappa_B) \neq (\underline{r_B}, \underline{\kappa_B})$ and country B's type is otherwise determined by priors.

Now turn to equilibrium strategies. Consider country B. Its minimum demand is determined by its beliefs about country A's type, specified above, and becomes arbitrarily close to $p_B(\kappa_B)d(\kappa_B) - c_B(r_B)$, for any history and any beliefs, given conditions (33) and (34).

Consider country A. Assume that an offer $x_{B1} < \underline{x_{B1}}(\overline{r_B}, \underline{\kappa_B})$ has been accepted, then given the above, country A believes that $(r_B, \kappa_B) = (\underline{r_B}, \underline{\kappa_B})$ and offers $\underline{x_{B2}}(\underline{r_B}, \underline{\kappa_B})$, which is arbitrarily close to $p_B(\underline{\kappa_B})d(\underline{\kappa_B}) - c_B(\underline{r_B})$, given conditions (33) and (34).

Assume that an offer $x_{B1} \geq \underline{x_{B1}}(\overline{r_B}, \underline{\kappa_B})$ has been accepted, then given the above, and condition (36), country A's beliefs are arbitrarily close to the following: $\kappa_B = \underline{\kappa_B}$ and, with probability μ_{B0}, $r_B = \overline{r_B}$ and, with probability $1 - \mu_{B0}$, $r_B = \underline{r_B}$. Therefore, country A chooses between $\underline{x_{B2}}(\underline{r_B}, \underline{\kappa_B})$ and $\underline{x_{B2}}(\overline{r_B}, \underline{\kappa_B})$ and prefers the former if and only if

$$(1-\mu_{B0})[1-(p_B(\underline{\kappa_B})-c_B(\underline{r_B}))]+\mu_{B0}[1-p_B(\underline{\kappa_B})-c_A(r_A)] > 1-(p_B(\underline{\kappa_B})-c_B(\overline{r_B})) \tag{44}$$

which holds for any r_A if and only if $\frac{\mu_{B0}}{1-\mu_{B0}} < \nu'$.

Assume that an offer $x_{B1} \geq \underline{x_{B1}}(\underline{r_B}, \overline{\kappa_B})$ has been rejected, then given the above, country A believes that $(r_B, \kappa_B) = (\overline{r_B}, \overline{\kappa_B})$ and it offers $\underline{x_{B2}}(\overline{r_B}, \overline{\kappa_B})$.

Assume that an offer $x_{B1} < \underline{x_{B1}}(\underline{r_B}, \overline{\kappa_B})$ has been rejected, then given the above and conditions (35) to (37), country A's beliefs are arbitrarily close to the following: $\kappa_B = \overline{\kappa_B}$ and, with probability μ_{B0}, $r_B = \overline{r_B}$ and, with probability $1-\mu_{B0}$, $r_B = \underline{r_B}$. Therefore, country A chooses between $\underline{x_{B2}}(\underline{r_B}, \overline{\kappa_B})$ and $\underline{x_{B2}}(\overline{r_B}, \overline{\kappa_B})$ and prefers the former if and only if

$$(1-\mu_{B0})[1-(p_B(\overline{\kappa_B})d(\overline{\kappa_B})-c_B(\underline{r_B}))]+\mu_{B0}[(1-p_B(\overline{\kappa_B}))d(\overline{\kappa_B})-c_A(r_A)] > 1-(p_B(\overline{\kappa_B})d(\overline{\kappa_B})-c_B(\overline{r_B})) \tag{45}$$

This holds for $r_A = \overline{r_A}$ if and only if $\frac{\mu_{B0}}{1-\mu_{B0}} < \nu''$ and it fails for $r_A = \underline{r_A}$ if and only if $\frac{\mu_{B0}}{1-\mu_{B0}} > \nu$.

Move up to period 1. We establish that each type has a minimum demand and that they are ordered as in condition (43).

