The Uncertainty Tradeoff: Re-Examining Opportunity Costs and War*

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Abstract

Conventional wisdom about economic interdependence and international conflict predicts increasing opportunity costs make war less likely, but some wars occur after costs grow. Why? We develop a model that shows a nonmonotonic relationship exists between the costs and probability of war when there is uncertainty over resolve. Under these conditions, increasing the costs of an uninformed party's opponent has a second-order effect of exacerbating informational asymmetries about that opponent's willingness to maintain peace. We derive conditions under which war can occur more frequently and empirically showcase the model's implications through a case study of Sino-Indian relations from 1949 to 2007. This finding challenges how scholars traditionally believe economic interdependence mediate incentives to fight: instruments like trade have competing effects on the probability of war.

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1 Introduction

What is the relationship between opportunity costs and war? Most political scientists invoke the "opportunity cost mechanism" to explain why commerce, trade ties, and other economic transactions decrease the probability of conflict.[1] As potential gains from interdependence increase, opportunity costs also rise. The range of mutually preferable settlements expands and the probability of war correspondingly drops (Fearon 1995; Oneal and Russett 2001; Polachek and Xiang 2010). In sum, changing opportunity costs underscore one of the most popular theories of war.

However, not all scholars believe opportunity costs are a panacea for war.[2] The historical record contains empirical inconsistencies in this relationship. At times, conflicts have arisen despite increased economic interdependence between parties, fueling concerns over when and whether opportunity costs reduce conflict. We therefore ask a simple question: holding all else equal, does increasing opportunity costs for war decrease the probability of conflict?[3]

In this paper, we develop a model that reconciles this puzzle by showing both proponents and skeptics of the opportunity cost mechanism are right. Instruments like trade have competing effects on the probability of war. How is this true? Despite raising the price of war, opportunity costs also have an indirect, second-order effect of exacerbating uncertainty about a state's resolve, which is among the most popular mechanisms that explain war.[4] Which effect is stronger? We show that the latter effect can dominate in equilibrium—that is, the probability of war increases *despite* raising opportunity costs.

The intuition falls back on screening models where a proposer is uncertain about its opponent's willingness to fight. Broadly, the uninformed state can pursue two strategies under these conditions. First, it can offer a generous amount that resolved types would accept. This has the benefit of avoiding the costs of war. Alternatively, it can propose

[1]See Hirschman (1977), Polachek (1980), Copeland (1996), and Simmons (2005) on trade, Polachek, Seiglie, and Xiang (2007) on capital flows, and Arena and Pechenkina (2015) on foreign aid.

[2]See Waltz (1979), Copeland (1996), Barbieri (1999), Gartzke (2007, 170), and Martin et al. (2008).

[3]In practice, increased trade flows do more than raise opportunity costs for war. For example, the increased flow of human capital may transmit information between states. Although the conventional wisdom literature suggests that this promotes peace (Kydd 2010, 104), explicit models of information acquisition show that the net effect is often indeterminate (Arena and Wolford 2012; Fey 2014). Holding these beliefs constant allows us to isolate whether greater opportunity costs induce peace.

[4]See, for example, Morrow (1989), Fearon (1995), Wolford (2007), and Slantchev (2011).

a stingy settlement and screen the opponent's willingness to fight, causing unresolved types to accept while inducing resolved types to reject. The latter benefits the proposer by giving it a large share of the settlement when the opponent accepts, but also forces it to pay the costs of war if its screening offer backfires.

When the difference between the costs of war for types is small, the proposing state has less incentive to screen. Why? Screening still forces the proposer to risk war, but the prospective gains from such a settlement are minimal. However, as the costs of conflict grow, a state is more likely to issue more aggressive demands because of a divergence in relative valuations among types. As the difference in relative costs between types increases, stingy offer strategies become more attractive. For the proposer, the increased screening incentives can outweigh the increased opportunity cost of conflict. This causes the proposer to risk war and trade breakdown by making more aggressive demands. Thus, increasing opportunity costs can have a countervailing effect of *raising* the risk of war even though these costs are common knowledge.

Our model verifies this counterintuitive relationship. It also generates comparative statics on when the uncertainty effect dominates over the opportunity cost effect. We focus on the role of opportunity costs in economic interdependence theory given its popularity. To preview, the effect arises as trade flows increase because a state cannot observe how its opponent weighs the benefits of trade relative to the costs of fighting. The probability of war increases when the state facing this uncertainty internalizes a larger portion of the military costs than the benefits of trade relative to their opponent's internalization. The conditional effect introduced here suggests caution in making broad claims about the relationship between trade and war, though the scope conditions the model generates provide a straightforward substantive interpretation that scholars can exploit.

We proceed as follows. The next section delves further into the conventional wisdom on economic interdependence and conflict. It demonstrates how our model makes several new contributions and addresses key inconsistencies in existing literature. We then introduce the model and generate comparative statics on the probability of conflict. Finally, we explore Sino-Indian relations from 1949 to 2007 to trace the mechanism's propositions and operationalize its key parameters. The case study focuses on three different decision points in Sino-Indian relations where trade affected the probability of conflict contrary to what the opportunity cost mechanism would predict. In particular, we argue that a major trade agreement between China and India in the 1950s exacerbated Indian uncertainty about Chinese resolve, which contributed to the 1962 Sino-Indian War. The overall contribution is to demonstrate how increased economic interdependence can have competing effects on the probability of war and identify under what condition each effect predominates.

2 Challenges to Economic Interdependence Theory

In the last few decades, a long line of research has explored how changing the costs of conflict affect the likelihood of war. These theories, generally steeped in the economic interdependence literature, argue that higher levels of bilateral transactions—like trade, capital flows, or foreign direct investment—increase the opportunity costs for war. As states become increasingly invested and reliant on economic commerce with each other, both become less willing to risk those gains during coercive bargaining episodes. As a result, peace becomes more likely (Keohane and Nye 1977; Polachek 1980; Rosecrance 1986; Gowa and Mansfield 1994; Oneal and Russett 2001). This finding has grown in popularity due to empirical evidence showing many measures of interdependence inversely correlated with the probability of conflict (Gartzke 2007).

However, there have been several challenges to this logic. Empirically, the historical record notes several anomalies where crises escalated to despite growing opportunity costs from trade. For example, policymakers in the 19th and early 20th Centuries heralded trade as an antidote to Europe's legacy of imperialist wars (Blainey 1988, 18-34). Nevertheless, World War I began at a time the core countries had never been more economically integrated (Copeland 1996).

Other scholars have challenged a key assumption driving the inverse trade-conflict relationship. Statistical results assume a linear relationship between trade and conflict, but historical inconsistencies call this assumption into question. Modeling specifications can substantially shift the direction and challenge underlying theoretical predictions when we thoroughly re-examine the linearity assumptions grounding the data generating process (Xiang et al. 2007). To wit, when scholars allow for a non-parametric setup, they recover a perplexing nonmonotonic relationship between growing trade flows and militarized conflict (Beck and Baum 2000; Xiang 2010).

Some scholars have tried to reconcile these inconsistencies by arguing instruments –

like trade – produce dual effects on conflict. Trade flows can generate different security externalities depending on the nature of the relationship (Gowa and Mansfield 1993; Gowa 1994; Copeland 1996). Increased trade flows between allies can be mutually beneficial in bolstering defenses and lowering the costs of war. However, increased trade flows can also raise tensions between rival states who fear exports will make their adversary militarily stronger. Accordingly, these relative gains can either promote or undermine cooperation. Similarly, trade flows can observably increase the proposer's costs of war and also affect how much a receiver is willing to fight (Morrow 1999). Nevertheless, this wave of research concluded that "the net effect of these two changes is indeterminate" (Morrow 1999, 481). Thus, scholars still lack theoretical clarity on when and whether opportunity costs decrease the probability of war.[5]

Together, these issues highlight several limits to opportunity cost explanations for war. Despite empirical evidence that increasing economic interdependence does not always lower the risk of war, a theoretical gap remains in understanding *why*. Previous theoretical work on the different ways trade affects conflict are unsatisfying because they predict indeterminacy. There is no theory, with clear observable implications, to explain when changing opportunity costs would have a nonmonotonic effect on the probability of war. We develop a new argument in this paper, which resolves these problems and advances the trade-conflict literature in three distinct ways.

First, we disaggregate the relative benefits from trade compared to the overall bilateral trade flows between parties. Consistent with previous literature, we argue that as overall bilateral trade increases, both states benefit from new trade gains (Gowa and Mansfield 1994; Morrow et al. 1998). However, we depart by noting that states do not necessarily internalize those benefits identically. This can affect their willingness to gamble on war. It also illustrates how increasing trade flows can have unanticipated effects in crisis bargaining.

Second, we analyze how opportunity costs change the probability of conflict when there is uncertainty over resolve. The model we develop below is closest to Polachek and Xiang's (2010), which analyzes the effect of increasing trade on the probability of conflict under cases of incomplete information. Their work argues that opportunity

[5]In keeping with this segment of the literature, we focus on bilateral trade flows. This makes our result distinct from Martin et al (2008), who argue that higher *multilateral* flows can increase the incentives for conflict within a particular dyad.

costs decrease the probability of conflict when there is uncertainty over military costs. We should be careful not to generalize results from one mechanism across all other mechanisms (Fey and Ramsay 2011). Indeed, we find that we should not generalize this result across the discussion of uncertainty over costs. In the next section, we change the information problem from uncertainty about military costs to uncertainty about the opponent's value of the good at stake, which scholars often refer to as a state's *resolve*. Resolve impacts a state's cost of fighting, as states must compare the military costs of engagement to their values of the prize. This change produces the counterintuitive result that the probability of war increases as trade flows increase.

Third, we identify more precise conditions under which these different effects predominate. We build on existing work about different security externalities of trade, but go further by showing that the source of uncertainty over costs should be further broken up into uncertainty over *military* costs and uncertainty over resolve. The difference between uncertainty over resolve and uncertainty over military costs is not a minor issue in the bargaining model of war literature. Powell (2004) and Fey and Ramsay (2011) show that uncertainty over costs behaves differently from uncertainty over the probability of victory.[6] Failing to note the differences can result in imprecise theoretical claims, which in turn leads to misleading empirical implications.

Accounting for these differences, new mechanisms governing the trade-conflict relationship emerge with some surprising results. Although opportunity costs decrease the probability of conflict, it is not the only mechanism governing the trade-conflict relationship. A second pathway exists whereby new trade exacerbates uncertainty about the relative valuations of trade (Figure 1). We develop a model to formalize these intuitions and identify the conditions under which the probability of war increases despite growing opportunity costs.

