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Erwin Amann and Nadine Leonhardt[1]

Commitment Problems and War in International Bargaining

Abstract

In the context of international bargaining, standard models predict that a shift in military power can cause preventive war because it changes the relative bargaining position between states. We find that shifts in military power are not the only cause of war under commitment problems and that commitment problems per se are not necessarily a cause of war even if the relative bargaining position changes substantially.

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1 Introduction

Commitment problems arise if the relative bargaining position between states changes and an increasingly powerful state is unable to credibly commit to a current settlement because it can demand revisions later in time. Anticipating this, a declining state may have reason to fight now in order to still guarantee itself a minimum of the stakes.

Fearon (1995) and Powell (2006) formalize this argument in a bargaining model in which war constitutes the parties' outside option. This war payoff coincides with a costly lottery that is determined by a party's military power and her costs of fighting. In the literature, so far, only shifts in military power have been analyzed and associated with commitment problems and the risk of war. The implications of changes in the parties' respective costs of war have not been studied yet. Also, previous works have not explicitely modeled bargaining power so that the effects of changes in bargaining power are still unclear.[1]

The present paper introduces variable proposal power which facilitates the analysis of situations in which both parties have some bargaining power. We show that a shift in bargaining power affects the distribution of the bargaining surplus, but does not lead to war. Also, an isolated *decrease* in one party's costs of war can have an impact on the realative bargaining position but never causes war. On the other hand, war can occur if a party's costs of war *increase* even though military power does not change.

The remainder of this paper is organized as follows: Section 2 presents the basic model while section 3 introduces commitment problems and specifies the conditions that lead to war. Section 4 summarizes and concludes.

2 The Basic Model

In every period, states A (he) and B (she) bargain about the distribution of an issue of size π. With probability α state A can make a take-it-or-leave-it offer to B, with

[1] see Fearon (1995) and Powell (2006)

probability $1-\alpha$ it is the other way around. A state's proposal is denoted $x_i^t \in [0, \pi]$ where x_i^t refers to the share of the pie that state i receives in period t. A state can respond to a proposal in two ways: accept the offer or opt out. In case of agreement the pie is shared according to the proposal and the game then proceeds to the next period. Otherwise, the negotiation is terminated and the states fight. In case of war, state A wins with probability $p \in [0, 1]$ and state B with probability $1-p$, leading to future payoffs per period $(\pi - c_A, 0)$ when A wins and $(0, \pi - c_B)$ when B wins, where c_i represent the irreversible costs of war. Consequently, the expected values of the outside options are $\frac{w_A}{1-\delta} = \frac{p(\pi - c_A)}{1-\delta}$ and $\frac{w_B}{1-\delta} = \frac{(1-p)(\pi - c_B)}{1-\delta}$ with $\delta \in [0, 1]$ being the states' common discount factor. Obviously, the two states have an incentive to reach an agreement if $c_A + c_B \geq 0$. *Figure 1* below illustrates the game tree:

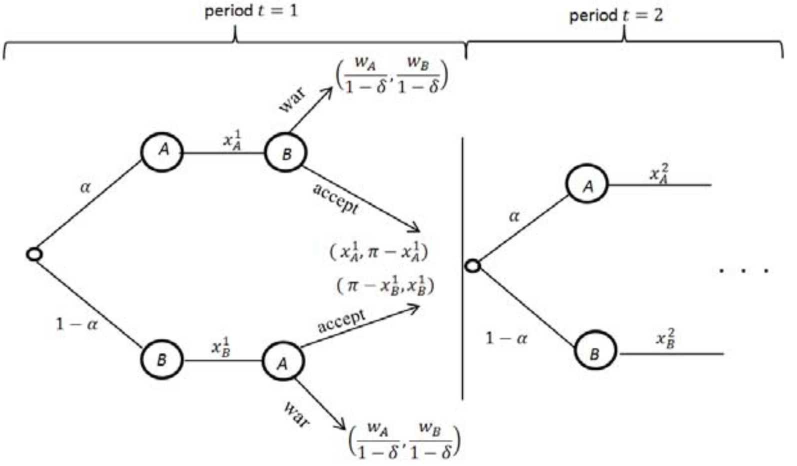

Figure 1: Game Tree

Note that, in contrast to standard bargaining models, here agreement leads to a continuation of bargaining in the next period and rejection of an offer leads to permanent breakdown in negotiations.

