

# Auctioning War

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## Abstract

Nearly all formal and quantitative analysis of war examines the interactions of *pairs* of states, thereby presuming two states' interactions are independent of what other states believe or do. Yet, we know many states face simultaneous security threats from multiple foreign challengers. We pose two questions in this paper. How do states address and manage multiple threats like these, and how can we model these multilateral interactions? We show that a large state can manage threats by publicly committing to a finite number of foreign wars, forcing would-be challengers to compete among themselves to be belligerent, but not to end up in one of those wars with the major power. We model this as an auction where the major power offers a certain number of wars and challengers "bid" on those wars in belligerence, hoping not to win the auction. The results imply the possibility of designing mechanisms to discourage war.

President Bush's "axis of evil" speech in January 2002 garnered plenty of attention for putting Iraq, Iran, and North Korea on notice that the US would "do what is necessary to ensure [American] security." Iraq, Iran, and North Korea "and their terrorist allies," he said, "constitute an axis of evil, arming to threaten the peace of the world. By seeking weapons of mass destruction, these regimes pose a grave and growing danger." Just over a year later, Mr. Bush made good on his promise to "do what is necessary" for American national security when he ordered the invasion of Iraq (Bush 2002).

What has gotten little comment is what three simultaneous threats of military action (on the heels of military action in Afghanistan three months earlier) and in light of a long-held two-war doctrine would goad those states to do, and how those threats would shape the strategic environment in which those states would make decisions. How would the leaderships of Iraq, Iran, and North Korea think about the American threats, whether the US would carry out military strikes, and whether the US was capable of fighting all three states? How would Iran's response influence the policies Iraq and North Korea pursued? If Iran were particularly belligerent, would that embolden the other two because US attention and resources would focus on Iran?

Let us frame this hypothetical a bit more specifically. The US has long advertised a specific military doctrine whereby its forces are prepared for a limited number of regional wars, two wars since the early 1990s. The leaders of the axis states can surely tell that if the US were to carry out its threat, only two states would undergo American attack (at least simultaneously). Since the US was, at the time of the State of the Union speech in 2002 where Mr. Bush laid down his warning, already at war in Afghanistan, the leaders of the axis countries could readily know they were really only at risk of war if they behaved more belligerently than the other two did; one war, three equally plausible targets. So as much as playing a strategic game with the United States over conformity to American will, international norms or terrorist desires, Iraq, Iran, and North Korea were also playing an

interesting strategic game among themselves, in many ways, competing to follow their own policy paths without becoming the recipient of America's second regional war.

Analytically speaking, existing models of conflict are not equipped to deal with this complex strategic environment, at least because most (if not all) bargaining models are pairwise, as are most (if not all) statistical models in the literature. Tractability is one major reason models are pairwise, but the limits of state power coupled with the multiplicity of opponents make it likely that large states will often face more opponents deserving of war than they can possibly commit to. The problem a large state faces then, is choosing which offender merits war, while the others do not. This is a problem the US has sought to solve during and since the Cold War by declaring publicly its capacity for a particular number of wars, and thereby generating a dilemma for its opponents. Its opponents now have a clear, credible statement of American military preparation and capacity, and within those confines must strive not to become an American target, competing against other US rivals to be belligerent, but not too belligerent compared to others. In this manner, the US or any major power, can effectively shift the strategic burden to its opponents and thereby try to induce "good" behavior and even, in the end, avoid war.

America's approach to the "axis of evil" and those countries' actions points to two important and related questions. First, how do interactions between two states influence how third parties then interact with either of those states? Our goal here is to examine how one state changes its behavior in reaction to bargaining between two other states. How do Iran and North Korea behave in light of US-Iraqi bargaining in the shadow of war? This question explicitly moves beyond the normal pairwise approach most models of conflict assume, and will require us to examine how larger sets of states interact strategically. Second, why would any state, a major power in particular, transparently commit to a particular military doctrine of a limited number of simultaneous wars as the US has since the onset of the Cold War? On its face, doing so seems to articulate the limits of American power in a way

disadvantageous to American efforts to influence its allies and enemies.

Our answer, in short, is that committing to a particular military doctrine and finite number of wars essentially allows the US to generate a strategic problem for its rivals. American rivals must assess each others' actions in order to determine which rivals are most likely to become US targets. Those rivals have the problem of determining how belligerently they can pursue their own interests while still avoiding war with the US. We approach these questions by framing the competition among a powerful state's rivals as an auction where the goods under auction are wars with the powerful state. All the bidders in the auction are states quarreling with the powerful state, and they would all prefer to pursue their own policy paths without fighting a war against the powerful state. The auction model allows us to examine how those rivals deal with the problem of avoiding war in a multilateral context.

Though the American anecdote motivates this general model, the problems the auction model addresses are themselves very general. For one thing, the pairwise nature of models of conflict requires the assumption that how two states interact is independent of those same states' contemporary interactions with other states; each bargaining game is independent of all other bargaining games. The structure of the auction model relaxes that restriction by capturing competition among would-be challengers. Additionally, all major powers, and in fact many regional powers will have multiple opponents posing threats to security at the same time, and they face the same problem the US does in our telling of the story. That problem is how to allocate finite military resources among those opponents in the most effective and efficient manner. Just as the US solves this problem through an explicit auction, so other states may solve it the same way, or through an auction structured differently, with perhaps more uncertainty regarding how many wars are available. Further, though the outcome of war with the great power is known in our model, uncertainty arises from two other sources; bidders do not know the great power's reservation price for war, nor do they know each others' bids. It is this uncertain environment that the major power can successfully use

its limited number of wars to deter more states than it could fight, and thereby to manage multiple opponents at the same time.