[6] Furthermore, non-traditional sources of uncertainty (e.g., the size of the pie, an opponent's level of moderation, or an opponent's ideal point) also behave differently from the traditional sources (Dal Bó and Powell 2009; Bils and Spaniel 2017; Spaniel and Bils 2017).

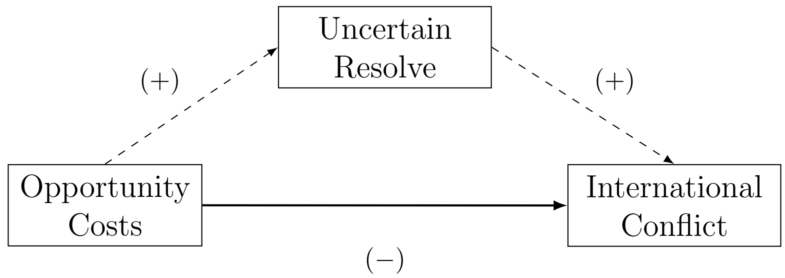

Figure 1: The causal pathways governing the opportunity cost-conflict relationship. The solid black line represents conventional wisdom that opportunity costs directly decreases the probability of conflict. The dashed line represents our new mechanism by which opportunity costs indirectly increase the probability of war by increasing uncertainty over resolve. We show that when the direct effect is less than the indirect effect, increased opportunity costs raise the risk of war.

3 Modeling Bargaining, Resolve, and the Changing Costs of War

This section develops a model in which increasing the costs of conflict creates uncertainty about the opponent's value of the good relative to original costs. We aim for simplicity here, showing that increased screening behaviors are a natural consequence of greater opportunity costs. The appendix covers many extensions that verify the robustness of our results, and we briefly discuss these throughout.

Consider a game consisting of two states, A and B, bargaining over an object they both desire. If they reach a settlement, then peace and efficiency prevail. If bargaining breaks down, a costly lottery generates an inefficient outcome.

The timing is as follows. Nature begins the game by drawing B's value of the good. Throughout the main text, we use the distribution $f(V) = \frac{1}{V^2}$ on the interval $[\underline{V}, \overline{V}]$ to describe and illustrate the result, where $\overline{V} > \underline{V} > 0$. We call the corresponding CDF $F(V)$, with $F(\underline{V}) = 0$ and $F(\overline{V}) = 1$. However, the central mechanism—that increasing trade can increase war—applies beyond this distribution, and we describe a class of distributions that generate the result in the appendix. Following Fearon (1995, 394) and Frieden, Lake, and Schultz (2013, 95), we say that a type with a higher V draw is more "resolved" than a lower type.[7] A more resolved type values the prize

[7]Frieden, Lake, and Schultz (2013, 95) define resolve as "how much the state values the object of

more and—as we will demonstrate below—is more likely to fight to capture it. This information is private to B; A only knows the prior distribution.[8] Everything else is common knowledge.

We standardize A's value of the good to be worth 1. Following the draw, A makes a take-it-or-leave-it offer $x \in [0, 1]$, where x represents the percentage of the good going to B.[9] B sees the offer and accepts or rejects.

Payoffs are as follows. If B accepts, it earns the offered portion x multiplied by its drawn value of the good, or Vx; A receives the remainder, or $1 - x$.[10] If B rejects, the states fight a war. Nature selects B as the winner with probability p_B and A as the winner with complementary probability. The winner captures the entire good.

Fighting is inefficient. Standard models typically describe costs with a single parameter. However, this is imprecise because states incur two different types of costs: military-associated costs and trade-associated costs. Our model distinguishes between these costs to draw inferences about the trade-conflict relationship. This insight is key to identifying new pathways to war. The first pair of costs, $c_A, c_B > 0$, reflect the standard military costs of war. Both these values are common knowledge. One might imagine this as the baseline price of fighting in the absence of any bilateral trade.

The second pair of costs incorporate the lost value of trade if conflict disrupts these flows. These represent the additional costs incurred by fighting on top of the military costs. An initial temptation may be to simply include two additional trade-related costs that capture the overall trade flows lost from conflict.[11] However, we cannot examine these variables in isolation. Trade flows go hand-in-hand—as one side benefits from increased trade, so does the other. To capture these associated benefits from trade, let $\phi \geq 0$ represent the overall flow between the two countries. Each state only receives a

dispute relative to [the costs of war]" and claim that this is one of the two major sources of uncertainty in crisis bargaining. This explicit formulation is also present in Arena 2013 and Smith and Spaniel 2019.

[8]We would obtain analogous results with two-sided incomplete information. The key driver of the relationship is how altering the costs of war change an actor's incentives to screen the opposing type, and uncertainty on the other end does not impact this in an ultimatum game with uncertainty over resolve.

[9]The ultimatum game is the most frequently used bargaining protocol in the crisis bargaining literature because it allows the modeler to explore central tradeoffs while maintaining tractability for the reader. We therefore adopt it here as well.

[10]This is implicitly multiplied by A's value of the good, which is standardized to 1.

[11]See Polachek and Xiang (2010).

portion of that benefit. Thus, let $\tau_A \in (0,1)$ represent A's percentage of those benefits and $\tau_B = 1 - \tau_A$ represent B's.

All told, $\phi\tau_A$ represents A's gains from trade and $\phi\tau_B$ represents B's gains from trade. When $\phi = 0$, only the military costs matter. As ϕ grows arbitrarily large—and this is key for the comparative static we develop later—the military costs become unimportant. Therefore, all told, A earns $1 - p_B - c_A - \phi\tau_A$ if it fights. Meanwhile, for any type V, B earns $Vp_B - c_B - \phi\tau_B$.

Games with positive affine expected utility transformations are identical. Thus, we can scale a type's payoffs by $\frac{1}{V}$. Doing so generates a more familiar-looking war payoff from the bargaining literature of $p_B - \frac{c_B + \phi\tau_B}{V}$. Higher values of V give a type a lower total price of war. When models explore uncertainty over resolve, they typically do so by taking the comparative static on a single composite parameter c (Fearon 1995, 387). If we used the standard representation, it would obscure how different components of the state's costs, including the military costs of war c_i, lost trade τ_i, and value of the prize V, each affect the probability of conflict. If these parameters all affect the direction of conflict in the same way, then there would be no need to disaggregate them. However, if these parameters affect conflict in different ways, then a failure to distinguish between them would cloud our understanding about how and why wars begin.

We therefore disaggregate the components to draw the correct inference. The transformation clarifies that A can observe B's benefits from trade, but *cannot* observe how it weighs those costs relative to the potential gains from fighting.[12] This asymmetric information problem affects A's screening incentives and willingness to gamble on war.

Because this is a sequential game of incomplete information, we solve for its perfect Bayesian equilibria. The appendix covers the details. In short, A faces a classic risk-return tradeoff. If it offers a lot, many types accept. Whenever that is the case, A avoids the costs of war. If it offers less, only unresolved types accept. This buys peace at a lower price but also risks provoking a costly war against resolved types. A's optimal demand must therefore balance its desire to concede less in a peaceful settlement and its aversion to war.

Our central question is whether increasing opportunity costs unambiguously decreases the probability of war. It does not:

Proposition 1. *Suppose the ratio of A's military cost of war to B's military cost of*

[12]This contrasts our model from Morrow's (1999) discussion.

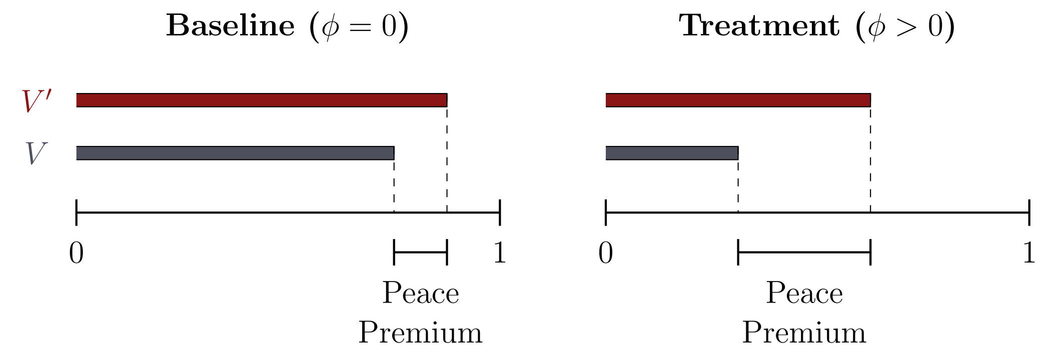

Figure 2: The functional difference in two types of B with and without trade benefits. Bars represent a type's payoff for war. Because the difference is greater in the treatment case ($\phi > 0$), A has greater incentive to risk war by offering smaller amounts.

war exceeds the ratio of A's trade benefits to B's trade benefits (i.e., $\frac{c_A}{c_B} > \frac{\tau_A}{\tau_B}$) and all types of B have a positive value for war. Then the probability of war weakly increases as ϕ increases.

What accounts for the unexpected result? As previewed earlier, higher trade flows exacerbate A's information problem. Consider A's decision whether to screen between a pair of types from the continuous distribution, one with resolve level V and the other with a greater resolve level V'. A V type earns $Vp_B - c_B - \phi\tau_B$ if it fights. Thus, with x representing the portion of the good B keeps if it accepts, the minimum amount necessary to induce a V type to accept is:

$$Vx = Vp_B - c_B - \phi\tau_B$$
$$x = p_B - \frac{c_B + \phi\tau_B}{V}$$

Analogously, a V' type exchanges V' for V.

Figure 2 illustrates how the premium A must pay a V type to obtain peace with a V' type changes as ϕ increases. The left side shows the reservation values without trade. The right side demonstrates how they change as trade increases the total price of war. Both values decline in the trade case. However, the V type's war payoff decreases at a faster rate. In turn, the difference in the types' reservation values grows.

Consider how this affects A's incentives to screen the types by making a risky offer that a V type would accept but a V' type would not. The total trade benefit of $\phi\tau_B$ *interacts* with A's source of uncertainty. When $\phi = 0$, A cannot capture much more by inducing only the unresolved type to accept. However, as ϕ grows, so too does the disparity. All else equal, this makes screening offers look more attractive to A.