Assuming that each type has a minimum demand, we show that they are ordered as in condition (43). $\underline{x_{B1}}(r_B, \underline{\kappa_B})$ is arbitrarily close to $p_B(\underline{\kappa_B}) - c_B(r_B)(1-\delta)$ given condition (35). $\underline{x_{B1}}(r_B, \overline{\kappa_B})$ is arbitrarily close to $p_B(\overline{\kappa_B})d(\overline{\kappa_B}) - c_B(r_B)(1-\delta) + \delta(1-d(\overline{\kappa_B}))[p_B(\overline{\kappa_B})d(\overline{\kappa_B}) - c_B(\overline{r_B})]$ given condition (33). Clearly, we have $\underline{x_{B1}}(\underline{r_B}, \kappa_B) < \underline{x_{B1}}(\overline{r_B}, \kappa_B)$ for any κ_B. $\underline{x_{B1}}(\overline{r_B}, \underline{\kappa_B}) < \underline{x_{B1}}(\underline{r_B}, \overline{\kappa_B})$ follows from condition (38).

Now establish that the cut-offs act as minimum demands. It is the case for $(r_B, \kappa_B) = (\overline{r_B}, \overline{\kappa_B})$, since its continuation payoff after any history is uniquely pinned down and equal to its war payoff. It is also the case for $\kappa_B = \underline{\kappa_B}$ given condition (35).

Consider type $(r_B, \kappa_B) = (\underline{r_B}, \overline{\kappa_B})$. Country A's offer after $\underline{x_{B1}}(\overline{r_B}, \underline{\kappa_B})$ is rejected is strictly *less* generous, in expectation, than its offer after $\underline{x_{B1}}(\underline{r_B}, \overline{\kappa_B})$ is rejected. To ensure that $(\underline{r_B}, \overline{\kappa_B})$ rejects any offer $x_{B1} < \underline{x_{B1}}(\underline{r_B}, \overline{\kappa_B})$, assume that country B's beliefs are as specified above. That there is a cut-off $\hat{x}_{B1}$ supporting this type's strategy follows from condition (38).

Moving up, consider country A's optimal offer. A chooses between $\underline{x_{B1}}(\underline{r_B}, \underline{\kappa_B})$ and $\underline{x_{B1}}(\overline{r_B}, \underline{\kappa_B})$, given condition (36). These yield values arbitrarily close to the following, respectively, given condition (35):

$$(1-\mu_{B0})[1-(p_B(\underline{\kappa_B})-c_B(\underline{r_B})(1-\delta))+\delta[1-(p_B(\underline{\kappa_B})-c_B(\underline{r_B}))]] \\ +\mu_{B0}[(1-p_B(\underline{\kappa_B}))(1+\delta)-c_A(r_A)] \quad (46)$$

$$(1-\mu_{B0})[1-(p_B(\underline{\kappa_B})-c_B(\overline{r_B})(1-\delta))+\delta[1-(p_B(\underline{\kappa_B})-c_B(\underline{r_B}))]] \\ +\mu_{B0}[1-(p_B(\underline{\kappa_B})-c_B(\overline{r_B})(1-\delta))+\delta[1-p_B(\underline{\kappa_B})-c_A(r_A)]] \quad (47)$$

The former is preferable for any r_A if and only if $\frac{\mu_{B0}}{1-\mu_{B0}} < \nu'$.

The following numerical example satisfies all the relevant conditions ((16), (17), (38), (39)), at the limit where conditions (33)-(37) hold:

$d(\overline{\kappa_B}) = \frac{2}{3}$, $p_B(\overline{\kappa_B}) = \frac{3}{8}$, $p_B(\underline{\kappa_B}) = \frac{1}{16}$, $c_A(\underline{r_A}) = \frac{3}{8}$, $c_A(\overline{r_A}) = \frac{1}{16}$, $c_B(\underline{r_B}) = \frac{1}{32}$, $c_B(\overline{r_B}) = \frac{1}{64}$, $\delta = \frac{1}{2}$, $\mu_{B0} = \frac{3}{100}$, along with any μ_{A0}, θ_{A0}. ■

Proof. (Proof of Result 3). Assume that $\kappa_i = \overline{\kappa_i}$ for $i \in \{A, B\}$.