## Why Multiple Opponents?

The bulk of formal and quantitative work on international conflict examines, appropriately enough, the interactions of pairs of states. Quantitative work heavily emphasizes dyadic analysis, generally regressing some outcome the pair of states experiences (conflict onset, for instance) on variables measuring characteristics of the dyad (like relative capabilities), or on characteristics of the individual states in the dyad. Formal models of conflict most often represent bargaining between two states where war is the outside option.<sup>1</sup> The variations in bargaining models of war are significant, but a constant feature is a restriction that capabilities are absolute to the pair in the sense that each state can presumably focus all of its attention and resources to its single opponent in the game. What this excludes, fairly obviously, is the possibility (or likelihood) that states are playing multiple bargaining games at the same time. Considering fighting a war in one game must happen in light of the possibility of war in another, and therefore in light of the possibility of allocating capabilities to efforts against other opponents .

But shouldn't war-minded states account for the capabilities their opponents will be forced to reserve for other crises such as possible wars with other states? In this essay we take issue with the premise that dyadic conflicts can be modeled as a closed system. Instead, we suggest, that, for major and regional powers at least, bargaining over the division of some good, while war is the outside option, is an open process. This means that the key parameters of the model, including the belief probabilities and the cost of fighting, depend on bargaining games with other states in which either party might be simultaneously involved. Thus we

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<sup>1</sup>Representative bargaining models and arguments include Wittman (1979), Morrow (1991), Bueno de Mesquita & Lalman (1992), Fearon (1995), Powell (1999), Filson & Werner (2002), and Slantchev (2005).

take a step here to advance modeling distributive conflict leading to war as a game with multiple opponents. Our current tack brings us closer to incorporating such substantive matters into analysis as, for instance, whether or not one of the bargainers is engaged in another war, committed to a major deterrence effort, involved in alliances, or generally committed to multiple, diverse foreign policy interests. While many questions have been successfully answered while abstracting away from these complexities, others remain that require having those considerations included in the picture.

Moving beyond the assumption of bilateral bargaining matters a great deal if we believe that states evaluate their opponents in light of the military commitments those opponents have made, including both ongoing military deployments and peacetime commitments they that would be hard to retract. In either case, a potential challenger's assessment of what demand it should or should not make (or to what demand it should yield) is partially a function of what it knows about its target's military commitments. American commitment to war in Afghanistan in October 2001 should have influenced beliefs about credibility of the war threat to each remaining individual belligerent. Israeli actions against Hamas in late 2008 represented a military commitment in Gaza and a potential vulnerability elsewhere.

States make these sorts of commitments in peacetime as well, potentially signalling both resolve and vulnerability. For instance, it became practice during the Cold War for American defense planners to prepare for specific numbers and types of wars, and to predicate on that strategic number of wars force structure, weapons development and purchases, and requirements for military capabilities. In the early 1960s, the American two war doctrine provided for one major war, possibly involving nuclear weapons, and a simultaneous minor war or intervention aimed at blocking Soviet expansion. That strategic doctrine evolved over time depending on the conditions of the Cold War (among other things) to deemphasize nuclear weapons, to allow for multiple regional engagements, and to rely on different sorts of deployment (i.e. quick reaction forces, forward deployment and basing, etc.). Nixon's first

administration undertook a major review of the two war position, and seriously considered three alternatives. The first allowed for a conventional war in Europe against a Soviet invasion, simultaneous with a major assistance effort to Asian allies against Chinese threats. The second, which Nixon's national security advisor Henry Kissinger endorsed and which Nixon accepted, called essentially for one major war, but for it either to be in Europe or in Asia, but not both. The third option essentially reverted to American pre-Vietnam strategy of two major simultaneous wars, one in Europe, the other in Asia (Kissinger 1979, 220-221). Shortly after the end of the Cold War, the Pentagon undertook a major review (the 1993 "Bottom-up review") which resulted in a doctrine aimed at fighting two simultaneous regional wars, a doctrine the US has largely held to since, though sometimes the doctrine has allowed for one and a half wars, sometimes two. The key is that American doctrine explicitly allows for multiple, simultaneous wars, so the allocation of capabilities is a major strategic consideration. Any foreign challenge, therefore, is not against the entirety of US capabilities but against some portion thereof. Still, as the number of available wars is limited, bargaining with the US in the shadow of war is not independent of other crisis bargaining games the US is engaged in with other states. This is how the auction model here contributes to the understanding of these processes: it examines the interactions between states as they are contingent on other considerations in foreign affairs, especially on the incentives the large state has not to allocate all its capabilities to a single crisis.

The curious thing about American doctrine is that the US has customarily advertised its existence and details very publicly, despite the intuition that countries have little incentive to reveal their war plans or war-fighting strategies, because doing so would compromise the strategic advantage they might gain from surprise, and from their capacity to misrepresent how they might allocate capabilities in war. The ability to misrepresent and the incentive to do so is the foundation of many bargaining model claims regarding why states fight each other, even when the costs of conflict make doing so undesirable. So why on earth does

the US advertise its plans? On one hand, one might suppose this permits US adversaries an opportunity to anticipate and counter American strategies. On the other hand, the particular war strategy the US reveals probably generates a number of different (and perhaps contrary) incentives for its adversaries. US doctrine and its publicity imply a commitment to prepare for war, perhaps suggesting a willingness to commit to war should US interests demand it, and a commitment to reserve resources sufficient to fight an additional war. One possible result may be to deter would-be challengers from testing American resolve to fight, because the first war is (relatively) easy to commit to due to the presence of additional capability sufficient for a second military endeavor. This is, in many ways, a commitment strategy that reveals both resolve and capabilities. Rational challengers may therefore operate under less uncertainty due to American strategy, and the result in general might be less predatory behavior by challengers.