But all else is not equal. Increasing trade flows also causes A more pain if B rejects the offer. In turn, it reduces A's desire to run risks. This helps make sense of Proposition 1's condition on the ratio of military costs to trade costs. When $\frac{c_A}{c_B} > \frac{\tau_A}{\tau_B}$, the relative impact of lost trade is less for A than B vis-à-vis the impact of military costs. As such, A's utility for a riskier demand increases at a faster rate than a safer demand; that is, A's incentive to screen the more diffuse types of B trumps its concern to avoid the extra costs. It therefore proposes a riskier offer, and war occurs more frequently. In fact, it is even possible for A to want to make peace with certainty in a world without trade but prefer making a riskier offer with positive probability of rejection in a world with trade.[13]

To obtain a better intuition for the cutpoint, consider a world without trade. What determines A's choice in the risk-return tradeoff is a comparison of its own costs to its rival's. When c_A is small, risky offers look less attractive due to punishment for guessing incorrectly. When c_B is large, the differences appearing in Figure 2 become exaggerated, thereby incentivizing screening. The ratio of the two costs summarizes A's tolerance for risk.

Trade flows generate the same incentives on a different front, with larger τ_A values promoting safer offers and larger τ_B values promoting riskier offers. When the trade ratios are identical to the military cost ratios, A's overall incentives remain the same. When the military cost ratio exceeds the trade ratio, the resulting mix whets A's appetite for risk more than in comparison to a world where only military costs matter. Furthermore, increasing trade flows mixes more of that appetite into A's decision. This accounts for the counterintuitive increase in the risk of war.

Meanwhile, the interactive relationship between B's total trade benefit differentiates our results from previous models on the trade-conflict relationship. Consider how trade flows change reservation values when A knows B's valuation of the good, but is uncertain of its military cost. For example, suppose that B's military cost is either c_B or $c'_B > c_B$. Now consider the reservation values for two arbitrary types, which are

[13]This explains why Proposition 1 stated that the relationship is weakly increasing.

$p_B - \frac{c_B+\phi\tau_B}{V}$ or $p_B - \frac{c'_B+\phi\tau_B}{V}$. Increasing the trade benefit decreases each of these values by the same rate.[14] It therefore does not have a second-order effect on the game's information structure.[15] In turn, additional trade only has the pacifying effect that standard interdependence theory anticipates.

When the inequality on the ratio of costs runs the other way, A's increased desire to avoid war can exceed its increased willingness to screen types. In turn, trade's standard pacifying effect takes hold.

That said, Proposition 1 only gives a local effect. If A's optimal demand lies on the interior (i.e., $x \neq 0$), then slight changes to ϕ increase the probability of war given the cost-to-trade ratio. A sufficient condition for the optimal demand to lie in the interior is if all types have a positive value of war, as A always tries to buy off some of its opposition. However, A's optimal demand can still lie in the interior even if some (sufficiently small) portion types would accept 0. Proposition 1's counterintuitive effect still applies there. But further increases to ϕ eventually start making all types accept any offer, which causes A to want to keep everything for itself. One may then wonder whether Proposition 1's counterintuitive finding extends into these corner solutions. The following proposition summarizes the results:

Proposition 2. *If the scale of trade flow ϕ is sufficiently large, further increases weakly decrease the probability of war.*

This is welcome news for traditional economic interdependence theory. It effectively states that additional trade only causes war in the short-term. Put differently, if trade is the problem, *larger* trade flows are the solution.

In practice, reaching such peace-inducing trade quantities may not be easy. Consider the reason why sufficiently large trade flows assuredly reduce war regardless of the ratio between military costs and trade benefits. As trade flows increase, eventually some types begin accepting offers of 0. Increasing trade further causes the more types' reservation values to move closer to 0 as well. As a result, they behave more identically. In turn, A has fewer incentives to screen.

[14] That is, the derivative of $\left(p_B - \frac{c_B+\phi\tau_B}{V}\right) - \left(p_B - \frac{c'_B+\phi\tau_B}{V}\right)$ with respect to ϕ is 0.

[15] This is true only for the interior solution. In the corner solution, it can *reduce* A's information problem and further promote peace. A similar effect occurs in our model, and we explain the intuition below.

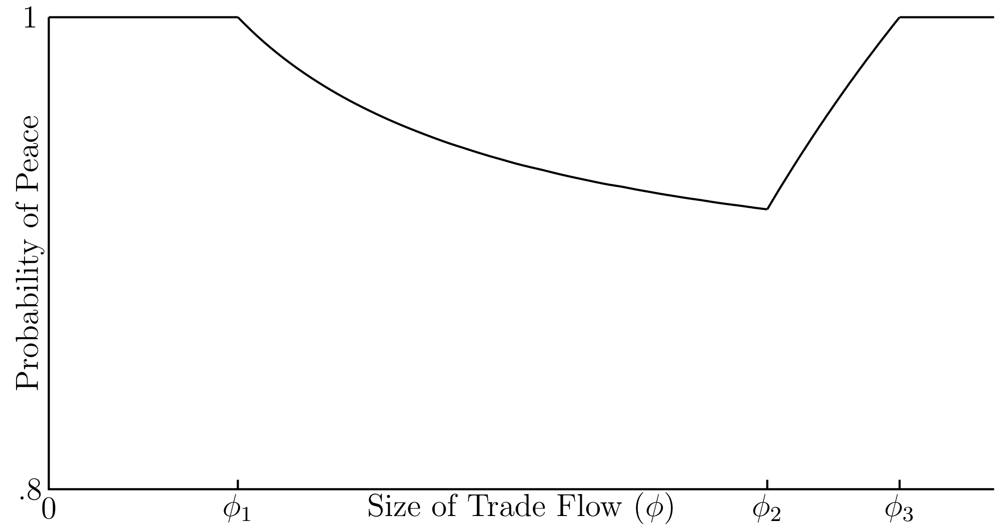

Figure 3: The equilibrium probability of peace as a function of the trade flow.

Taken to the extreme, massive trade ties cause all types of B to accept all offers. In turn, A optimally offers 0 and extracts the entire good peacefully. This is why Proposition 2 states that the effect is weakly decreasing. The result also helps explain World War I as a noted exception to the inverse trade-conflict pattern. Although trade had never been greater, Gowa and Hicks (2015) find that countries covered most of the losses through new trade channels or domestic reallocations. Thus, the World War I combatants had not reached the point where trade swamps all other concerns.

Further, this complements a more recent critique about the start of World War I. Gartzke and Lupu (2012, 143) argue that the common World War I narrative is a misinterpretation of the economic interdependence argument because incentives to misrepresent resolve predominated over the opportunity costs of conflict. We agree that the competing effects of trade can lead war to become more likely in some scenarios but not others.

To recap, Figure 3 shows how the equilibrium probability of peace changes as a function of the trade flow. For the parameters graphed, A prefers taking no risks if the trade flow is sufficiently small. However, increasing trade flows separates unresolved types' reservation values from resolved types' reservation values. By the time the trade flow reaches ϕ_1, the overpayment to the least resolved type necessary to appease the most resolved type is so large that A becomes willing to risk war. The gulf between all the types' reservation values further increases from there, and peace correspondingly declines. This summarizes the findings of Proposition 1.

Nevertheless, further increases to ϕ eventually cause A to take so much risk that it demands the entire good for itself. Yet larger trade flows make A want to demand even more, but that demand is already at the maximum. With that in mind, consider the types who were barely willing to fight beforehand. With the slightly larger flow, they become barely unwilling. In turn, the probability of peace begins to increase at ϕ_2, representing the cutpoint at which A's optimal offer is $x = 0$. This trend continues to ϕ_3, which represents the minimum trade level at which all types accept all offers. Peace stays certain after that point. These cases summarize the findings of Proposition 2.

4 Discussion

Before moving on to our case study, we have a few modeling notes. First, a careful reader may observe that changing the cost of conflict in the above setup alters both the mean and variance of the distribution of the receiver's reservation values. More generally, one may note that increasing ϕ actually has three effects:

1. It increases A's overall cost of war.
2. It increases each type of B's overall cost of war.
3. It increases the difference between the resolved type's reservation value for war and the unresolved type's reservation value for war.

Correspondingly, one may wonder which causes the increase in war. The intuition from Figure 2 indicates that the third effect is responsible because it incentivizes riskier offers.[16] Furthermore, the problem goes away once ϕ transitions the game to the corner solution, at which point the difference in types' reservation values decreases.

This has a reasonable logic. Regardless of the bargaining protocol, when reservation values diverge, A faces more functional uncertainty about its opponent. Exacerbating this information problem incentivizes the uninformed party to make riskier offers, which

[16] Reed (2003) and Spaniel (2018) shows that expanding the distribution of reservation values also leads to more conflict.

in turn leads to more conflict. In contrast, increasing the cost of war when there is uncertainty over military costs does not exacerbate information problems—the parameter τ_B has no interaction with the costs A is uncertain about. Consequently, increasing the opportunity cost for war does not increase the probability of conflict.

As a second modeling note, one may wonder how the result works when increasing the trade flow differentially helps the states. In the baseline setup, for example, a state with 40% of the economic benefits from trade when flows were low maintained that 40% benefit when flows were high. This is a natural assumption make. Nevertheless, we still obtain the counterintuitive relationship when the division fluctuates in the appendix, though now the cutpoint depends on the derivative of the function mapping flows to shares.

Third, we modeled the probability of victory not as a function of resolve. In practice, more resolved states have more incentive to work harder to win a war, and therefore p_B may be correlated with V. In the appendix, we endogenize military allotments. Consistent with this, the more resolved type spends more to arm itself. This complicates the risk-return tradeoff because now A faces uncertainty over both the probability of victory and B's resolve. Per the standard logic, increasing opportunity costs decrease incentives for war for uncertainty over victory. However, the counterintuitive effect remains true for uncertainty over resolve. As a result, if effort does not sway the probability of victory too much, we still observe higher trade flows increasing conflict.

Fourth, and relatedly, one might imagine that the trade flows are correlated with the probability of victory. This is because states can take the existing gains from trade accrued from before a war and funnel them into military resources. However, the key scope condition for Proposition 1's result is just a function of the costs of war and trade balance. The probability of victory simply determines the size of the offer, not A's propensity to run risks.[17] It does, however, determine when A's optimal offer reaches the corner solution. If B is weak, then trade flows begin the calming effect sooner.[18] Stronger B states see trade exacerbate the likelihood of war for longer.

Overall, increasing trade does not always have the monotonic effect on the probability of conflict that economic interdependence theories would predict. Rather, interdependence can increase the likelihood of conflict initially before eventually decreasing

[17] See Benson, Meirowitz, and Ramsay (2016) for how this logic plays out with risk-averse states.