(i) In the above equilibrium, using condition (34), we have that $E_{B1}[p_B(\kappa_A, \kappa_B)|I_{B1}]$ converges to $p_B(\overline{\kappa_B})$ and $E_{A1}[p_A(\kappa_A, \kappa_B)|I_{A1}]$ converges to $\lambda p_A(\overline{\kappa_B}) + (1-\lambda)p_A(\underline{\kappa_B})$, where $\lambda = \frac{\theta_B}{\theta_B+(1-\theta_B)\mu_B}$. Therefore, $E_{A1}[p_A(\kappa_A, \kappa_B)|I_{A1}]+E_{B1}[p_B(\kappa_A, \kappa_B)|I_{B1}]$ converges to some value greater than 1, since $p_A(\overline{\kappa_B}) < p_A(\underline{\kappa_B})$ and $\lambda < 1$.

(ii) In the above equilibrium, war in period 1 generates the following histories along the equilibrium path: victory for A in period 1; victory for B in period 1; a stalemate in period 1 and a generous offer $x_{B2}^{*''} = \underline{x_{B2}}(\overline{r_B}, \overline{\kappa_B})$ in period 2, which is accepted by country B; a stalemate in period 1, an aggressive offer $x_{B2}^{*'''} = \underline{x_{B2}}(\underline{r_B}, \overline{\kappa_B})$ in period 2, which is accepted by country B; a stalemate in period 1, an aggressive offer $x_{B2}^{*'''}$ in period 2, which is rejected by country B and leads either to stalemate, a victory for A or a victory for B.

Consider country A. A path to victory involves either a victory in period 1; or a stalemate in period 1 followed by an aggressive offer $x_{B2}^{*'''}$, accepted by country B; or a stalemate in period 1 followed by an aggressive offer $x_{B2}^{*'''}$, rejected by country B, followed by a victory for country A. Given conditions (35) and (36), country A's ex ante beliefs that a war in period 1 would be indecisive is arbitrarily close to 0. The only path to victory which country A believes occurs with some probability bounded away from 0 is a victory in period 1. This happens with a probability arbitrarily close to $p_A(\underline{\kappa_B})$, given conditions (33) to (36).

Consider country B. A path to victory involves a victory in period 1; or a stalemate in period 1 followed by a generous offer $x_{B2}^{*''}$, accepted by country B. If country B has high resolve, an additional path to victory would be a stalemate in period 1 followed by an aggressive offer $x_{B2}^{*'''}$, rejected by country B, followed by a victory for country B. Now use conditions (33) and (34). Country B's belief that it achieves a victory in period 1 is arbitrarily close to $p_B(\overline{\kappa_B})d(\overline{\kappa_B})$. Its belief that there is a stalemate in period 1 followed by a generous offer $x_{B2}^{*''}$ is arbitrarily close to $(1 - d(\overline{\kappa_B}))(1 - \mu_{A0})$. If it has a high resolve, its belief that there is a stalemate in period 1 followed by an aggressive offer $x_{B2}^{*'''}$ and a victory in period 2 is arbitrarily close to $(1 - d(\overline{\kappa_B}))\mu_{A0}p_B(\overline{\kappa_B})d(\overline{\kappa_B})$.

Assume that the paths to victory for countries A and B involve, for each country, a victory in period 1. They are mutually optimistic about these paths to victory if and only if $p_A(\underline{\kappa_B}) + p_B(\overline{\kappa_B})d(\overline{\kappa_B}) > 1$, which cannot be ruled out. This condition holds with the above numerical example, where $p_A(\underline{k_B}) = 1 - p_B(\underline{k_B}) = \frac{15}{16}$, $p_B(\overline{k_B}) = \frac{3}{8}$, $d(\overline{k_B}) = \frac{2}{3}$.

Assume that the paths to victory for countries A and B involve, for country A, a victory in period 1 and, for country B, a stalemate in period 1 followed by a generous offer $x_{B2}^{*''}$, accepted by country B. They are mutually optimistic about these paths to victory if and only if $p_A(\underline{\kappa_B}) + (1 - d(\overline{\kappa_B}))(1 - \mu_{A0}) > 1$, which cannot be ruled out. This condition holds with the above numerical example, where $p_A(\underline{k_B}) = 1 - p_B(\underline{k_B}) = \frac{15}{16}$, $d(\overline{k_B}) = \frac{2}{3}$, as long as $\mu_{A0} < \frac{13}{16}$.