At the same time, the selection of the doctrine is puzzling. Does not such a public strategy reveal the limits of American capability by quantifying it as a number of conflicts of particular size? Once the first such conflict is undertaken, potential adversaries could reasonably think that committing to the second (and final) available conflict is risky for the US because to do so would fully allocate US capabilities, leaving other American interests vulnerable. From a strategic point of view, this sort of public commitment seems at cross-purposes. On the one hand, commitment like this should deter aggression and lead states to recognize US military resolve. Such states should tend not to make demands of the US, and to give in to demands the US makes. On the other hand, the very act of commitment that signals American resolve also credibly communicates the limits of US power, and thereby defines the point at which the US has fully committed to military crises abroad, has little in reserve, and is therefore vulnerable to foreign aggression against it or its interests. So it seems at first glance that a commitment strategy aimed in part at bargaining leverage also communicates vulnerability. The model we detail below deals with this paradox directly by positing that

open commitment to a multi-war doctrine can be viewed as a mechanism by which the US sets incentives for its adversaries to behave within acceptable limits. Committing publicly to a particular number of wars simultaneously advertises the limits of American power and American preparation for conflict, leaving its potential opponents to avoid becoming American targets. For the US, the result should be a reduction in the number of actual wars that need to be fought in order to achieve an equal level of policy concessions. Or, to formulate the same proposition in a different way, an increase in policy gains for the same number of wars fought. For potential opponents, the result is that they must anticipate each other's actions toward the US in order to appropriately estimate the level of belligerence which would trigger war. Why foreign states have to behave this way in light of American strategic doctrine is the subject of the model below.

This paper takes the multiple wars that a major power like the US can simultaneously fight as goods under auction. The major power puts them on the block, and its adversaries "bid" on those goods by committing transgressions in their foreign policy. The major power designs its preferred auction by declaring and committing publicly to a particular  $j$ -war strategy, so adversaries know they are jointly "bidding" on  $j$  goods. The currency of bidding is "bad behavior," a sufficient amount of which will win the high bidder a war with the major power. The group of states that are its adversaries have a preference to maximize their bids without "winning" the auction. Thus bidders will try to bid as high as possible without receiving one of the "available" wars. The pairwise focus of existing models violates the budget constraint of the major power by assuming that the wars it fights are independent. In the context of multiple adversaries (and multiple bargaining games), the major power's capabilities could be completely allocated to each and every crisis. Put differently, pairwise analysis suggests that bargaining games in which defender engages with various challengers are independent from each other, with a logical implication that the major power is able to offer a number of wars that equals or exceeds the number of adversaries. By conceiving

of crisis bargaining in an auction context, we account for the limit on the number of wars a state could conceivably fight, and by doing so, introduce the possibility that states can challenge a major power and not face war either because wars are scarce and the major power has incentives to reserve capabilities, or because it has allocated all its wars and therefore capabilities, so no more are possible. In this manner, allocation of capabilities is an essential and publicly known part of the model, and explicitly allows crises to be interrelated and nonindependent. In the remainder of the paper, we discuss the findings on war, and particularly on information problems in war, and we lay out the auction of war.

## **Information Problems in War: The Limits of Bargaining**

Bargaining models of war have produced a number of insights regarding interstate crisis behavior and conflict. Most specifically, they have established the centrality of information revelation in interstate bargaining. Fearon's (1995) argument enumerates three basic causes of war in a rationalist framework. First, states have incentives to misrepresent private information, particularly regarding capabilities and resolve. Second, some of the issues over which states disagree are not divisible, thwarting efforts at peaceful settlement. Third, states find it difficult to commit credibly to settlement, thereby making such settlements difficult to achieve. The incentive to misrepresent, however, is the principle obstacle to finding bargains the parties can agree to without resorting to war. The significant attention the literature pays to asymmetric information speaks to how central incentives to misrepresent are to bargaining.

Lack of information about capabilities is compounded by the lack of information about the willingness of the opponent to allocate those capabilities toward the outside option of war, and in the multi-state model in particular – to the option of waging a war against any given

adversary. Allocation of capabilities is itself a topic largely absent in the literature on war.<sup>2</sup> Allocation decisions are, like many things in foreign policy decision making, likely driven by a combination of external interests and threats, and domestic political constraints and demands. What matters most for our purposes is that states simply do not have an option to allocate their full capabilities to every militarized crisis where war is an option. That is not to say states cannot end up expending close to everything in war, but they can neither practically nor credibly commit to deploy every military resource against a given adversary prior to the war onset. To do so would not be credible because it would leave the state vulnerable to other opponents which could predatorily challenge the state knowing it would face little or no resistance. Survival oriented leaders could not make such commitments, at least not believably so. What leaders can do is promise or threaten to allocate enough, or even more than enough, to ensure a substantially weaker opponent will lose in a military contest. Doing so permits a leader to make a believable threat about the quantity of force, specifically about the allocation of capabilities to war. Part of what makes such a claim believable is that he is able to conserve some observable quantity of the state's capability for other potential crises.