[18] That is, the corresponding ϕ_2 in Figure 3 shifts to the left.

it.

5 Tracing the Model: Sino-Indian Relations, 1949-2007

In this section, we use the case of Sino-Indian relations from 1949-2007 to illustrate the model's main propositions. The case helps illustrates under what conditions increasing opportunity costs affect the strategic interactions between parties. We focus on three different periods in the dyad where varying bilateral trade flows led to outcomes inconsistent with the predictions of the trade-conflict literature. Conventional wisdom suggests Sino-Indian tensions should have dropped when trade flows were growing, but, in fact, the opposite occurred. The deviation in expected behavior enables us to leverage the case to explore what mechanism is at play.

Examining three different periods in the relationship also helps us test whether the model's key conditions and propositions materialize. If the traditional opportunity cost mechanism applies, then we should see no informational asymmetries arise as a result of changing trade flows. If our model's scope conditions hold, we expect growing bilateral trade to exacerbate information problems. Screening should result. During the case study's exploration of Indian decision-making and beliefs about Chinese resolve, we find evidence consistent with the model's main predictions.

We choose to use a case study because the model relies on strategic logic, uncertainty, resolve. Traditional regressions have a difficult time establishing causal relationships under relatively rosy conditions (Samii 2016). Our situation is more challenging because these parameters of interest not easily operationalized for use in a statistical model. Formal models provide a framework for conceptual discussion. Even if the prediction of a model bears out, statistical tests cannot say whether the model is correct (Primo and Clarke 2012). Instead, process-tracing and historical case studies provide descriptive tools to analyze the theoretical concepts and parameters of interest in the model (Goemans and Spaniel 2016). The case study is an opportunity for exploring the plausibility of the model's main propositions. Nevertheless, we believe the testable hypotheses from this model, namely the nonmonotonic effect of growing trade on the probability of war, have already been tested and corroborate the model's main empirical predictions (Beck and Baum 2000; Xiang 2010).

Our focus in this case study is the history of Sino-Indian relations from 1949-2007 for three reasons. First, as we expand on shortly, this case matches the model's scope conditions due to the signing of several profitable trade agreements, India's relative uncertainty about Chinese resolve, and the discrepancy in new trade gains relative to the ratio of original military capabilities between the two countries. This case also complements newer work examining the strategic interactions between China and India (Slantchev 2011; Garver 2011). Second, focusing on one dyad allows us to control for potential time-invariant confounders that could also affect the probability of conflict.[19] Trade flows for most of this period are endogenous to alliance networks and the bipolarity of the international system (Gowa and Mansfield 1994; Morrow et al. 1998). Identifying two non-aligned states that traded with each other helps circumvent these concerns. Third, it allows us to use interstate war as the dependent variable of interest rather than lower-level militarized interstate disputes that are common in empirical tests of economic interdependence. These lower-level disputes do not accurately record the strategic logic and decision-making outlined in the model above because these incidents are often accidental or involve non-state actors (Gleditsch and Pickering 2013).

The model implies three important scope conditions must be met if increasing opportunity costs lead to a nonmonotonic effect on the probability of war. We argue decision-making during three periods of Sino-Indian relations meets these conditions. First, there must be changes in the trade flows between countries across these three periods. After 1949, economic interdependence between India and China was relatively small until a 1954 trade agreement between the two countries increased gains from trade for both sides.

One of the adversaries must also face uncertainty about its opponent's willingness to fight over an issue at stake. The primary territorial dispute between the two countries was, and continues to be, centered over the high desert area of Aksai Chin in the west, Bara-Hoti in the center, and the mountainous North-East Frontier Agency (NEFA) in the east. The origins of the dispute lie in a 19th century disagreement between British, Tibetan, and Chinese officials about ancient trade routes, including parts of Shipki La

[19]The model makes no predictions about the temporal dynamics or conflict sequencing and this is a coincidence in the dyad.

(the Silk Road), and control over trading posts around the eastern city of Tawang.[20] British Indian and Tibetan officials agreed to the McMahon line demarcating the NEFA region in 1914, but Chinese representatives rejected the final accord. This line proved to be a growing source of tension between India and China during the late 1950s, culminating in the 1962 Sino-Indian War.

In his personal papers and diplomatic correspondence, the first Indian Prime Minister Jawaharal Nehru repeatedly expressed uncertainty over Chinese intentions regarding the border issue. Despite the Chinese military's harassment of Indian traders operating in the Tibetan region, impediments in existing trade routes, and a growing militarized presence in Tibet after the 1959 rebellion, Nehru remained uncertain about "whether it [was] just local aggressiveness or just to show us our place" (Jetly 1979, 84). Indeed, much of India's policy banked on the belief that China would likely prefer to back down than start a war over the seemingly valueless territories (Slantchev 2011, 185-186). Thus, in relating the case to the model we develop, India plays the role of state A (the uncertain state), while China plays state B.

Finally, the ratio of the uncertain state's military costs to the opponent's military costs must be greater than the ratio of the uncertain state's trade benefits to the opponent's trade benefits ($\frac{c_A}{c_B} > \frac{\tau_A}{\tau_B}$). Under these conditions, we would expect the risk of conflict to initially increase with the addition of these benefits before eventually tapering off. To operationalize the key ratio, we capture the relative military costs each side would incur by fighting by comparing each country's military assistance and combat experience to yield a measure of c_A and c_B. Combat experience is inversely related to the expected costs of fighting. The parameters τ_A and τ_B measure the relative value of trade, which we operationalize using data on bilateral trade flows between the countries. The parameter ϕ captures the overall flows.

To preview our case study, in the early 1950s, before the countries established strong trade relations, Prime Minister Nehru overlooked Chinese aggression along the Indian-Tibetan border and hawkish domestic opposition to preserve the peace. Low trade flows but high military costs for fighting meant that India would not risk war against China. In other words, ϕ was nearly zero. Risking high costs of war was not worth screening out unresolved types.

Following a 1954 trade deal, India's relative benefits from trade increased so that ϕ

[20] For a longer history of the territorial dispute, see Maxwell (1970).

was now non-zero. At the same time, Chinese harassment of traders in and around the disputed territory exacerbated India's uncertainty over Chinese willingness to fight and disrupt what India perceived as mutually-valuable trade flows. These issues culminated in the 1962 Sino-Indian War because India was more willing to screen China over the disputed good (Proposition 1).

In the third period of relations, during the 1990s, the mutual pursuit of economic development and market integration between China and India overshadowed the lingering border dispute. The rapid growth in the opportunity costs of war made trade so valuable relative to the military costs of fighting that ϕ was large and peace between these two monoliths sustainable (Proposition 2).

5.1 1949-1954: Low Trade, Little Incentive to Gamble, Peace

In the first period of Sino-Indian relations, India refused to gamble on war with China despite minor trade flows and domestic pressure to fight. India's independence from Britain in 1947 and the creation of the People's Republic of China in 1949 transformed the political landscape of Asia. Nehru saw cooperation between India and China as important for "it has been to some extent a trade relationship" (Nehru 2001b, 241). During the first half of 1950, India built up relations by advocating China's entry to the United Nations, publicly denouncing Chiang Kai-Shek's government in Taiwan in public speeches, and lobbying for potential trade talks (Jetly 1979, 11).

On October 7, 1950, Chinese forces annexed Tibet, which, until then, had been India's primary buffer state with China and a principal trading partner for the Indian economy. The event sparked fears in India that China would next challenge the McMahon Line and seize the disputed NEFA region. Members of Parliament in India urged Nehru to militarily respond in defense. It was "dangerous self-delusion," they argued, to appease China, especially as the latter threatened India to not "obstruct the exercise of its sovereign rights" (Jetly 1979, 16, 18). Despite domestic pressure to act militarily, Nehru reiterated his "desire to maintain friendly relations" with China (Jetly 1979, 29). In May 1951, India formally signed a treaty recognizing China's control over Tibet, effectively closing debate about whether India would escalate the Tibetan crisis.

India's willingness to keep the status quo during this period follows the model's prediction in Proposition 1. At the time, Nehru faced virtually no second-order uncertainty through the loss of trade; flows between the two countries in 1950 was a paltry USD $6.1 million and followed a 75% drop from pre-Chinese Communist regime trade levels (Barieri, Keshk, and Pollins 2009). Meanwhile, China was spending about five times more than India on an army ten times as large. The key point here is *not* that China militarily dominated India; the probability of victory from the model subsumes that aspect and does not determine whether a gamble is optimal within any one case. Rather, this military discrepancy meant that, win or lose, India would pay high military costs for conflict and no real losses in trade. In other words, ϕ was approximately zero; the difference in facing an unresolved China versus a resolved China was not worth screening with a small offer. As a result, India acted cautiously, pursuing a policy that was acceptable to both a resolved or unresolved China.

Nehru's cautious behavior in this period is particularly compelling evidence in support of the model because competing explanations would predict an *increase* in conflict likelihood. First, Nehru was a relatively new leader with reputational incentives to stand firm against China (Wolford 2007), but he instead chose to do nothing. Second, domestic political opinion was in favor of taking more aggressive action against China. This should have tied his hands and made it harder for Nehru to back down, but he instead faced little meaningful backlash from elites during the crisis. Finally, preventive war logic would predict that Nehru had large and compelling incentives to address the threat of China in the present, but Nehru took relatively minor military actions apart from a few routine defensive measures to protect the border.[21]

5.2 1954-1962: Rising Trade, Rising Tensions, and War

In the second period, conflict emerged between India and China despite rising opportunity costs. After India acknowledged China's sovereignty over Tibet, the former tried to capitalize on this concession by advocating for additional economic and confidence-building measures to re-institute critical trade talks. The two parties formed a number of Indo-Chinese Friendship Associations in 1952, and those trade talks materialized in December 1953. Four months of negotiations produced the Sino-Indian Agreement on Trade and Intercourse on April 29, 1954. It established new commerce and new trade routes through the disputed border areas.

[21]See "Nehru reaffirms border." *New York Times*. November 21, 1950.

After China and India signed the 1954 trade agreement, both countries boasted about the strength and durability of their friendship. A second agreement in October 1954 outlined additional tradeable goods and services. The countries renewed it in 1956 and 1958 (Jetly 1979, 47). Together, these agreements substantially improved transport technology and ease of access across the Himalayan trade routes.