Assume that country B has a high resolve and the the paths to victory for countries A and B involve, for country A, a victory in period 1 and, for country B, a stalemate in period 1 followed by an aggressive offer $x_{B2}^{*'''}$, rejected by country B, and followed by victory in period 2. They are mutually optimistic about these paths to victory if and only if $p_A(\underline{\kappa_B}) +$

$(1 - d(\overline{\kappa_B}))\mu_{A0} p_B(\overline{\kappa_B}) d(\overline{\kappa_B}) > 1$, which cannot be ruled out. This condition holds with the above numerical example, where $p_A(\underline{k_B}) = 1 - p_B(\underline{k_B}) = \frac{15}{16}$, $d(\overline{k_B}) = \frac{2}{3}$, as long as $\mu_{A0} > \frac{1}{4}$. ■

Figure 1:
Cuban Missile Crisis, 1962

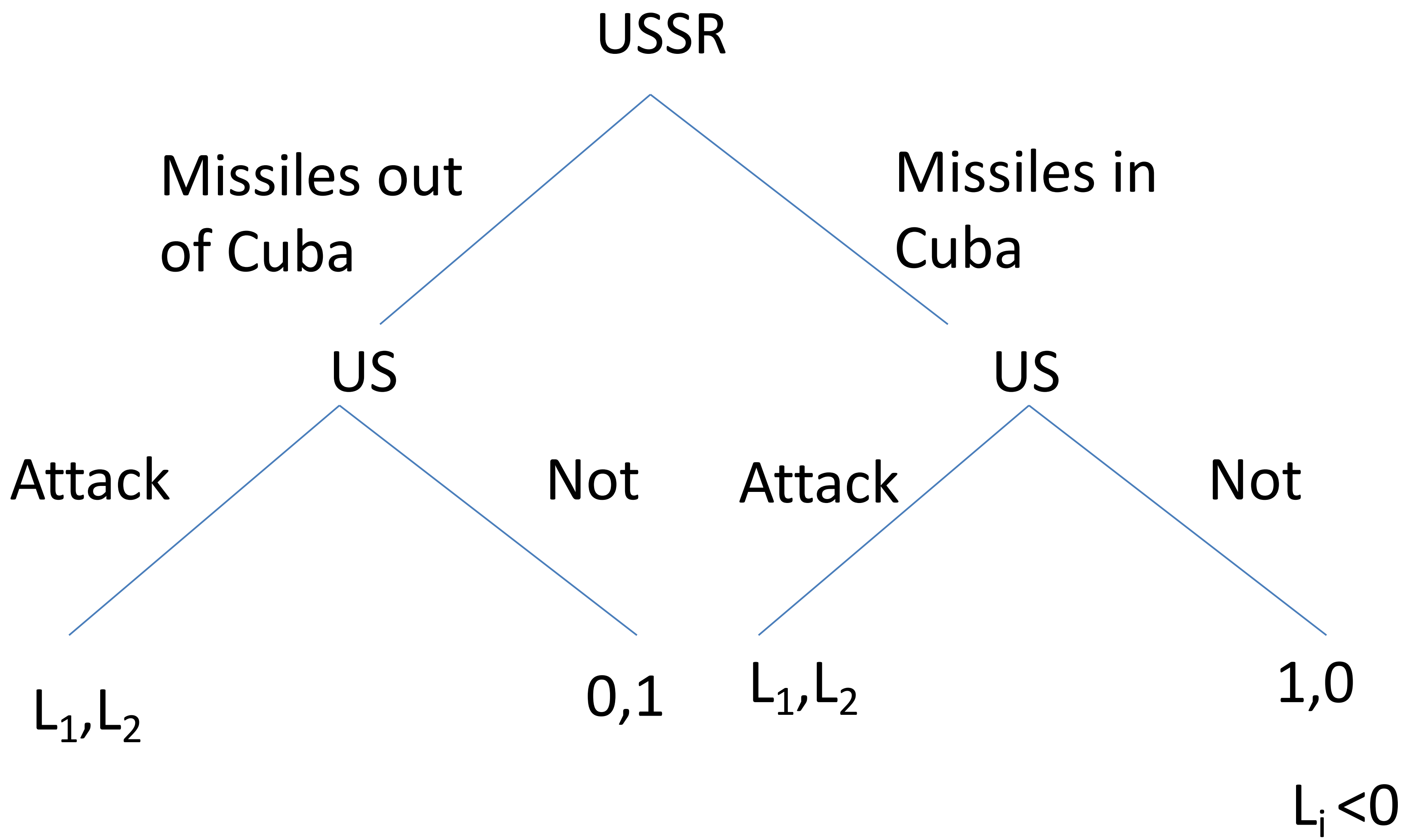
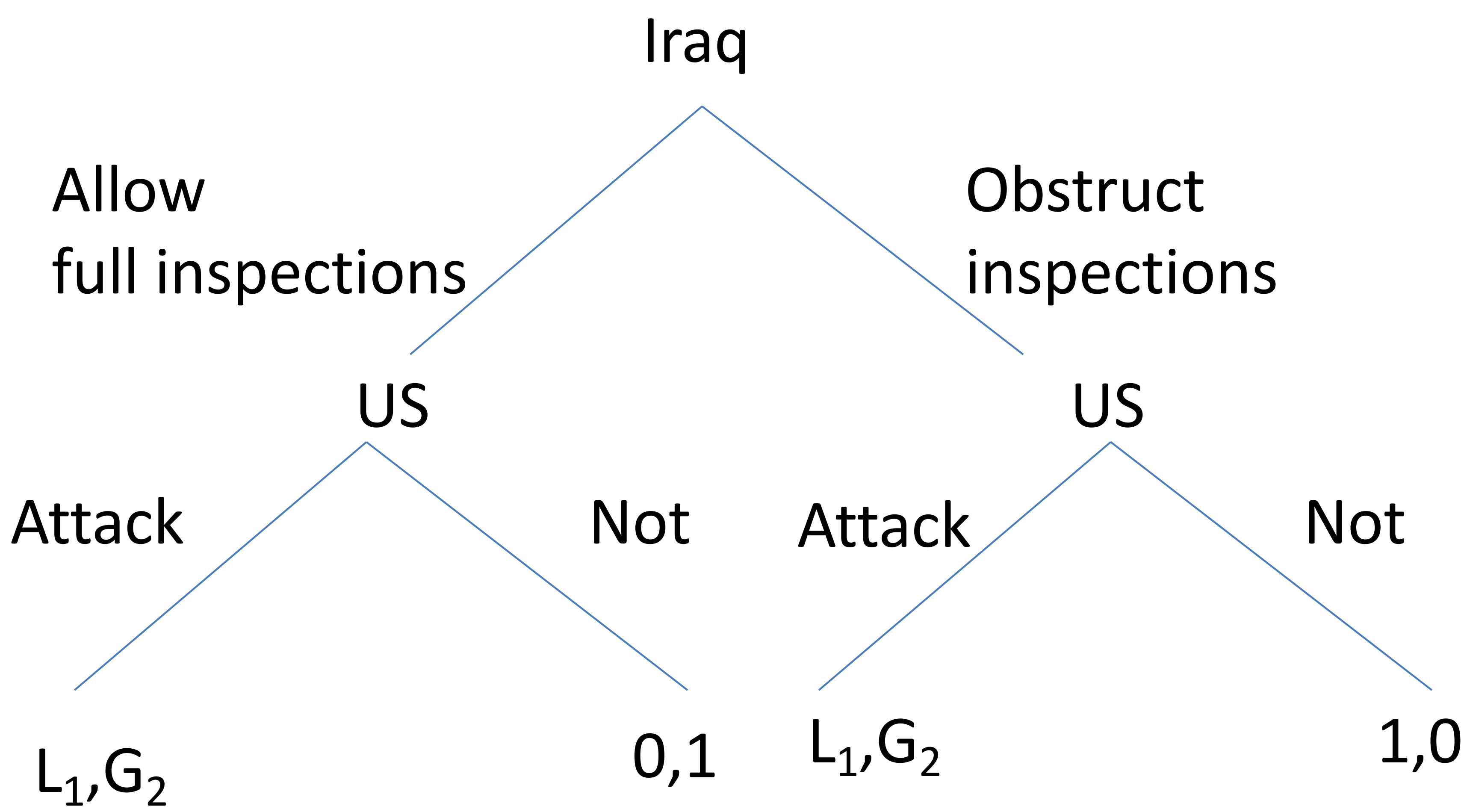