Lemma 1 *In any subgame perfect equilibrium of the basic model, agreement is always reached and the equilibrium outcome is therefore Pareto efficient.*

Proof. Let (M_A, M_B) be the expected payoffs to A and B in a subgame perfect equilibrium of the game, or correspondingly any subgame starting with a move of nature. Let $M_A^{min} \leq M_A \leq M_A^{max}$ and $M_B^{min} \leq M_B \leq M_B^{max}$ be the corresponding interval for a specific set of parameters of this game. Then $\frac{w_A+w_B}{1-\delta} \leq M_A + M_B \leq \frac{\pi}{1-\delta}$. Since the aggregate payoff in case of agreement in period t is always bigger than the war payoff, $\frac{w_A+w_B}{1-\delta} \leq \pi + \delta(M_A + M_B)$, war can occur only if the whole pie π $(x_i = 0)$ is too small to meet the expectations of the opponent,

$$\pi + \delta M_{-i} < \frac{w_{-i}}{1-\delta}. \tag{1}$$

However, $M_{-i}^{min} \geq \alpha \frac{w_{-i}}{1-\delta} + (1-\alpha)\frac{w_{-i}}{1-\delta} = \frac{w_{-i}}{1-\delta}$ since the opponent can always respond by choosing the outside option, and if he gets to make an offer, additionally extract potential efficiency gains in the current period and therefore expects to get at least his own outside option payoff. This, however, is in contradiction to Equation (1)

$$\pi + \delta \frac{w_{-i}}{1-\delta} \leq \pi + \delta M_{-i} < \frac{w_{-i}}{1-\delta}$$

as long as $\pi \geq w_{-i}$. ■

Thus, in any subgame perfect equilibrium the equilibrium offer is always accepted and either makes the respondend indifferent between acceptance and war or provides the respondend with the minimal value $(x_i^* = \pi)$ in which case the outside option is not necessarily binding.

Figure 2 below depicts different regions of the player's proposals depending on whether or not the outside options are binding.

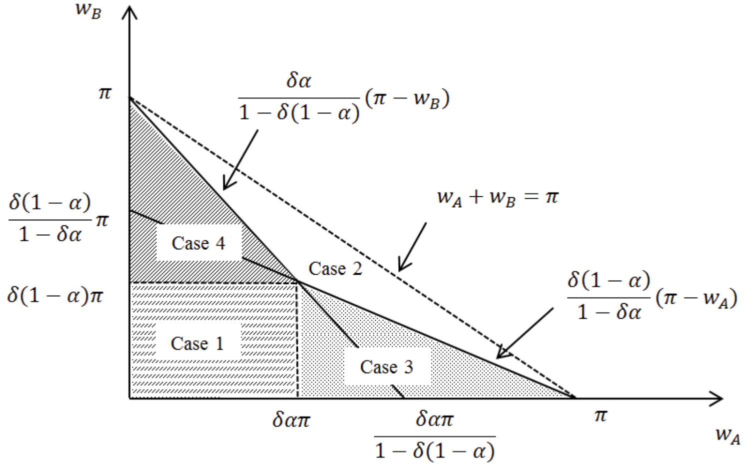

Figure 2: Equilibrium Proposals subject to w_A and w_B

Theorem 1 caracterizes all subgame perfect equilibria.

Theorem 1 *The equilibrium offers depend on the relative size of the outside options w_A and w_B:*

$$
\begin{aligned}
&x_A^* = \pi && \text{and} \quad x_B^* = \pi && \text{(case 1)}\\
&x_A^* = \tfrac{\delta}{1-\delta}\left(\alpha(\pi - w_B) - (1-\alpha)w_A\right) && \text{and} \quad x_B^* = \tfrac{\delta}{1-\delta}\left((1-\alpha)(\pi - w_A) - \alpha w_B\right) && \text{(case 2)}\\
&x_A^* = \pi && \text{and} \quad x_B^* = \tfrac{\pi - w_A}{1-\delta\alpha} && \text{(case 3)}\\
&x_A^* = \tfrac{\pi - w_B}{1-\delta(1-\alpha)} && \text{and} \quad x_B^* = \pi && \text{(case 4)}
\end{aligned}
$$

Proof. In *case 1* ($w_A \leq \delta\alpha\pi$ and $w_B \leq \delta(1-\alpha)\pi$) both outside options are not binding since both players can claim the whole pie in all future periods and therefore have no incentive to end peaceful settlement. The respondend is better off accepting the minimal offer peacefully and hoping for future peaceful returns.