The model emphasizes that the ratio of military costs ($\frac{c_A}{c_B}$) and trade costs ($\frac{\tau_A}{\tau_B}$) affects the conditions under which war is more likely. This is evident in Sino-Indian relations during this period. After 1954, ϕ began to increase due to trade flows from the landmark agreement. This marked the beginning of a foreign policy period remembered by the moniker "Hindi Chini Bhai-Bhai" (*India and China are brothers*) as trade relations between the two countries grew from USD $4.4 million in 1953 to USD $36.6 million by 1959, an absolute gain of 831% and a dramatic shift for the relatively-closed economies (Anderson and Geiger 2010, 129). The trade benefited both sides immensely such that $\frac{\tau_A}{\tau_B}$ was in relative parity. In contrast, the costs of fighting remained heavily asymmetric. Chinese military expenditures outweighed Indian military expenditures at a ratio of five to one. Further, the Chinese military had more recent combat experience from the Korean War and Taiwan Straits Conflict plus assistance from the Soviet Union. Under these conditions, India's military costs of fighting remained much higher than China's such that the ratio $\frac{c_A}{c_B}$ was very large. This pins $\frac{\tau_A}{\tau_B}$ as less than $\frac{c_A}{c_B}$. Under this condition, the model indicates that increasing trade flows further would increase the risk of conflict.

As trade grew during this decade, reports also emerged about a number of Indian and Chinese intrusions into the central Bara Hoti area on the Tibetan-Indian border (India Ministry of External Affairs 1959, 5). Soon after, more reports emerged that Chinese forces in Tibet began impeding trade by freezing merchandise, harassing traders, demanding currency changes, and creating obstacles to move goods. These actions generated uncertainty in Indian political discussions about whether China was willing to risk harming (what India believed were) new and valuable trade flows over an old border dispute.

In protests sent back and forth between the countries over the incidents, Nehru argued Chinese actions in the area were hampering peaceful commerce. The Prime Minsiter wrote that "we certainly want normal trade to be restored and have pointed out to the Chinese authorities in Tibet the difficulties that have arisen in it" (Nehru 2001a, 469). Although India knew China was benefiting from their new trading agreements, it did not know how China weighed those costs relative to the potential gains from fighting over the border.

The Tibetan Revolt in March 1959 created additional challenges for Sino-Indian relations, but did not assuage or exacerbate Nehru's uncertainty about Chinese resolve. Importantly, Nehru wrote "there has been pressure on the Indian traders even before these Tibetan developments" (Nehru 2001, 448). This event alone did not create uncertainty about China's willingness to challenge India; it also checks against competing explanations that exogenous political shocks might be driving an increase in India's uncertainty rather than trade itself.

Shortly after the rebellion, India reasserted its demand that China remove its new border defense, which would both free up trade routes and distance the Chinese military. Why? The strategy stemmed from Nehru's uncertainty over Chinese resolve. He wrote that it was "unlikely that the Chinese force [would] take up any aggressive line on this frontier" (Maxwell 1970, 130).[22] When Nehru sent troops to Bara-Hoti and other disputed areas to match Chinese forces, the PLA's restrained, peaceful response led Nehru to underestimate China's valuation of the stakes compared to continued trade. Nehru believed that the probability he was facing an unresolved type was high.

Because China enjoyed gains from trade, screening the types became more attractive for India. At this time, Nehru adopted his "Forward Policy" in 1961 to screen and "serve as a test of long-range intentions regarding China" (Patterson 1963, 279). The policy worked by having Indian troops systematically construct more posts deeper in the disputed territory to match Chinese advances in Aksai Chin and NEFA. Nehru thought this policy would "irritate the Chinese, but no more" (Jetly 1979, 149).

When talks to renew the series of trade agreements fell through in 1962, China increased its military presence in the border region to between 140,000 and 150,000 by the fall—a hefty investment given the logistical difficulties of sending troops out to the border and a "more than ample superiority" of personnel (Whiting 1975, 93). In

[22] This raises a secondary question about two-sided information problems. How accurate were India's beliefs about Chinese resolve? The Chinese government's main propaganda channel, the newspaper *People's Daily*, paid little attention to threats by the Indian governments (Whiting 1975, 48). In retrospect, we know now that China had also likely intercepted Indian military communication in the period at this time enabling it to track both the size and movements of Indian troops in the region further alleviating potential informational asymmetries (Whiting 1975, 44).

October 1962, China invaded India to end the border standoff, catalyzing the Sino-Indian war. To summarize, Nehru's uncertainty about Chinese willingness to fight over the border misled the development of India's Forward Policy and increased the risk of war.

5.3 1984-2007: Massive Trade and Return to Stability

In the final period of Sino-Indian relations, the relative valuation of trade flows compared to the military costs of fighting dominated Indian decision-making. In terms of the model, ϕ was so large that the old military costs of fighting became unimportant. India would not risk opportunity costs from trade despite any lingering second-order uncertainty. When Rajiv Gandhi became Prime Minister in 1984, India's foreign policy centered on rapprochement and re-starting bilateral trade flows with China (Andersen and Geiger 2010, 132). Direct border trade formally resumed in July 1992, helping to contribute to the sum total USD $270 million in dyadic trade flows that year. By 1995, trade flows surpassed USD $1 billion, with plans to push trade higher. Both sides pledged a mutual commitment to forge an everlasting agreement on the disputed border to best strengthen the countries' "long-term interests and overall bilateral relationship" (Sandhu 2008, 23). Concurrently, both countries agreed to reduce troop levels in the NEFA region now known as Arunachal Pradesh. Over the next ten years, economic trade flourished, rising to $18 billion by 2005 and turning China into India's top trading partner (Rusko and Sasikumar 2007, 110). In the language of the model, this pushed ϕ to increasingly larger values.

By 2000, both countries' relative economic gains from trading with each were too valuable to risk sacrificing for potential gains on the border. Scholars attributed the trade ties as "the most agreeable instrument of China-India rapprochement" and a strong cornerstone of peace and cooperation (Singh 2005, 62). It reflects the idea that sufficiently high levels of trade flows make screening unattractive. In 2003, both countries agreed to re-open Nathu La, the traditional trade route between India and China closed after the 1962 War. The re-opening of Shipki La followed in 2006, reaffirming the predictions of economic interdependence theory (Anderson and Geiger 2010, 136). Thus, trade flows outweighed the potential gains either country could yield from flaring up the border dispute.

Overall, the Sino-Indian dyad from 1947-2007 shows how growing trade had varying effects on India's willingness to fight China. Even though India signed increasingly fruitful trade agreements with China in 1954, 1956, and 1958 that should have increased the costs of war, Nehru became more aggressive towards China because of informational asymmetries about the relative value of these prospective gains (Blainey 1988, 50). The decision-making at three distinct periods of Sino-Indian relations fits the formal model's theoretical predictions that varying trade flows have nonmonotonic effects on the probability of war.

6 Conclusion

A large literature on economic interdependence argues trade decreases the probability of war due to rising opportunity costs. Although we do not disagree with this work's main findings, we think it is important to analyze under what conditions this claim holds true given the theoretical and empirical gaps identified.

This paper's main contribution is to identify the precise conditions under which the probability of war increases despite rising opportunity costs. We show that, unlike other mechanisms, rising opportunity costs may counter-intuitively make war more likely because it also increases the difference between reservation points for unresolved versus resolved opponents. As a result, these informational asymmetries can lead states to screen their opponents and risk war. This new finding reshapes our understanding about the relationship between opportunity costs and war. It introduces a more nuanced mechanism about when and how this relationship operates, sometimes contrary to expectations.

Our work advances economic interdependence theories of war in several ways. First, it provides new insight on the causes of war at odds with traditional cases where opportunity costs increased, yet conflict still erupted. Second, it demonstrates how and when competing effects of economic instruments predominate, driving changes in the probability of conflict. In contrast to previous work, we identify specific conditions under which increasing opportunity costs shifts the probability of conflict, consistent with the empirical evidence. Finally, it demonstrates the important, but subtle, effects of changing instruments, like trade flows, in the presence of uncertainty. The model advances a growing line of research that various sources of uncertainty have disparate effects on crisis bargaining.

This paper has more general implications for trade-conflict research. It complements growing calls to disaggregate the effects of instruments like trade (Martin et al. 2008). Empirical analyses must carefully trace what precisely parties do not know about each other to draw the correct inference. It also suggests states should be careful in interpreting how other states value or benefit from mutual trade flows. A free trade agreement championed by one state may be perceived as relatively less beneficial in another state. This uncertainty may undermine the credibility to abide by the agreement in the long-run.

We also highlight the need for future research to consider screening incentives in trade deals themselves. Although the proposer benefits from greater trade—both from the direct economic benefit and indirect ability to steal more surplus from the receiver—trade can harm unresolved receivers and incentivize screening. This could generate some constraints in the deals a state is willing to sign, in fear that the rearranged incentives under uncertainty could hurt its ability to effectively bluff later. A more unified approach to trade and crisis negotiations would yield additional interesting insights.

Moving forward, the results speak to other lines of research in international relations theory predicated on changing costs of conflict. We couched our results in the interdependence literature due its clear application. However, the comparative static speaks to cases where the receiver's costs increase more generally.[23] Framed this way, the results have clear implications for other literatures. For example, standard nuclear deterrence theory argues that possessing nuclear weapons increases the costs of war for potential challengers due to the risk of a retaliatory nuclear response (Morgenthau 1961, 280; Gilpin 1983, 213-219). The logic of alliance formation similarly relies on the assumption that entering these pacts induces peace by raising an opponent's costs of conflict (Morrow 1994). Together, these mechanisms assume raising the costs of war should decrease conflict. Our results demonstrate this effect is likely more conditional than previously realized. We find increased costs of conflict can exacerbate issues with uncertainty over resolve even if both states possess destructive weaponry. This promises to shed new insights into how raising costs affects deterrence and coercive bargaining in other contexts.

[23]One can observe this by setting $\phi = 0$ and taking a comparative static on c_B.

7 References

Anderson, David A. and Isabel Geiger. 2010. "Sino-Indian Trade Relations and the Ongoing Border Dispute." *The China and Eurasia Forum Quarterly* 8 (4): 125-141.

Arena, Philip. 2013. "Costly Signaling, Resolve, and Martial Effectiveness." Manuscript, University of Buffalo.

Arena, Philip and Anna Pechenkina. 2015. "External Subsidies and Lasting Peace." *Journal of Conflict Resolution* 60 (7): 1278-1311.

Arena, Philip and Scott Wolford. 2012. "Arms, Intelligence, and War." *International Studies Quarterly* 56 (2): 351-365.

Barbieri, Katherine, Omar M. G. Keshk, and Brian Pollins. 2009. "Trading Data: Evaluating our Assumptions and Coding Rules" *Conflict Management and Peace Science.* 26 (5): 471-491.