Figure 2:
US-Iraq conflict, 1990s and early 2000s



$L_1 < 0 < 1 < G_2$

Figure 3: Minimum Demands under Uncertainty on Resolve

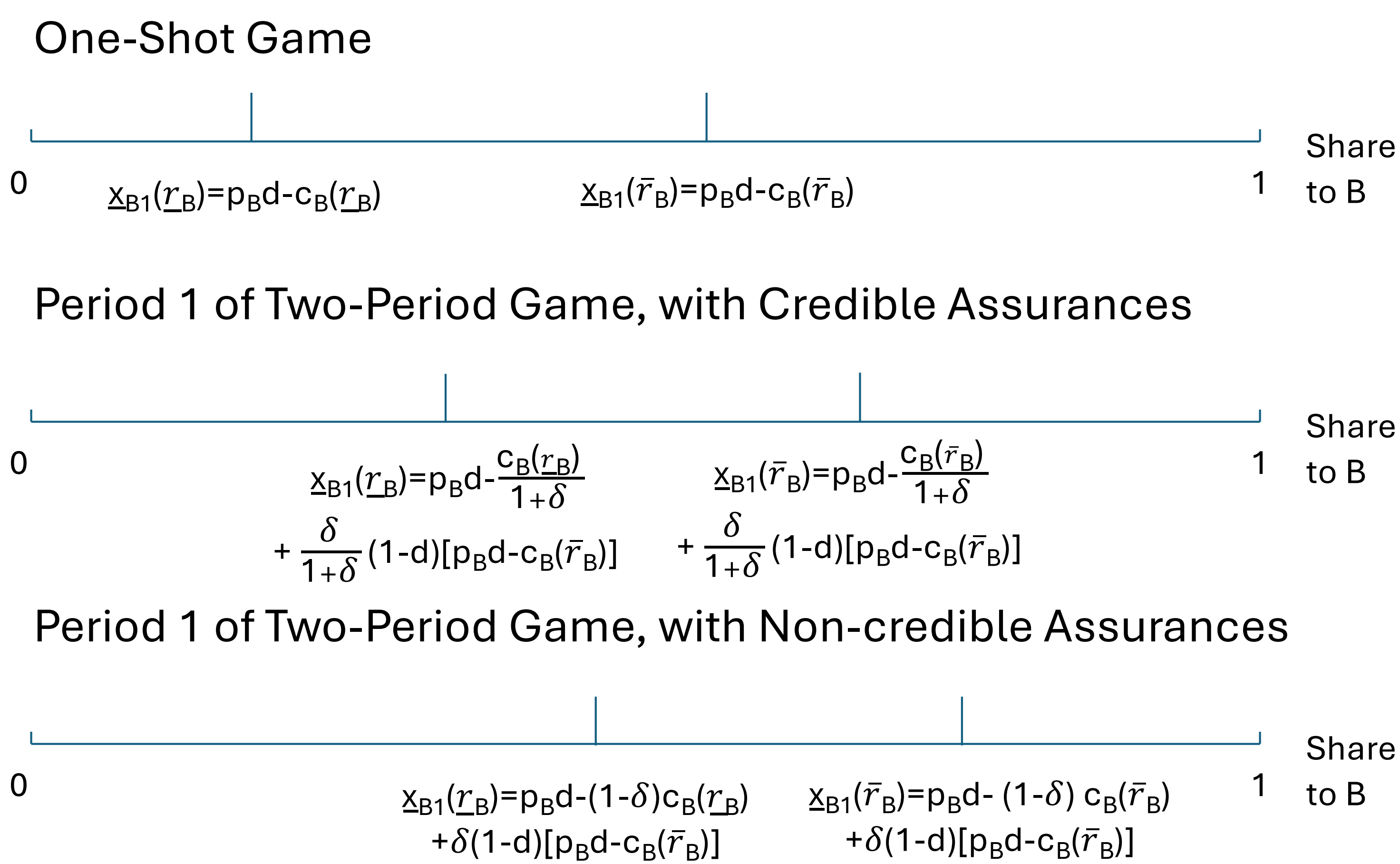