Leaders concerned with the possibility of multiple crises have little choice but to conserve some portion of capabilities for the eventuality that they face multiple opponents at the same time. Allocating in this manner, and doing so publicly has the advantages of making the first threatened allocation believable, and signaling to other states that it has capabilities in reserve for allocation to secondary (or tertiary) challengers, thereby discouraging predatory or opportunistic challenges. What these incentives mean from an analytic standpoint is that allocation decisions are interdependent, and so too must be crisis bargaining games: adversaries' beliefs about the likelihood of war must derive at least partially from their

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<sup>2</sup>Exceptions lie largely in research on the phenomenon that democracies tend to win the wars they fight. Among explanations for this are claims that democracies either allocate more effectively to war efforts than do authoritarian states, or that democracies allocate more of their total resources than autocrats do. Neither explanation finds terribly strong empirical support (e.g. Reiter & Stam 2002).

beliefs about allocation.

This is why the American war doctrine coupled with the practice of making the doctrine quite public are interesting; they explicitly structure potential adversaries' beliefs about American military allocations to war and thereby inform challengers precisely regarding how crises are interdependent. Furthermore, the domestic audience serves as a guarantor of the government sticking with the strategy, thus by virtue of being made public, the doctrine is made credible. When American doctrine calls for two major, regional wars as it has mostly since the end of the first Gulf War, challengers know American allocations and what types of military campaigns the US military anticipates. Stylizing those two wars a bit, a challenger might reasonably intuit US allocation to each war is about fifty percent of American capabilities. Further, once the first of those two possible wars is underway, a potential challenger might intuit commitment to the second war will decline the longer the first war goes on. Such a challenger may find comfort in that belief and adjust his estimate of likelihood of a war accordingly. Supposing two simultaneous wars, another reasonable potential challenger might suppose American forces are wholly committed with insufficient reserve for a third military action, and that a third challenge might essentially go without significant response. Put differently, a third challenger would also adjust her estimate of the likelihood of a war and find it very much in her favor. Estimating one's chances of being attacked by a major power in response to transgressions is not so much a function of intelligence about the opponent's military hardware and personnel, or about what some scholars have called "unobserved" capabilities like morale and resolve (e.g. Morrow 1989, Bueno de Mesquita, Morrow & Zorick 1997), but about its observable actual and potential military commitments and thus the expected decline in remaining military capability.

The challenge here is to incorporate how a public war doctrine structures beliefs and expectations about relevant capabilities when foreign states consider military challenges and induces behavior which, in turn, falls according to the expectations of the authors of doctrine

(at least presumably). Rather than conceiving of this in a bargaining framework, we focus on the strategic problem potential challengers have to solve in the face of a public war doctrine. To do so, we think of the public war doctrine as an auction offering a known number of goods to a field of bidders. The goods, as it were, are wars called for in the doctrine. The bidders are potential challenger states interested in some change in the status quo, and the currency in which they bid is in hostile behavior aimed at challenging that status quo. Two important dynamics are worth highlighting before we proceed to the model. First, how challengers bid depends on the committed allocation of capabilities to wars, and so estimates of the optimal demand in one crisis depend critically on allocations to other potential crises. Second, the auction is not pairwise. Multiple bidders (rouge states) simultaneously consider challenges, and must be strategically concerned with the bids or challenges other states are considering at the same time. This is a significant departure from the bargaining framework because it incorporates challengers' beliefs about other potential challengers' likely actions given the major power's public allocation of capabilities.

## Multilateral World sans the Doctrine

Having convinced the reader that it is worth the while to enquire into the dynamics of multilateral conflict engagement, we put forth here a brief illustration of what a counterfactual strategic environment to an auction-generating military doctrine would be. Consider, as in the above, a major power (the US or a regional power) which is confronted with three potential belligerents. Each belligerent state,  $i = 1, 2, 3$ , derives utility  $u_i(x_s)$  from acting in defiance of the major power's policy preference and implementing instead its ideal point, and utility  $u_i(x_s) < u_i(x_i)$  from conforming to that policy preference. Suppose also that, without loss of generality, the ideal points of challenger states are removed from the major power's requested policy, with the distance that declines in  $i$ , so that  $|x_s, x_1| > |x_s, x_2| > |x_s, x_3|$ . Setting

$u_i(x_i) = 0$  for all  $i$ , and normalizing over the feasible set of outcomes, we will thus have  $u_i(x_s) < 0$  for all challengers and increasing in  $i$ . Assume also that to issue a challenge and receive the war yields  $u_i(x_w) < u_i(x_s)$  for all  $i$ . The major power,  $s$ , prefers to fight the challenger which takes a stand, i.e., adopts policy  $x_i$ . If many such are in evidence, then the greatest policy gain to  $s$  accrues from fighting the country with the most distant  $x_i$ . The final consideration is that the three challengers and the major power that presents them with a war are fully informed about each other's policy ideals and utilities. Challengers move simultaneously, and then  $s$  decides on the war. By backwards induction,  $s$ 's move can be reduced. Then the interaction among the challengers is schematically captured in Figure 1.

		$x_i$	$x_s$	$3$			$x_s$
		$2$					$2$
		$x_i$	$x_s$			$x_i$	$x_s$
$1$	$x_i$	$W_1,$	$W_1,$	$1$	$x_i$	$W_1,$	$W_1,$
		$u_2(x_2),$	$u_2(x_s),$			$u_2(x_2),$	$u_2(x_s),$
		$u_3(x_3)$	$u_3(x_3)$			$u_3(x_s)$	$u_3(x_s)$
	$x_s$	$u_1(x_s),$	$u_1(x_s),$		$x_s$	$u_1(x_s),$	$u_1(x_s),$
		$W_2,$	$u_2(x_s),$			$W_2,$	$u_2(x_s),$
		$u_3(x_3)$	$W_3$			$u_3(x_s)$	$u_3(x_s)$

**Figure 1:** Threat of war with three challengers under complete information

Notice, that as presented, the game has a unique Nash equilibrium with all three challengers conforming to the demands of  $s$ , and no war. It is equally easy to verify, that the policy strategies of challengers remain the same in equilibrium with continuous strategy spaces (all converge to  $x_s$ ), as well as if challengers move sequentially (regardless of the order of moves).