In *case 3* ($\delta\alpha\pi < w_A$ and $w_B \leq \frac{\delta(1-\alpha)}{1-\delta\alpha}(\pi - w_A)$) player A's outside option is binding even though he can claim the whole pie when he gets to make an offer in the future ($x_B^* < \pi$). Player B's expected payoff, if it is her turn to accept the offer, must satisfy $\frac{w_B}{1-\delta} \leq (\pi - x_A^*) + \delta M_B^{t+1}$. In any stationary subgame perfect equilibrium if her outside option is not binding (A can extract the whole surplus, $x_A = \pi$) then

$$\frac{w_B}{1-\delta} \leq \delta M_B = \frac{(1-\alpha)x_B}{1-\delta} \text{ and } \frac{w_A}{1-\delta} = \pi - x_B + \delta M_A. \tag{2}$$

$$\pi - x_B + \delta M_A = \pi - x_B + \delta\frac{\alpha\pi + (1-\alpha)(\pi - x_B)}{1-\delta} = \frac{1-\delta\alpha}{1-\delta}(\pi - x_B) + \delta\alpha\pi$$

$$x_B^* = \frac{\pi - w_A}{1-\delta\alpha} \text{ and } w_B \leq \delta(1-\alpha)x_B^*$$

Case 4 ($w_A \leq \frac{\delta\alpha}{1-\delta(1-\alpha)}(\pi - w_B)$ and $\delta(1-\alpha)\pi < w_B$) and is analogous to case 3 with the roles of player A and B reversed.

Case 2 ($\frac{\delta\alpha}{1-\delta(1-\alpha)}(\pi - w_B) < w_A$ and $\frac{\delta(1-\alpha)}{1-\delta\alpha}(\pi - w_A) < w_B$), in which the size of net utility gained by peaceful settlement is not sufficient to cover the outside option payoff, describes all other conditions not covered in cases 1, 3 and 4, which implies that both outside options become binding.

$$\frac{w_A}{1-\delta} = (\pi - x_B) + \frac{\delta}{1-\delta}\left(\alpha x_A + (1-\alpha)(\pi - x_B)\right)$$
$$\frac{w_B}{1-\delta} = (\pi - x_A) + \frac{\delta}{1-\delta}\left(\alpha(\pi - x_A) + (1-\alpha)x_B\right)$$

has the unique solution

$$x_A^* = \frac{\delta}{1-\delta}\left(\alpha(\pi - w_B) - (1-\alpha)w_A\right) \text{ and } x_B^* = \frac{\delta}{1-\delta}\left((1-\alpha)(\pi - w_A) - \alpha w_B\right)$$

■

Given the optimal proposals defined by Theorem 1, the player's expected payoffs in any period are given by:

$$u_A^* = \begin{cases} \alpha\pi & \textit{in case 1} \\ \alpha(\pi - w_B) + (1-\alpha)w_A & \textit{in case 2} \\ \frac{(1-\delta)\pi\alpha + (1-\alpha)w_A}{1-\delta\alpha} & \textit{in case 3} \\ \frac{\alpha(\pi - w_B)}{1-\delta(1-\alpha)} & \textit{in case 4} \end{cases}$$

$$u_B^* = \begin{cases} (1-\alpha)\pi & \textit{in case 1} \\ \alpha w_B + (1-\alpha)(\pi - w_A) & \textit{in case 2} \\ \frac{(1-\alpha)(\pi - w_A)}{1-\delta\alpha} & \textit{in case 3} \\ \frac{(1-\delta)(1-\alpha)\pi + \alpha w_B}{1-\delta(1-\alpha)} & \textit{in case 4} \end{cases}$$

3 Commitment Problems

Now we assume that the game tree is extended to include an additional stage $t = 0$ after which the players' relative bargaining position changes. This change, beginning at $t = 1$, lasts for all periods to come and is fully expected by both players at the start of period $t = 0$ but not before. Note that every period of the extended game, from period $t = 1$ on, is strategically equivalent and equilibrium payoffs are determined by Theorem 1. In the following, we will only consider changes in the relative bargaining position in favor of player B. This means that player A's bargaining position deteriorates either because his military power decreases, his costs of war increase, B's costs of war decrease or he loses proposal power. Suppose player B has no other means to buy off player A in the current period but to give him the entire pie, so that $x_B^0 = 0$.

Again the collective reasoning supports peaceful settlement. Player A has no incentive to trigger war because war would make him worse off than demanding the maximal acceptable share, since

$$x_A^* + \delta M_A^1 < \frac{w_A^0}{1-\delta}, \text{ when } \pi - x_A^* + \delta M_B^1 = \frac{w_B^0}{1-\delta}$$

$$\Rightarrow \pi + \delta(M_A^1 + M_B^1) = \pi + \delta\frac{\pi}{1-\delta} < \frac{w_A^0 + w_B^0}{1-\delta} \quad \text{in contradiction to } w_A^0 + w_B^0 < \pi.$$

The same argument applies to player B who also prefers bargaining over fighting.