Figure 4: Minimum Demands under Uncertainty on Capabilities

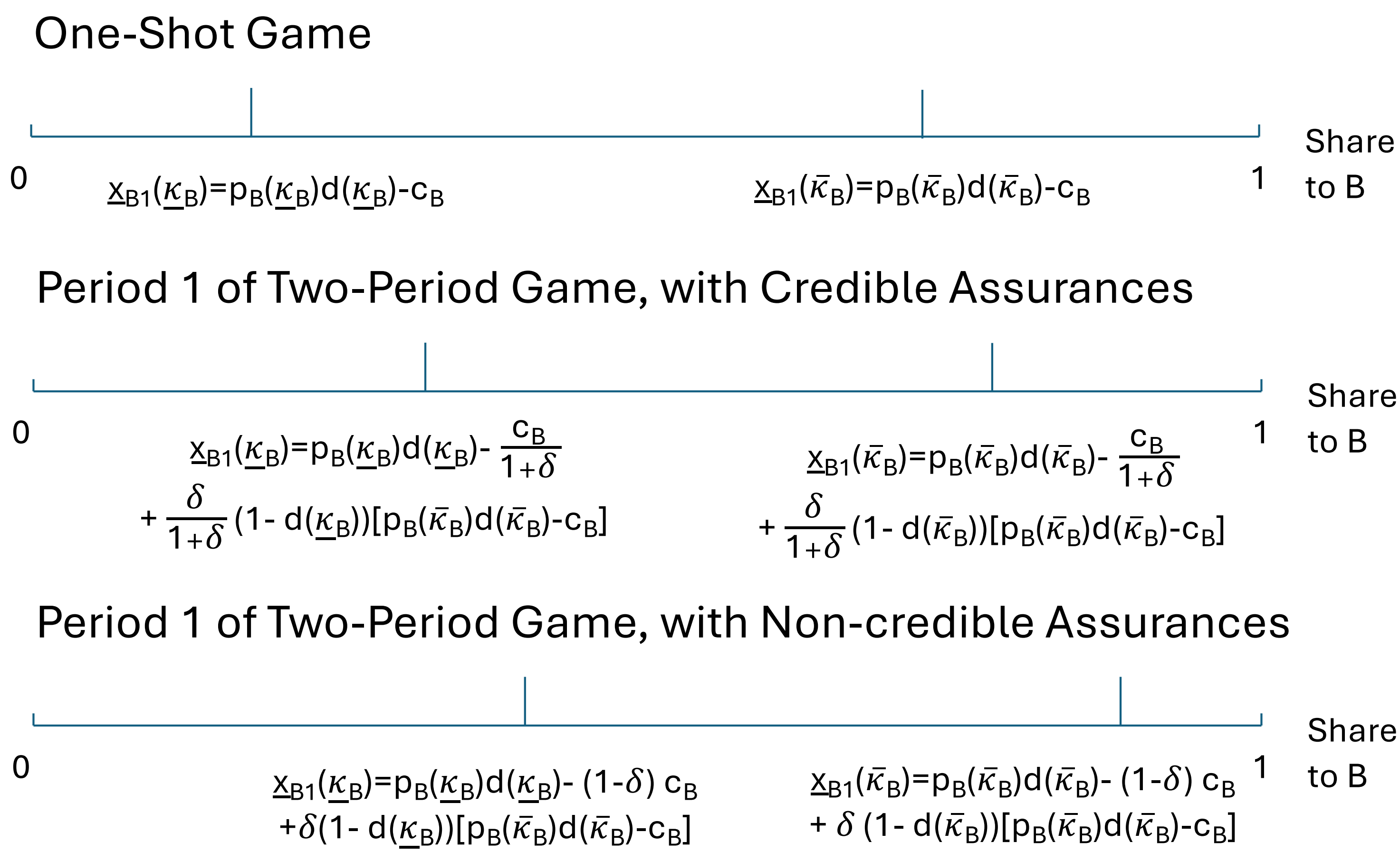


Figure 5: Minimum Demands under Two-Sided Uncertainty on Resolve and Capabilities