However, in a world where information has value but comes at a cost, assuming complete information and devising a doctrine based on this assumption is unreasonable. This reality, information incompleteness, is of course not captured in this simple illustration, nor, is it consistent with the never-war unique equilibrium. In a bayesian game with private information, players' strategies signal their types. If a major power wishes to receive a signal of a particular sort, it needs in turn to commit itself to such a strategy or mechanism that would be most likely to elicit a desired response. In other words, it needs a doctrine; the doctrine that it chooses will shape the strategic environment for the potential belligerents before those even issued a challenge. Such an approach can be thought of as a sort of mechanism design, one we characterize as an auction.

## **An Auction Model of War**

An auction by definition is a distributive mechanism to multiple players under incomplete information (e.g. Menezes & Monteiro 2005, 5). We model a major power's decision to go to war with a rogue state as a sealed bid auction with non-returnable bids. The good being auctioned off is the war; the bidders in the game try not to buy it. In addition to offering the auction model as a new way to look at wars, this paper is comparing the return for the seller (e.g., the US) from committing to auctioning one such good versus auctioning two of them. In the first case, we consider a strategic doctrine where a major power prepares for one war (and therefore in the model, offers one war for auction). In some ways, this model is parallel to most bargaining models insofar as the players are making strategic decisions in the shadow of war. Where this departs from the bargaining structure is in the possibility that other challengers will enter the auction and make high bids for war. So, in bargaining terms, a challenger,  $i$ , makes a demand that, all things equal, should produce war ( $x > x^*$ ), but the game does not devolve to war because another challenger,  $j$  makes a bid where

$x_j > x_i > x^*$ , and the defender goes to war with the second challenger,  $j$ . Bargaining models do not address this possibility, nor do they address what happens in light of the initial challenger's demand. The first auction below conceives of these multiple challengers competing to maximize their bids yet avoiding war, and doing so without knowing what the bids of the other challengers are.

The second case we examine is more reflective of American doctrine (and of circumstances in many states that prepare for simultaneous military engagements). In this case, we model an auction of two wars in order to examine how states will bid where they know two wars are under auction, where they seek to maximize their bids without being awarded a war, and where they do not know the bids of the other challengers. In the bargaining context, if two challengers,  $i$  and  $j$  make demands such that  $(x_j, x_i) > x^*$ , both  $i$  and  $j$  are awarded wars with the major power defender.

## One-war Auction

Suppose there are 3 countries,  $i=1, 2, 3$ , with ideal points  $x_i$ , i.i.d.,  $x_i \sim f(x)$ . There is exactly one war being sold ( $q = 1$ ), with a reservation price  $\hat{x}$ , so that bids  $\mu_i \leq \hat{x}$  do not buy the war, while placing any bid  $\mu_i > (1 - p)^2$  makes player  $i$  eligible to purchase a war. If multiple bidders bid above the reservation price, the war is allocated to one of them at random, regardless of the values of their bids. This is similar to allowing the seller to observe only the type of a bid – high or low; above or below the reservation price. There are, then, two types of bidders, determined by Nature either to be the low type, i.e.,  $x_i \leq \hat{x}$ , or the high type,  $x_i > \hat{x}$ .

Assume for now that if country  $i$  successfully purchases the war under auction, it will lose that war with probability 1, with a consequence that the policy reverts to the winner's (the major power's) ideal point,  $x_o < \hat{x}$ , and country  $i$  also bears additional cost of war,  $c$ . Low type bidders' best response is to submit a bid at their ideal points, which by definition

fall below the reservation level, and they receive no war. High type bidders, with their ideal points to the right of the reservation price, have a choice between the highest value of the low type bid,  $\mu^L = \hat{x}$ , and bidding at their ideal points, thus incurring war with a positive probability.

**Proposition 1** (*existence 1*). *Denote the probability  $x_i \in T$ ,  $T$  a proper subset of  $[\hat{x}, 1]$ , i.e., country  $i$  is a (selectively) high type, as  $p$ . Under generic conditions, when  $1 - p + \frac{1}{3}p^2 \leq b$ , where  $\frac{u_i(\hat{x})}{u_i(x_o) - c} = b \in [0, 1]$ , there can exist a symmetric Bayesian equilibrium where, for some  $T$ , all countries with  $x_i \in T$  bid for war.*

Proof of Proposition 1 is in the Appendix. Here we indicate the basic intuition behind it.

For example, for  $p = .3$ , equation Proposition 1 holds for  $b \geq .73$ . Generally, higher probability of a high type, more restrictive reservation value, and lower the cost of war are conducive to everyone of high type issuing the challenge to the major power. States that believe other potential challengers will be belligerent toward the major power will be emboldened to make challenges themselves, provided they are high types. It is not simply that the number of potential challengers exceeds the number of wars under auction that emboldens  $i$ , but that state  $i$  believes at least one other state is a high type and will make a high bid, reducing the chances  $i$  is awarded war with the major power. What this implies is that, even when state  $i$  and the major power are completely informed about each other (and therefore should avoid war in the bargaining model), war is possible because of the interdependence of potential challengers' beliefs and their bids. One way to frame this finding is that it constitutes an additional rationalist explanation for war (Fearon 1995), one that obtains even under complete information in the traditional pairwise sense. Further, it illustrates how the ratio of possible wars to possible opponents is merely an instrument by which the major power offering the wars induces bidding states to compete against each

other.