A commitment problem can arise in this situation if player player B cannot credibly commit in $t = 0$ to not exploit her improved bargaining position in future periods.

3.1 Shift in military power

A shift in military power changes the states' respective probabilities of winning war p and $1-p$. When military power shifts in favor of B, A's outside option decreases and B's outside option increases, since $\frac{w_A}{1-\delta} = \frac{p(\pi-c_A)}{1-\delta}$ decreases in $1-p$ and $\frac{w_B}{1-\delta} = \frac{(1-p)(\pi-c_B)}{1-\delta}$ increases in $1-p$. This change in the players' outside options can create a shift in the relative bargaining position if it alters the future distribution of the bargaining surplus. It can lead to preventive war if player A's current outside option exceeds his expected future gains from bargaining. The war condition determines the critical value of w_A^0 from which player A prefers going to war to bargaining. That is,

$$\frac{w_A^0}{1-\delta} > \pi + \frac{\delta}{1-\delta}u_A \tag{3}$$

Corollary 1 *Since the aggregate future bargaining payoff $\frac{\delta}{1-\delta}u_A$ depends on the 4 cases defined by Theorem 1, the war condition can be specified as follows:*

$$\begin{aligned}
&case \quad 1: \quad \tfrac{w_A^0}{1-\delta} > \pi + \tfrac{\delta}{1-\delta}\alpha\pi \\
&case \quad 2: \quad \tfrac{w_A^0}{1-\delta} > \pi + \tfrac{\delta}{1-\delta}\left(\alpha(\pi - w_B^1) + (1-\alpha)w_A^1\right) \\
&case \quad 3: \quad \tfrac{w_A^0}{1-\delta} > \pi + \tfrac{\delta}{1-\delta}\left(\tfrac{\alpha(1-\delta)\pi + (1-\alpha)w_A^1}{1-\delta\alpha}\right) \\
&case \quad 4: \quad \tfrac{w_A^0}{1-\delta} > \pi + \tfrac{\delta}{1-\delta}\left(\tfrac{\alpha(\pi - w_B^1)}{1-\delta(1-\alpha)}\right)
\end{aligned}$$

This finding confirms the standard argument that a shift in military power can change the relative bargaining position which can cause preventive war. But in contrast to Powell (2006) who concludes that the shift in military power necessary to cause preventive war needs to be "large and rapid" we can show that the necessary shift depends on the parties' respective bargaining power. When the declining party has little bargaining power and can only extract a small amount of the bargaining surplus through bargaining then even a small shift in military power can trigger war.

Corollary 2 *The fulfillment of the war condition decreases in α. It depends on the level of α, how substantial a change in military power has to be to cause preventive war.*

Proof. The fulfillment of the war condition depends on A's expected future bargaining payoff u_A. The bigger this payoff, the more he prefers bargaining over fighting. It can easily be verified that u_A increases in α in all 4 cases:

$$\begin{array}{ll} case \quad 1: & \frac{\partial u_A}{\partial \alpha} = \frac{\delta}{1-\delta}\pi > 0 \\ case \quad 2: & \frac{\partial u_A}{\partial \alpha} = \frac{\delta}{1-\delta}\left(\pi - (w_A^1 + w_B^1)\right) > 0 \\ case \quad 3: & \frac{\partial u_A}{\partial \alpha} = \frac{\delta}{(1-\delta\alpha)^2}\left(\pi - w_A^1\right) > 0 \\ case \quad 4: & \frac{\partial u_A}{\partial \alpha} = \frac{\delta}{(1-\delta(1-\alpha))^2}\left(\pi - w_B^1\right) > 0 \end{array}$$

■

3.2 Increase in A's costs of war

An increase in A's costs of war reduces A's outside option since $\frac{w_A}{1-\delta} = \frac{p(\pi - c_A)}{1-\delta}$ decreases in c_A. It has no effect on player B's outside option because $\frac{w_B}{1-\delta} = \frac{(1-p)(\pi - c_B)}{1-\delta}$ does not depend on c_A. This reduction in player A's outside option can create a shift in the relative bargaining position if it alters the future distribution of the bargaining surplus and again lead to preventive war if player A's current outside option exceeds his expected future gains from bargaining. The war condition in this case is also determined by *equation 3* and specified by *corollary 1*.

It is easy to verify that the war condition in cases 1 and 3 does not depend on B's outside option w_B^1. This means that changes in player B's outside option do not affect the war condition.