Beck, Nathaniel and Matthew Baum. 2000. "Trade and Conflict in the Cold War Era: An Empirical Analysis Using Directed Dyads." Paper presented at the Workshop on Trade and Conflict of the 2000 ECPR Joint Workshops, Copenhagen, Denmark. `https://www.hks.harvard.edu/fs/mbaum/documents/Beck_and_Baum_2000.pdf`

Bils, Peter, and William Spaniel. 2017. "Policy Bargaining and Militarized Conflict." *Journal of Theoretical Politics* 29 (4): 647-678.

Blainey, Geoffrey. 1988. *Causes of War.* New York: Simon and Schuster.

Benson, Brett V., Adam Meirowitz, and Kristopher W. Ramsay. 2016. "Changing Capabilities, Uncertainty, and the Risk of War in Crisis Bargaining." *Research and Politics* 3 (3): 1-6.

Clarke, Kevin A. and David M. Primo. 2012. *A Model Discipline: Political Science and the Logic of Representations.* Oxford: Oxford University Press.

Copeland, Dale C. 1996. "Economic Interdependence and War: A Theory of Trade Expectations." *International Security* 20 (4): 5-41.

Dal Bó, Ernesto and Robert Powell. 2009. "A Model of Spoils Politics." *American Journal of Political Science* 53 (1): 207-222.

Fearon, James D. 1994. "Domestic Political Audiences and the Escalation of International Disputes." *American Political Science Review* 88 (3): 577-592.

Fearon, James D. 1995. "Rationalist Explanations for War." *International Organization* 49 (3): 379-414.

Fearon, James D. 1997. "Signaling Foreign Policy Interests: Tying Hands versus Sinking Costs." *Journal of Conflict Resolution* 41 (1): 68-90.

Fey, Mark. 2014. "Learning to Fight: Information, Uncertainty, and the Risk of War." Manuscript, University of Rochester.

Fey, Mark and Kristopher W. Ramsay. 2011. "Uncertainty and Incentives in Crisis Bargaining: Game-Free Analysis of International Conflict." *American Journal of Political Science* 55 (1): 149-169.

Frieden, Jeffry A., David A. Lake, and Kenneth A. Schultz. 2013. *Interests, Interactions, Institutions: World Politics, Second Edition.* New York: W.W. Norton.

Gartzke, Erik. 2007. "The Capitalist Peace." *American Journal of Political Science* 51 (1): 166-191.

Gartzke, Erik and Yonatan Lupu. 2012. "Trading on Preconceptions: Why World War I Was Not a Failure of Economic Interdependence." *International Security* 36 (4): 115-150.

Garver, John W. *Protracted contest: Sino-Indian rivalry in the twentieth century.* University of Washington Press, 2011.

Gilpin, Robert. 1983. *War and Change in World Politics.* Cambridge: Cambridge University Press.

Goemans, Hein and William Spaniel. 2016. "Multimethod Research: A Case for Formal

Theory." *Security Studies* 25 (1): 25-33.

Gowa, Joanne and Raymond Hicks. 2015. "Commerce and Conflict: New Data about the Great War." *British Journal of Political Science.*

Gowa, Joanne., and Edward Mansfield. 1993. "Power Politics and International Trade." *The American Political Science Review.* 87(2): 408-420.

Hirschman, A. O. 1977. *The Passions and the Interests: Political Arguments for Capitalism Before Its Triumph.* Princeton: Princeton University Press.

Hoffman, Steven A. 1990. *India and the China Crisis.* Berkeley: The University of California Press.

Huth, Paul. 2009. *Standing Your Ground: Territorial Disputes and International Conflict.* Ann Arbor: University of Michigan Press.

Jetly, Nancy. 1979. *India-China Relations, 1947-1977: A Study of Parliament's Role in the Making of Foreign Policy.* New Delhi: Radiant Publishers.

Keohane, Robert Owen and Joseph S. Nye. 1977. *Power and Interdependence: World Politics in Transition.* Boston: Little, Brown.

Kydd, Andrew H. 2010. "Rationalist Approaches to Conflict Prevention and Resolution." *Annual Review of Political Science* 13: 101-121.

Martin, Philippe. Thierry Mayer, Mathias Thoenig. 2008. "Make Trade Not War?" *Review of Economic Studies* 75(3) 865-900.

Maxwell, Neville. 1970. *India's China War.* New York: Pantheon Books.

Mearsheimer, John J. 1984. "Nuclear Weapons and Deterrence in Europe." *International Security* 9 (3): 19-46.

Morgenthau, Hans. 1961. *Politics among Nations: The Struggle for Peace and Power.* New York: Knopf.

Morrow, James D. 1989. "Capabilities, Uncertainty, and Resolve: A Limited Information Model of Crisis Bargaining." *American Journal of Political Science* 33 (4): 941-972.

Morrow, James D. 1994. "Alliances, Credibility, and Peacetime Costs?" *Journal of Peace Research* 36 (4): 481-489.

Morrow, James D. 1999. "How Could Trade Affect Conflict?" *Journal of Conflict Research* 38 (2): 270-297.

Morrow, James D., Randolph M. Siverson, and Tressa E. Tabares. 1998. "The Political Determinants of International Trade: The Major Powers, 1907-90." *The American Political Science Review.* 92(3): 649-61.

Mueller, John. 1989. *Retreat from Doomsday: The Obsolescence of Major War.* New York: Basic Books.

"Nehru Reaffirms Border With Tibet," New York Times, Nov. 20, 1950.

Nehru, Jawaharlal. 2001a. *Selected Works of Jawaharlal Nehru. Vol. 51.* Cambridge: Oxford University Press.

Nehru, Jawaharlal. 2001b. *Selected Works of Jawaharlal Nehru. Vol. 52.* Cambridge: Oxford University Press.

India Ministry of External Affairs. 1959. *Notes, Memoranda and Letters Exchanged and Agreements Signed Between the Governments of India and China, 1954-1959.* Ministry of External Affairs.

Oneal, John R. and Bruce M. Russett. 2001. *Triangulating Peace: Democracy, Interdepenedence, and International Organizations.* New York: W. W. Norton.

Patterson, George N. 1963. *Peking versus Delhi.* London: Faber and Faber.

Polachek, Solomon. 1980. "Conflict and Trade." *Journal of Conflict Resolution* 24 (1): 55-78.

Polachek, Solomon, Carlos Seiglie, and Jun Xiang. 2007. "The impact of foreign direct investment on international conflict." *Defence and Peace Economics* 18(5): 415-429.

Polachek, Solomon and Jun Xiang. 2010. "How Opportunity Costs Decrease the Probability of War in an Incomplete Information Game." *International Organization*

64(1): 133-144.

Powell, Robert. 1999. *In the Shadow of Power: States and Strategies in International Politics.* Princeton: Princeton University Press.

Powell, Robert. 2004. "Bargaining and Learning While Fighting." *American Journal of Political Science* 48 (2): 344-361.

Reed, William. 2003. "Information, Power, and War." *American Political Science Review.* 97 (4): 633-641.

Rosecrance, Richard. 1986. *The Rise of the Trading State: Commerce and Conquest in the Modern World.* New York: Basic Books.

Rusko, Christopher J. and Karthika Sasikumar. 2007. "India and China: From Trade to Peace?" *Asian Perspective* 31 (4): 99-123.

Samii, Cyrus. 2016. "Causal Empiricism in Quantitative Research." *Journal of Politics* 78 (3): 941-955.

Sandhu, Bhim. 2008. "Sino-Indian Relations, 1947 to Present: From Conflict to Cooperation." *International Journal of South Asian Studies* 1 (1): 24.

Simmons, Beth. 2005. "Rules over Real Estate: Trade, Territorial Conflict, and International Borders as Institution." *Journal of Conflict Resolution* 49 (6): 823-848.

Singh, Swaran. 2005. "China-India Bilateral Trade: Strong Fundamentals, Bright Future." *China Perspectives* 62.

Slantchev, Branislav L. 2011. *Military Threats: The Costs of Coercion and the Price of Peace.* Cambridge: Cambridge University Press.

Smith, Bradley C. and William Spaniel. 2019. "Militarized Disputes, Uncertainty, and Leader Tenure." *Journal of Conflict Resolution* Forthcoming.

Spaniel, William. 2018. "Only Here to Help? Bargaining and the Perverse Incentives of International Institutions." *International Studies Quarterly* 62 (1): 14-22.

Spaniel, William and Peter Bils. 2017. "Slow to Learn: Bargaining, Uncertainty, and the Calculus of Conquest." *Journal of Conflict Resolution* 62 (4): 774-796

Waltz, Kenneth N. 1988. "The Origins of War in Neorealist Theory." *Journal of Interdisciplinary History* 18 (4): 615-628.

Whiting, Allen S. 1975. *The Chinese Calculus of Deterrence.* Ann Arbor: University of Michigan Press.

Wolford, Scott. 2007. "The Turnover Trap: New Leaders, Reputation, and International Conflict." *American Journal of Political Science* 51 (4): 772-788.

Xiang, Jun. 2010. "Relevance as a Latent Variable in Dyadic Analysis of Conflict." *Journal of Politics.* 72(2): 484-498.

Appendix for "The Uncertainty Tradeoff"

Proof of the Main Propositions

Recall that the PDF of the distribution described in the text is $\frac{1}{V^2}$. The CDF is therefore $\frac{1}{\underline{V}} - \frac{1}{V}$. The proof below applies for any $\underline{V}$ and $\overline{V}$ that create a valid probability distribution (e.g., $\underline{V} = \frac{2}{3}$ and $\overline{V} = 2$, or $\underline{V} = \frac{3}{5}$ and $\overline{V} = \frac{3}{2}$, etc.).

By backward induction, a type with value V accepts x if:[24]

$$Vx > Vp_B - c_B - \phi\tau_B$$
$$x > p_B - \frac{c_B + \phi\tau_B}{V}$$

A's decision is substantially more complicated. We break down the equilibrium space into five cases.