Second, Proposition 1 implies that if state  $i$  believes  $\sigma_{-i} = 0$  (so other bidders are not making high bids regardless of type), then  $i$  should place a low bid conditional on its being a high type, because doing otherwise guarantees it a war and thus utility below  $u_i(\hat{x})$ . In this equilibrium, a low type state bids at its ideal point, while high type states bid at the reservation price, and this (pooling) equilibrium always exists. In this case, because  $i$  believes other states are not likely to bid above the major power's reservation price, placing a high bid itself will result in war which it will lose. (Varying the probability of losing to major power from 1 will result in this equilibrium to exist conditionally on probability of winning.) The result is that, under these beliefs and regardless of whether  $i$  is a high or low type, it chooses to bid low in order to avert war. Interestingly, it bids low to avoid war because of its beliefs about other possible challengers, not because of its beliefs about the major power, nor explicitly because of the ratio of wars to possible challengers. Significantly, this finding results from our departure from pairwise bargaining models where other states' challenges are assumed away.

Finally, if state  $i$  believes that  $\sigma_{-i} \in (0, 1)$ , its beliefs would be consistent iff:

$$\sigma p(1 - p') + \frac{2}{3}\sigma^2 p'^2 = 1 - b \quad (1)$$

where  $p'$  is the probability that country  $i$  is of the type that will play a mixed strategy.

## Two-war Auction

Now, suppose the major power offers two wars for auction. This is more reflective of the American doctrine of preparing for multiple wars. With two of the high bidders now being issued a war, we observe more restricted interval for the existence of a separating equilibrium where the major power is being challenged.

**Proposition 2** (*existence 2*). Denote the probability  $x_i \in T$ ,  $T$  a proper subset of  $[\hat{x}, 1]$ , i.e., country  $i$  is a (selectively) high type, as  $p$ . Under generic conditions, when  $1 - \frac{1}{3}p^2 \leq b$ , where  $\frac{u_i(\hat{x})}{u_i(x_o)-c} = b \in [0, 1]$ , there can exist a symmetric Bayesian equilibrium where, for some  $T$ , all countries with  $x_i \in T$  bid for war.

Proof of Proposition 2 is in the Appendix. Notice, that  $1 - \frac{1}{3}p^2 \geq 1 - p + \frac{1}{3}p^2$ . Thus the separating equilibrium in Proposition 2 will exist under higher  $b$  than it did under the conditions of Proposition 1.

The second equilibrium is when a low type state bids at its ideal point, and a high type state bids at the reservation price, i.e., all countries bid  $\mu_i^L$ , and this (pooling) equilibrium always exists. In this equilibrium, low and high types are indistinguishable to the major power because they both bid low in terms of hostility or provocation of the major power, and no war is awarded from the auction. Thus if state  $i$  believes that  $\sigma_{-i} = 0$ , then it would place a low bid conditional on its being a high type, so the beliefs are consistent iff:

$$b \leq 1, \tag{2}$$

Note the generality of this equilibrium. When state  $i$  believes other challengers will not make high bids, it cannot bid high without facing war. Under this condition, the number of wars will equal or exceed the number of high bidders, so war is a certainty for any high bidders. If bidding high means certain war, and if states prefer to avoid wars (which they lose by assumption in our model), then the war doctrine has a significant deterrent value. Most importantly, though, the deterrent value does not arise either from threats or actions by the major power, but from the jockeying among would-be challengers to avoid war. Their beliefs about each other, rather than their beliefs about the major power, are key to the absence of war in this equilibrium. This provides a stark illustration of the value of modeling how challengers consider making demands conditioned by their beliefs about other challengers.

The characteristic pairwise model neglects those beliefs, essentially modeling the case where the number of wars available is equal to the number of potential challengers, regardless of their bids. So there is always some non-zero probability of war in pairwise bargaining models.

Finally, in the third equilibrium condition, state  $i$  believes that  $\sigma_{-i} \in (0, 1)$ , and these beliefs would be consistent iff:

$$\frac{1}{3}\sigma^2 p^2 = 1 - b \quad (3)$$

In this case, the equilibrium probability of a high type bidding at its ideal point is  $\sigma = 3\frac{\sqrt{1-b}}{p}$ .

## Discussion

American foreign policy since at least 1945 has consistently suffered the complexity of facing multiple foreign enemies at the same time, an affliction of all great powers, perhaps of most states. Deterrence was not the only objective, as American foreign policy was increasingly aimed at achieving acceptable behavior of as many potential adversaries as possible. While the Cold War experience was dominated by US-Soviet hostility, US foreign relations since have been even more complicated by an array of regional challenges to varied American interests. Simultaneous US wars in Afghanistan and Iraq illustrate this as does President Bush's "axis of evil" declaration designating three simultaneous and immediate primary threats to US national security. The danger of the "axis" states lay in their pursuit of weapons of mass destruction, principally nuclear weapons. In light of threats like these, the US (and other states) has little choice but to prepare for multiple, simultaneous interstate crises. And that preparation is public and well-documented, and it means no one of these threats will face the entirety of American power. This is not to say the forces an American president can level against any one of these threats is not daunting; it is in fact devastating. But the US prepares for two wars, not three, and these states have had to continually judge both American intentions and resolve, and how assertive their "axis of evil" counterparts

are prepared to be at any given point in time. The first of these factors, American intention and resolve, is the subject of bargaining models, and is understood well in that context. The latter of these, how belligerent or forceful *other* states are liable to be toward the US at any moment, does not enter the bargaining model. The war auction incorporates this dimension of interstate interactions and suggests its importance to understanding why states go to war, as well as how a major power can design the rules to improve behavior of many adversaries and not actually have to engage in war at full capacity.