Corollary 3 *If w_B^1 is not binding (cases 1 and 3 in $t = 1$), then the war condition is identical for the case of a shift in military power and the case of an increase in player A's costs of war.*

In cases 2 and 4 the war condition depends on w_B^1. This means that it makes a difference whether a change in military power causes A's decline or an increase in his costs of war. A cost increase only affects A's outside option while a shift in military power not only reduces A's outside option but at the same time increases B's outside option which further reduces A's expected future gains from bargaining.

Corollary 4 *If w_B^1 is binding (cases 2 and 4 in $t = 1$), then a shift in military power has greater impact on the war condition than a cost increase.*

The results presented in *Corollary 3* and *4* are novel and have not yet been acknowledged in the formal literature on war initiation: Bargaining can break down not only because of a change in military power but also because of an isolated increase in one state's costs of war. Increased costs of war can result if, for example, one state intends to take measures to direct the blame of potential war to the adversary and secure diplomatic support. If this were the case, a shift in military power would not take place but still the adversary would sustain a reduction in his outside option.

Next we will present two cases of shifts in the relative bargaining position which in contrast to military power shifts and costs increases do not result in bargaining breakdowns.

3.3 Decrease in B's costs of war

A decrease in player B's costs of war increases her outside option because $\frac{w_B}{1-\delta} = \frac{(1-p)(\pi-c_B)}{1-\delta}$ decreases in c_B. It has no effect on player A's outside option because $\frac{w_A}{1-\delta} = \frac{p(\pi-c_A)}{1-\delta}$ is independent of c_B. This is the reason why A has no incentive to opt out, even though his future payoffs may deteriorate.

Corollary 5 *If player A's outside option remains constant, so that $w_A^0 = w_A^1$, then war is not an equilibrium outcome.*

Proof. Player A only opts for war in $t = 0$ if the whole pie in $t = 0$ is too small to satisfy his demand,

$$\pi + \delta M_A^1 < \frac{w_A^0}{1-\delta}. \tag{4}$$

However $M_A^{min} \geq \frac{w_A^1}{1-\delta}$ since player A can always guarantee at least his outside option payoff which does not change from period $t = 0$ to period $t = 1$. This is in contradiction to $w_A^1 = w_A^0 < \pi$. ■

Notice that this result contradicts the standard argument that a shift in the player's respective bargaining position can by itself be enough to make war a rational possibility. Here, the relative bargaining position of player B can improve at the cost of diminished expected gains for player A, without involving inefficient outcomes.

The analysis concludes with the verification that changes in proposal power can also not be the cause of bargaining breakdowns.

3.4 Shift in proposal power

A shift in proposal power does not affect the players' respective outside options. It does change the players' relative bargaining position because it affects the distribution of the bargaining surplus. A negative shift in proposal power reduces player A's expected future bargaining payoff u_A and thus also positively affects the fulfillment of the war condition as shown in *corollary 2*. However, a negative shift in proposal power alone cannot cause preventive war because player A's outside option does not decrease.

Corollary 6 *A reduction in player A's proposal power does not lead to war.*

Proof. Player A opts for war in $t = 0$ if the whole pie in $t = 0$ is too small to satisfy his demand, that is

$$\pi + \delta M_A^1 < \frac{w_A}{1-\delta}. \tag{5}$$

However, player A's minimum payoff is determined by $M_A^{min} \geq \frac{w_A}{1-\delta}$ which is independent of α and

$$\pi + \frac{\delta w_A}{1-\delta} \leq \pi + \delta M_A^1 < \frac{w_A}{1-\delta}$$

is in contradiction to $\pi > w_A$. ■

4 Conclusion

In the present paper we specify the relation between commitment problems and war in international bargaining. The paper provides two main results. First, it shows that a negative shift in the relative bargaining position under commitment problems does not necessarily lead to preventive war. Both, a decrease in one party's costs of war and a loss of proposal power affect the parties' relative bargaining position, and can in fact diminish a party's gains, but interestingly, cannot lead to preventive war. Second, it finds that in addition to shifts in military power, increased costs of war can also result in preventive war under commitment problems.

This analysis builds the formal groundwork for preventive war arguments. It also allows conjectures about the role of third party intervention in international conflicts because it clarifies, what kinds of power shifts between nations can actually induce preventive war. The model predicts that both, economic support (reduced costs of war) and military support (higher probability of winning war) can improve a party's bargaining position, while only military intervention can cause preventive war.

References

[1] Fearon, James D. (1995), “Rationalist Explanations for War”, *International Organization*, **49(3)**, p379-414.

[2] Powell, Robert (2006), “War as a Commitment Problem”, *International Organization*, **60(1)**, p169-203.