When $p_B - \frac{c_B+\phi\tau_B}{\underline{V}} > 0$ and $c_A + \phi\tau_A < (c_B + \phi\tau_B)\left(\frac{1}{\underline{V}} - \frac{2}{\overline{V}}\right)$

If $x < p_B - \frac{c_B+\phi\tau_B}{\underline{V}}$, all types reject. If $x > p_B - \frac{c_B+\phi\tau_B}{\overline{V}}$, all types accept. In all other cases, we must run through the distribution function to obtain a probability of settlement. Rearranging $x > p_B - \frac{c_B+\phi\tau_B}{V}$ in terms of V and placing the result into the CDF, the probability B accepts an offer x is:

$$\frac{1}{\underline{V}} - \frac{p_B - x}{c_B + \phi\tau_B}$$

Therefore, A's expected utility for an offer x (on the interior) is:

$$(1-x)\left(\frac{1}{\underline{V}} - \frac{p_B - x}{c_B + \phi\tau_B}\right) + (1 - p_B - c_A - \phi\tau_A)\left(1 - \frac{1}{\underline{V}} + \frac{p_B - x}{c_B + \phi\tau_B}\right)$$

The first order condition for this yields a unique solution:

[24]Because the indifferent type has measure zero, how an indifferent type responds is immaterial.

$$\frac{\underline{V}(2p_B + c_A + \phi\tau_A - 2x) - c_B - \phi\tau_B}{\underline{V}(c_B + \phi\tau_B)} = 0$$

$$x^* \equiv p_B + \frac{c_A + \phi\tau_A}{2} - \frac{c_B + \phi\tau_B}{2\underline{V}}$$

This is a maximum because the second derivative is $-\frac{2}{c_B+\phi\tau_B}$, which is negative. If the maximum is greater than $p_B - \frac{c_B+\phi\tau_B}{\overline{V}}$, then $p_B - \frac{c_B+\phi\tau_B}{\overline{V}}$ yields the best payoff for A; this is because that amount is the smallest offer that guarantees acceptance. Otherwise, x^* is the optimal offer. The condition for x^* being the optimal offer is therefore:

$$p_B + \frac{c_A + \phi\tau_A}{2} - \frac{c_B + \phi\tau_B}{2\underline{V}} < p_B - \frac{c_B + \phi\tau_B}{\overline{V}}$$

$$c_A + \phi\tau_A < (c_B + \phi\tau_B)\left(\frac{1}{\underline{V}} - \frac{2}{\overline{V}}\right)$$

This condition holds for this case. We therefore turn to the comparative statics on ϕ. Using the solution to the first order condition, the probability of B accepting in equilibrium is:

$$\frac{1}{\underline{V}} - \frac{p_B - \left(p_B + \frac{c_A+\phi\tau_A}{2} - \frac{c_B+\phi\tau_B}{2\underline{V}}\right)}{c_B + \phi\tau_B}$$

$$\frac{1}{2\underline{V}} + \frac{c_A + \phi\tau_A}{2(c_B + \phi\tau_B)}$$

Increasing levels of ϕ results in more war if this value is decreasing. Therefore, we must investigate where the first derivative is negative:

$$\frac{\tau_A c_B - c_A\tau_B}{2(c_B + \phi\tau_B)^2} < 0$$

$$\frac{c_A}{c_B} > \frac{\tau_A}{\tau_B}$$

This is the same condition as in Proposition 1. By analogous argument, the probability of war is decreasing if $\frac{c_A}{c_B} < \frac{\tau_A}{\tau_B}$.

When $p_B - \frac{c_B+\phi\tau_B}{\underline{V}} > 0$ and $c_A + \phi\tau_A > (c_B + \phi\tau_B)\left(\frac{1}{\underline{V}} - \frac{2}{\overline{V}}\right)$

By the first case's argument, A's optimal offer is the corner solution of $x = p_B - \frac{c_B+\phi\tau_B}{\overline{V}}$. Because this is a corner solution, the probability of war is locally unchanging. However, we still must investigate how the probability of war transitions from the corner solution to the interior solution. Such a transition can only occur if increasing ϕ flips the sign of this case's second condition. To find out if that can happen, note that we may rewrite the condition's inequality as:

$$\frac{c_A + \phi\tau_A}{c_B + \phi\tau_B} - \left(\frac{1}{\underline{V}} - \frac{2}{\overline{V}}\right) > 0$$

Taking the derivative of the left hand side with respect to ϕ and investigating when it is decreasing yields:

$$\frac{c_B\tau_A - c_A\tau_B}{(c_B + \phi\tau_B)^2} < 0$$
$$\frac{c_A}{c_B} > \frac{\tau_A}{\tau_B}$$

Recall that this is the same condition that resulted in expanded trade flows increasing the probability of war in Proposition 1. A similar logic prevails here—if that condition holds, increasing trade flows can shift the parameters out of the corner solution to the interior solution. This moves the probability of war from 0 to some strictly positive value. But if $\frac{c_A}{c_B} < \frac{\tau_A}{\tau_B}$, increasing trade flows only reinforces A's incentive to make the safe offer. In turn, the probability of war remains static at 0.

When $p_B - \frac{c_B+\phi\tau_B}{\overline{V}} > 0 > p_B - \frac{c_B+\phi\tau_B}{\underline{V}}$ and $c_A + \phi\tau_A < (c_B + \phi\tau_B)\left(\frac{1}{\underline{V}} - \frac{2}{\overline{V}}\right)$

The latter condition implies that A prefers making the interior solution to offering $x = p_B - \frac{c_B+\phi\tau_B}{\overline{V}}$. However, the first condition now says that some types of B have a negative payoff for war. Thus, the interior solution may be *less* than 0. In turn, A's optimal demand becomes the maximum of x^* and 0.

If the maximum is 0, then the probability of war is strictly decreasing in ϕ locally. To see why, note that offering 0 maximizes the probability of war given B's best response function. Local increases to ϕ increase the portion of types of B that have negative war payoffs and thus accept all offers. In turn, no matter what offer A proposes after

ϕ increases, the probability of war must be *lower* than before the change.

If the maximum is x^*, then the comparative statics for the first case apply. Locally, if $\frac{c_A}{c_B} > \frac{\tau_A}{\tau_B}$, the probability of war is strictly increasing; if $\frac{c_A}{c_B} < \frac{\tau_A}{\tau_B}$, it is strictly decreasing.[25]

When $p_B - \frac{c_B + \phi\tau_B}{\overline{V}} > 0 > p_B - \frac{c_B + \phi\tau_B}{\underline{V}}$ and $c_A + \phi\tau_A > (c_B + \phi\tau_B)\left(\frac{1}{\underline{V}} - \frac{2}{\overline{V}}\right)$.

Under these parameters, some types of B have negative war values, and A optimally offers the minimum amount that all types accept. The comparative static on the probability of war is locally unchanging because it remains fixed at 0. Increasing ϕ does not transition the parameters to the third case if $\frac{c_A}{c_B} < \frac{\tau_A}{\tau_B}$ because it only makes A more inclined to pursue the corner solution. In contrast, if $\frac{c_A}{c_B} > \frac{\tau_A}{\tau_B}$, then the parameters can transition to the third case, and war may occur with positive probability. This increase in the probability of war is consistent with Proposition 1's condition.

When $p_B - \frac{c_B + \phi\tau_B}{\overline{V}} < 0$

All types of B have negative war payoffs and accept all offers. Trivially, A's optimal offer is 0. Increasing ϕ retains the negative war payoffs for all types and therefore has no effect on the zero probability of war.

Proof for a Class of Continuous Distributions

We begin with some notation before generalizing the main counterintuitive result.[26] Let $I(\phi, c_A, c_B, \tau_A, \tau_B, p_B)$ be the implicit function that maps ϕ to the equilibrium offer x. Then the following are sufficient for the probability of war to be strictly increasing in ϕ for the interior solution:[27]

[25] Note that if the probability of war is strictly increasing locally in ϕ, it can eventually decrease. This is because sufficiently large values of ϕ can transition the optimal offer from x^* to 0, and the probability of war is strictly decreasing once the optimal offer becomes 0. For this to be the case, x^* must be decreasing in ϕ, or $\tau_A - \frac{\tau_B}{\underline{V}} < 0$.

[26] This section focuses on continuous distributions. The following section demonstrates the result for discrete type spaces as well.

[27] Because these are sufficient conditions, they are not the only conditions that generate the main result. For example, the condition on the reverse hazard rate guarantees a unique solution to the first order condition on A's offer. Without a unique solution, the equilibrium probability of war may

1. All types of B have a positive payoff for war (i.e., $\underline{V} > \frac{c_B+\phi\tau_B}{p_B}$)

2. The function $\left(\frac{f\left(\frac{c_B+\phi\tau_B}{p_B-x}\right)}{F\left(\frac{c_B+\phi\tau_B}{p_B-x}\right)}\right)\left(\frac{c_B+\phi\tau_B}{(p_B-x)^2}\right)$ is weakly decreasing in x[28]

3. A's optimal offer size is decreasing in ϕ sufficiently fast (i.e., $\frac{\partial I}{\partial \phi} < -\frac{\tau_B(p_B-I(\phi))}{c_B+\phi\tau_B}$)

Proof: Any given type, B accepts if $x > p_B - \frac{c_B+\phi\tau_B}{V}$. Reworking in terms of V, a type accepts if $V < \frac{c_B+\phi\tau_B}{p_B-x}$. Therefore, $F\left(\frac{c_B+\phi\tau_B}{p_B-x}\right)$ gives the probability of acceptance for an offer x. This generates A's utility for any offer x on the interior:

$$F\left(\frac{c_B+\phi\tau_B}{p_B-x}\right)(1-x)+\left(1-F\left(\frac{c_B+\phi\tau_B}{p_B-x}\right)\right)(1-p_B-c_A-\phi\tau_A)$$

We now take the derivative of this with respect to x. Note that doing so requires us to use the chain rule on the CDFs. Writing this as the first order condition gives:

$$\begin{aligned}0 =& f\left(\frac{c_B+\phi\tau_B}{p_B-x}\right)\left(\frac{c_B+\phi\tau_B}{(p_B-x)^2}\right) - f\left(\frac{c_B+\phi\tau_B}{p_B-x}\right)\left(\frac{c_B+\phi\tau_B}{(p_B-x)^2}\right)x \\ &- F\left(\frac{c_B+\phi\tau_B}{p_B-x}\right) - f\left(\frac{c_B+\phi\tau_B}{p_B-x}\right)\left(\frac{c_B+\phi\tau_B}{(p_B-x)^2}\right)(1-p_B-c_A-\phi\tau_A)\end{aligned}$$

Rearranging yields:

$$\left(\frac{f\left(\frac{c_B+\phi\tau_B}{p_B-x}\right)}{F\left(\frac{c_B+\phi\tau_B}{p_B-x}\right)}\right)\left(\frac{c_B+\phi\tau_B}{(p_B-x)^2}\right) = \left(\frac{1}{p_B+c_A+\phi\tau_A-x}\right)$$

By the second assumption, the left hand side is decreasing. Because $p_B > x$ on the interior, the right hand side is strictly increasing in x. If the left hand side is greater than the right hand side for $x = p_B - \frac{c_B+\phi\tau_B}{\overline{V}}$, no solution exists. This implies that the derivative of A's utility function strictly increases in x on the interior. Thus, A chooses the largest value without providing an unnecessary concession, which is $x = p_B - \frac{c_B+\phi\tau_B}{\overline{V}}$.

increase. However, to show that, we would need to compare A's utility for each solution, which cannot be done cleanly for a general distribution function. We have also run numerical simulations on a wide variety of other distributions and have recovered the same result.