Auctioning war requires bidder-states to assess each other because they are competing with each other to bid high enough to satisfy whatever national needs they might have, but to do so only where there are other states making similarly high bids, thereby reducing the chances of winning the auction and facing war. The model illustrates two stark cases; where states believe other bidders will make high bids, and where states believe they will not. When multiple challenger states will make high bids, the risk associated with bidding high is diminished because of the nature of the auction; the good under auction, war, is scarce. There are more bidders than goods under auction. When challenger states will make low bids, the danger of bidding high escalates because a single high bid is very likely to win the auction and result in war. If states are unsure about the types of bids their fellow-challengers will make, uncertainty induces over and under-bidding. Over-bidding produces an unintended war; under-bidding leaves an opportunity to bid high on the table. And this source of uncertainty, which lies entirely outside the bargaining framework, is a condition under which rational states can go to war despite the widely accepted ex post inefficiency of war. This new rationalist explanation for war points to the consequence of the pairwise restriction inherent to bargaining models. It also points to a potentially important assumption in empirical models examining dyadic behavior, namely that dyadic interactions are independent of one another. It is a tractability assumption to be sure, but the auction model suggests it is a consequential one as well.

There are a number of complications and improvements we might make in thinking about auctioning war. At a conceptual level, attaching the auction to American doctrine is appealing because it is so well known, and so unambiguous. But the portability of the concept is significant as well. Many, if not most, states have to deal with multiple enemies, and must divide their capabilities. Holding the strategic interplay of beliefs among potential challengers constant as pairwise models must do sets this aside and treats simultaneous crises, or potential crises, as independent, though they matter a great deal to each other. Importantly, even crises that do not occur are important here, not for an obscure counterfactual, but because the fact that they *could* occur can materially shape the strategic calculus other states undertake. Because the counterfactual is immediate and real, it must influence how states consider their foreign policy challenges. In a lot of ways, this is not a shocking insight, because it is the foundation of arguments about collective action; one actor either free-rides or does not depending on his beliefs about other actors' likely behaviors. But in the case of auctioning war, the question is less benign both from the standpoint of the exploitive substance of the opportunistic challenges multiple bidders might afford, and from the formal standpoint of setting aside an important interdependency in an environment that is so interactive.

The auction presented here assumes complete information, and part of that assumption is founded on the clear statement and cost sinking of strategic doctrine aimed toward fighting a certain type and number of wars. The US has, for reasons well beyond the scope of this paper, chosen such a path, but most states, even major powers, have not. So what happens if the number of wars under auction is not known, or is only known to be greater than, say, one?

Falling back on the auction literature, consider the fact that auctions, as mechanisms, are specifically designed to reveal private information about the bidders' types. The modification here is that the seller does not insist on selling all wars, as long as the critical thresholds

are not overstepped. And so our framework allows for pooling behavior, while auction mechanisms are generally constructed to preclude that possibility.

The use of auctions and, more generally, of mechanism design to model war onset and war prevention means that we are applying the principal-agent framework. While we are certainly not the first to contemplate international conflict behavior of multiple states through the lens of the principal-agent approach, we do introduce an innovation here. Our principal seeks to obtain acceptable behavior the rogue states that are, in essence, its agents. In line with the notion of war as an instrument, the threat of multiple wars is a better, more effective instrument for controlling agents' behavior than a threat of a single war is. Notice, that attainment of policy goals occurs for the most part prior to the war and without it. The multi-war doctrine thus is an instrument of policy in its own right; it is an instrument that reduces the actual use of war.

In such a case, not only the superpower such as the US, but regional major powers as well might find commitment to a fixed number of wars benefiting their geopolitical causes. Indeed, Russia has recently proclaimed its own official two-war doctrine, though still vaguely defined insofar as the resource planning for multiple wars is concerned. Lacking democratic credentials, Russia is consequently lacking the credibility of its commitment that derives from the domestic audience acting as an enforcer. This may in part explain why the Russian military establishment felt it necessary to resort to a demonstrative engagement with Georgia in August 2008. A brief and successful campaign was evidently not a huge drain on the Russian capabilities, suggesting that the doctrine might be credible simply because, in terms of capabilities, it was affordable. Whether Russia can conduct effective auctions of war in the future remains to be seen

One final question that will bear examination in the future is what happens when auctioning war fails from the principle-agent standpoint. Since the spring of 2003, the US has been engaged in two regional wars, ostensibly committed to its doctrinal limit. What incen-

tives to rogue states have once all the goods under auction are sold, and more importantly, how do their interactions and beliefs about one another matter to their actions toward the major power?