[28] This is the product of the reverse hazard rate and the derivative with respect to the offer of the function that maps an offer to an indifferent type.

If the left hand side is less than the right hand side for $x = p_B - \frac{c_B+\phi\tau_B}{\overline{V}}$, then a solution exists. Moreover, by the intermediate value theorem, it is unique. It is also a maximizer because the derivative is negative as x goes to $p_B - \frac{c_B+\phi\tau_B}{\overline{V}}$. State A chooses that unique optimizer. We focus on this case for the rest of the proof.

Recall that I is the implicit function that maps ϕ to an optimal offer x, through the first order condition given. Then the probability of rejection equals $1-F\left(\frac{c_B+\phi\tau_B}{p_B-I(\phi)}\right)$. We want to know how this changes as a function of ϕ. Using the chain rule, the derivative of the probability of rejection is:

$$-f\left(\frac{c_B+\phi\tau_B}{p_B-I}\right)\left[\frac{\partial}{\partial\phi}\left(\frac{c_B+\phi\tau_B}{p_B-I}\right)\right]$$

$$\frac{-f\left(\frac{c_B+\phi\tau_B}{p_B-I(\phi)}\right)\left[\tau_B(p_B-I)+\left(\frac{\partial I}{\partial\phi}\right)(c_B+\phi\tau_B)\right]}{(p_B-I)^2}$$

This probability is increasing in ϕ if:

$$\frac{\partial I}{\partial\phi} < -\frac{\tau_B(p_B-I)}{c_B+\phi\tau_B}$$

This is the third condition.

A remaining question is whether the continuous type distribution exhibits the same nonmonotonicity as the case in the main text. The simplest proof for this is that raising ϕ to sufficiently high levels eventually ensures that $\overline{V} < \frac{c_B+\phi\tau_B}{p_B}$. Such a condition means that all types of B accept all offers. Trivially, A's optimal offer is $x = 0$. All types accept, and therefore the probability of war equals 0. Thus, any case in which the probability of war is positive (such as those that meet the conditions from the proof of Proposition 1) must eventually transition into this case. This is a decrease in the probability of war. The relationship is weak because further increases to ϕ yield no change in the probability of war.

Robustness Check: Generalized Trade Flows

In the main model, the percentage of trade benefits remained the same as trade flows increased. Suppose instead we generalized it such A's opportunity cost was $\tau_A(\phi) \geq 0$ and B's was $\tau_B(\phi) \geq 0$. The only restriction we place on these is that both of their first derivatives are positive—that is, increasing overall trade flows only increases the total benefits to each party.

We now investigate whether the main result holds up under these conditions. To reduce the complexity of our robustness checks, we consider a two type model where Nature draws V with probability q and $V' > V$ with probability $1 - q$. For such a distribution, only two possible offers are optimal: $p_B - \frac{c_B+\tau_B(\phi)}{V'}$ and $p_B - \frac{c_B+\tau_B(\phi)}{V}$. The former induces both types to accept; the latter results in peace with the unresolved type but war with the resolved type. Thus, A prefers the risky offer if:

$$q\left(1 - p_B + \frac{c_B + \tau_B(\phi)}{V}\right) + (1-q)\left(1 - p_B - c_A - \tau_A(\phi)\right) > 1 - p_B + \frac{c_B + \tau_B(\phi)}{V'}$$

$$q > \frac{c_A + \tau_A(\phi) + \frac{c_B+\tau_B(\phi)}{V'}}{c_A + \tau_A(\phi) + \frac{c_B+\tau_B(\phi)}{V}}$$

Thus, if the cutpoint is decreasing in ϕ, the parameters for which war occur expands. Taking the derivative of it with respect to ϕ and then checking when it is negative yields:

$$-\frac{V(V'-V)((c_A + \tau_A(\phi))\tau_B'(\phi) - ((c_B + \tau_B(\phi))\tau_A'(\phi))}{V'(Vc_A + c_B + \tau_B(\phi) + V\tau_A(\phi))^2} < 0$$

$$(c_A + \tau_A(\phi))\tau_B'(\phi) > (c_B + \tau_B(\phi))\tau_A'(\phi)$$

This is the new condition for the result. Note that it maintains a couple critical characteristics of the main comparative static. Namely, the game is more conflict prone when c_A is large and when c_B is small.[29]

Robustness Check: Uncertainty over Value with Endogenous Armaments

We now blend two different sources of uncertainty: uncertainty over value (as in the main model) and second-order uncertainty over the probability of victory due to endogenous armaments. The game begins with Nature choosing a value V for B with

[29]In fact, it recovers the same cutpoint on $\frac{c_A}{c_B} > \frac{\tau_A}{\tau_B}$ when $\tau_i'(\phi)$ is equal to some constant.

probability q and V' with probability $1-q$. State A then makes an offer x, which B accepts or rejects. Accepting implements the agreement, while rejecting means that B must decide on a level of armaments. Specifically, it chooses $m_B \geq 0$. Nature awards the prize to A with probability $\frac{m_A}{m_A+m_B}$ and to B with complementary probability, where $m_A > 0$ is A's (exogenous) level of armaments.[30] A's overall payoff is therefore $\frac{m_A}{m_A+m_B} - c_A - \phi\tau_A$, while the low type's is $V\left(\frac{m_B}{m_A+m_B}\right) - m_B - c_B - \phi\tau_B$ and the high type's is $V'\left(\frac{m_B}{m_A+m_B}\right) - m_B - c_B - \phi\tau_B$, where the $-m_B$ term reflects B's costs to develop that level of armaments.

We proceed with backward induction, focusing on the interior solution and beginning with B's armament decision. The first order condition of the low type's objective function with respect to m_B is:

$$V\left(\frac{m_A + m_B - m_B}{(m_A + m_B)^2}\right) - 1 = 0$$

$$m_B^2 + 2m_A m_B + m_A^2 - V m_A = 0$$

The quadratic equation produces a unique positive root:

$$\frac{-2m_A + \sqrt{4m_A^2 - 4m_A^2 + 4Vm_A}}{2}$$

$$\sqrt{Vm_A} - m_A$$

Analogously, the high type's equilibrium armament is $\sqrt{V'm_A} - m_A$. Note that these differing armament decisions give A second-order uncertainty over its probability of victory. That is, the high type produces higher levels than the low type. Consequently, if A fights a war, it might not know how much it expects to receive from fighting.

Now consider B's accept/reject decision. Placing the optimal level of armaments back into B's utility function, the low value type earns the following if it rejects:

$$\frac{\sqrt{Vm_A} - m_A}{m_A + \sqrt{Vm_A} - m_A} - \sqrt{Vm_A} - m_A - c_B - \phi\tau_B$$

$$(\sqrt{V} - \sqrt{m_A})^2 - c_B - \phi\tau_B$$

If the low type accepts an offer, it receives Vx. Therefore, it is willing to accept if:

[30] Thus, B's probability of victory is increasing in m_B, while A's probability of victory is decreasing.

$$Vx \geq (\sqrt{V} - \sqrt{m_A})^2 - c_B - \phi\tau_B$$
$$x \geq 1 - \frac{2\sqrt{m_A}}{\sqrt{V}} + \frac{m_A - c_B - \phi\tau_B}{V}$$

Analogously, the high type is willing to accept if:

$$x \geq 1 - \frac{2\sqrt{m_A}}{\sqrt{V'}} + \frac{m_A - c_B - \phi\tau_B}{V'}$$

Now consider A's offer. For the standard reasons, only two offers can be a part of an equilibrium: $1 - \frac{2\sqrt{m_A}}{\sqrt{V}} + \frac{m_A - c_B - \phi\tau_B}{V}$ (just enough for the low type to accept) and $x \geq 1 - \frac{2\sqrt{m_A}}{\sqrt{V'}} + \frac{m_A - c_B - \phi\tau_B}{V'}$ (just enough for the high type to accept, which is also sufficient for the low type to accept). Offering the smaller amount is preferable for A if:

$$\frac{2\sqrt{m_A}}{\sqrt{V'}} - \frac{m_A - c_B - \phi\tau_B}{V'} > q\left(\frac{2\sqrt{m_A}}{\sqrt{V}} - \frac{m_A - c_B - \phi\tau_B}{V}\right) + (1-q)\left(\sqrt{\frac{m_A}{V}} - c_A - \phi\tau_A\right)$$

$$q > \frac{\frac{2\sqrt{m_A}}{\sqrt{V'}} + \frac{c_B + \phi\tau_B - m_A}{V'} - \frac{\sqrt{m_A}}{\sqrt{V'}} + c_A + \phi\tau_A}{\frac{2\sqrt{m_A}}{\sqrt{V}} + \frac{c_B + \phi\tau_B - m_A}{V} - \frac{\sqrt{m_A}}{\sqrt{V'}} + c_A + \phi\tau_A}$$

The question is whether this value can be decreasing in ϕ; if it is, the range of parameter values for which war occurs with positive probability increase. Taking the first derivative and solving for τ_B yields:

$$\tau_B > \frac{\frac{\frac{2\sqrt{m_A}}{\sqrt{V'}} - \sqrt{\frac{m_A}{V'}} + c_A}{V} - \frac{\frac{2\sqrt{m_A}}{\sqrt{V}} - \sqrt{\frac{m_A}{V'}} + c_A}{V'}}{\frac{2\sqrt{m_A}}{\sqrt{V}} + \frac{c_B - m_A}{V} - \frac{2\sqrt{m_A}}{\sqrt{V'}} + \frac{c_B - m_A}{V'}}$$

This holds for sufficiently high τ_B. The critical difference between this and uncertainty over value without endogenous armaments is that the probability of victory depends on the specific value. The extra terms (involving p_B) that had previously canceled out do not do so here as a result, leading to the murkier cutpoint. Nevertheless, the intuition remains the same: if τ_B is sufficiently large, the difference between the potential offers grows, incentivizing state A to screen the types with the small offer.