## Appendix

Proof of Proposition 1: Denote the conditional probability of a country  $i$ , if it observes  $x_i \in T$ ,  $T$  a proper subset of  $[\hat{x}, 1]$ , issuing the high bid,  $\mu_i^H > \hat{x}$ , as  $\sigma_i \in [0, 1]$ . Notice, that, since the utility maximization problem of all bidders is identically specified, we will be looking for symmetric equilibria of this bidding game. Conditional upon discovering oneself to be a high type, country  $i$ 's best response is to issue a high bid iff:

$$(u_i(x_o) - c) \Pr(war_i) + u_i(x_i)(1 - \Pr(war_i)) \geq u_i(\hat{x}) \quad (4)$$

Or, considering that  $u_i(x_i)$  is a global maximum of  $i$ 's utility, and setting it at zero, equation (4) can be rewritten as

$$(u_i(x_o) - c) \Pr(war_i) \geq u_i(\hat{x}) \quad (5)$$

The conditional probability of being issued a war upon placing a high bid,  $\Pr(war_i)$ , depends on the number of other high bidders, which is in turn a function of the probability of others being high types ( $x_j \in T$ ), and of the conditional probability of a high type placing a high bid,  $\sigma$ . Specifically,

$$\Pr(war_i) = (1 - p)^2 + \frac{1}{2}\sigma 2p(1 - p) + \frac{1}{3}\sigma^2 p^2$$

Dividing both sides of equation (5) by  $u_i(x_o) - c < 0$ , we obtain:

$$(1-p)^2 + \frac{1}{2}\sigma^2 2p(1-p) + \frac{1}{3}\sigma^2 p^2 \leq \frac{u_i(\hat{x})}{u_i(x_o) - c}$$

Denoting  $\frac{u_i(\hat{x})}{u_i(x_o) - c} = b \in [0, 1]$ , we have

$$(1-p)^2 + \frac{1}{2}\sigma^2 2p(1-p) + \frac{1}{3}\sigma^2 p^2 \leq b \quad (6)$$

Thus, if country  $i$  believes that  $\sigma_{-i} = 1$  (so other bidders, if high types, will make high bids), then it too should place a high bid if  $x_i \in T$ ; should bid  $\hat{x}$  if  $x_i \in T$ ; and should bid  $x_i$  if  $x_i < \hat{x}$ . and the beliefs are consistent iff:

$$1 - p + \frac{1}{3}p^2 \leq b \quad (6')$$

To show existence, we need to make assumptions about the functional form of  $u_i(x)$ .

First observe, that  $\Pr(\text{war}_i | \sigma_i = 1) = 1 - (F(t^*) - F(t_*)) + \frac{1}{3}(F(t^*) - F(t_*))^2 = \gamma(t_*, t^*) > 0$ ,  $\gamma(t_*, t^*) < 1$ .

For linear utilities, uniform  $F(x)$ , expression 3' can now be rewritten as

$$1 - (t^* - t_*) + \frac{1}{3}(t^* - t_*)^2 \leq \frac{t - \hat{x}}{t - (x_o - c)}.$$

For the l.h.s. of this expression is always less than 1, while the r.h.s. is strictly increasing in  $t$ . Thus the expression can hold for the given values  $\hat{x}, x_o, c$ . In this case, for instance, setting  $\hat{x} = .2, x_o = .1, c = .1$ , and remembering that  $t > \hat{x}$ , we will observe the existence of the separating equilibrium as in Proposition 1 at  $x_i \in [.425, 1]$ .

Proof of Proposition 2: Once again, a necessary and sufficient condition for placing  $\mu_i^H > \hat{x}$  is that

$$(u_i(x_o) - c) \Pr(\text{war}_i) \geq u_i(\hat{x}). \quad (7)$$

The conditional probability of being issued a war upon placing a high bid,  $\Pr(\text{war}_i)$ ,

again, depends on the number of other high bidders, but now all three must be high types *and* must place high bids for there to be a chance of avoiding war. Thus,

$$\Pr(\text{war}_i) = 1 - \Pr(\neg \text{war}_i) = 1 - \frac{1}{3}\sigma^2 p^2$$

Dividing both sides of (7) by  $u_i(x_o) - c < 0$ , we obtain

$$1 - \frac{1}{3}\sigma^2 p^2 \leq \frac{u_i(\hat{x})}{u_i(x_o) - c}$$

And, denoting  $\frac{u_i(\hat{x})}{u_i(x_o) - c} = b \in [0, 1]$ , we have

$$1 - \frac{1}{3}\sigma^2 p^2 \leq b \tag{8}$$

If state  $i$  believes that  $\sigma_{-i} = 1$ , if  $x_i \in T$ ; should bid  $\hat{x}$  if  $x_{i-} \in T$ ; and should bid  $x_i$  if  $x_i < \hat{x}$ . and the beliefs are consistent iff: thus, the beliefs are consistent iff:

$$1 - \frac{1}{3}p^2 \leq b \tag{8'}$$

Now observe, that  $\Pr(\text{war}_i | \sigma_i = 1) = 1 - \frac{1}{3}(F(t^*) - F(t_*))^2 = \gamma(t_*, t^*) > 0$ ,  $\gamma(t_*, t^*) < 1$ .

For the same case of linear utilities, uniform  $F(x)$ , expression 8' can now be rewritten as

$$1 - \frac{1}{3}(t^* - t_*)^2 \leq \frac{(t - \hat{x})}{t - (x_o - c)}.$$

Again, the l.h.s. of this expression is always less than 1, while the r.h.s. is strictly increasing in  $t$ . Thus the expression can hold for the given values  $\hat{x}, x_o, c$ . Using the same values as in proof of Proposition 1,  $\hat{x} = .2, x_o = .1, c = .1$ , and remembering that  $t > \hat{x}$ , the separating equilibrium will not exist. It will reappear at lower values of parameters, i.e., under  $\hat{x} = .2, x_o = .175, c = .0$ , we will observe the existence of the separating equilibrium in a two-war auction when  $x_i \in [.5, 1]$ . Thus, with much less punishment threatened by a major power, fewer types of  $i$  will bid on wars.

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