War as a Stick: Fighting to Keep Adversary's Unobservable Actions in Check

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Abstract

This article provides a novel rationalist explanation for war based on unobservable actions. When the parameters of a crisis bargaining is determined endogenously by unobservable actions of players, it becomes impossible for the players to commit to certain actions. In that case, war may break out because fighting today keeps adversary's unobservable actions in check in the future. War breaks out in equilibrium even though players can locate mutually beneficial prewar bargains.

1 Introduction

Regardless of who wins and who loses, war is a costly affair. Both sides would be better off if they achieved the same final outcome without suffering the costs of fighting. Then what prevents states from reaching prewar bargains that would avoid a costly fight? This is a central puzzle in the international relations literature. In his seminal article, Fearon (1995) provides three rationalist explanations for the puzzle: Informational issues, commitment problems and bargaining indivisibilities.

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When negotiating parties hold private information about their resolve or military capability, incentives to misrepresent this privately held information play a key role in shaping the behavior of the participants and thereby the likelihood of war and a peaceful settlement (Fearon 1995, Powell 1996a, 1999).[1] Commitment problems arise when states are unable to honor peaceful agreements and have incentives to renege in the future. In that case, some states may prefer war to untenable peace agreements in order to avoid the disadvantage of a future potential power shift among negotiating parties (Fearon 1995, Powell 2004, 2006). Bargaining indivisibilities, on the other hand, may lead to war when the issue on the table can be divided only in a few ways and no division satisfies all negotiating parties. Powell (2006) shows that the issue of bargaining indivisibilities is also a commitment problem.

A fundamental feature of crisis bargaining is that some of its parameters may be determined endogenously by negotiating parties' observable and unobservable actions. For example, consider a government and a violent separatist organization in an ethnic conflict. The balance of power between them is determined partly by actions of the organization, such as investment on arms and recruitment, as well as support by the constituency of the organization, which may all be unobservable. The actions of the government, such as investment in security forces and intelligence also play a role. Similarly, consider two states engaged in a potentially costly conflict. The states may secretly invest in new technology to shift the military power in their favor.

Even when parties mutually agree on which action to take, the unobservable nature of actions makes it impossible for parties to commit to certain actions. I argue that, in this case, war may become an instrument in shaping players' incentives to take unobservable actions and it may become a rational choice even in the absence of previously identified informational issues and commitment problems. If the likelihood of a power shift is determined by her adversary's unobservable actions, a player can keep her adversary's future unobservable actions in check by fighting with him when there is a power shift in favor of the adversary. The possibility of war in case of a power shift creates an ex-ante trade-off for the adversary: Taking a potentially power shifting action increases the adversary's expected payoff from fighting. But it also decreases the likelihood of a peaceful bargaining process, which may

[1]The international conflict literature has long argued that some kind of incomplete information, uncertainty and misperception between them make two more-or-less rationally led states go into war (e.g. Blainey 1988, Jervis 1976, Powell 1996b, Schultz 1998, Slantchev 2003b, Smith and Stam 2006, Van Evera 1999, Wagner 2000, Wittman 1979).

provide him with a more favorable deal. If the adversary's trade-off tilts towards peace, the player may use war as a stick to prevent adversary's unobservable actions that may distort power distribution. War may break out in the absence of informational problems between parties and even after a power shift.[2]

To develop my argument formally, I build a stylized infinitely repeated crisis bargaining game between two players, A and B. The players discount future payoffs. They play the following extensive form stage game every period: There is a flow of one unit of pie. First, A decides whether to take an action that is unobservable for B. Then the (military) power distribution between parties is determined stochastically. The stochastic process favors A when A takes the unobservable action. To abstract away from further issues of informational asymmetry, I assume that both parties observe the power distribution once it is determined. Then B decides whether to engage in a costly fight with A. If they fight, who obtains the entire pie is determined randomly according to the power distribution. If they decide to resolve the conflict peacefully, then they share the pie through an efficient bargaining process according to their military strength and some exogenously given distribution of bargaining power.

There always exists a unique peaceful sequential equilibrium (Kreps and Wilson 1982): A chooses to take the unobservable action, B does not fight with A and they settle peacefully in every period (Lemma 1). Since this efficient equilibrium is unique, fighting must occur on any equilibrium path that B prefers to the efficient equilibrium (Corollary 2). If A has sufficient bargaining power in the peaceful negotiation process, then the following pure strategy profile forms an equilibrium with inefficient fighting, and player B prefers it to the efficient equilibrium: Player A chooses *not* to take the unobservable action, B fights with A whenever there is a power shift in favor of A and otherwise they resolve the conflict peacefully (Theorem 3).

This equilibrium provides a new theory of war based on sorting incentives regarding unobservable actions. The mechanism works as follows: A favorable power shift provides A with two benefits. First, A's war payoff increases in case war breaks out. Second, it improves A's share from a peaceful settle-

[2]Note that one can read war or fight in more broader terms. For example, we can interpret economic sanctions also as some costly conflict, because they are costly for the imposing state as it takes international political give-and-takes to successfully implement sanctions; and they are also costly for the country that is subject to sanctions, because sanctions limit the economic productivity of the country.

ment by improving his payoff from fighting. Therefore, A has every reason to take the unobservable action. Anticipating that, B creates a trade-off for A by fighting whenever there is a power shift in favor of A. The trade-off is the following: There is a surplus from a peaceful resolution, and how players share the pie peacefully is determined by A's bargaining power as well as military power distribution. However, given B's equilibrium strategy, players collect the surplus only if there is no power shift. If A takes the unobservable action, that potentially increases his war payoff, but also risks his share from a peaceful bargain by increasing the likelihood of war. Given this trade-off, A finds it optimal to take no unobservable action today and in the future.

How is this new theory different from the incomplete information and commitments problems identified in the literature as major rationalist explanations for war? In the incomplete information account (Fearon 1995), war may break out from a risk-return trade-off when a player does not know whether she is negotiating with a high-resolve or low-resolve adversary, or whether with a militarily strong or weak adversary. In my model, although A's action is unobservable, there is no such informational problem. Players know each other's payoffs. Both players observe the power distribution, so there is no information asymmetry when B decides to fight. In addition, despite the unobservable nature of A's action, B is certain at every point on the inefficient equilibrium path that A did not and will not take an action to distort the power distribution.

The literature also identifies several different commitment problems as a major cause of war: preventive war, preemptive attacks, conflicts resulting from bargaining over issues that affect future bargaining power and shifting of power between domestic factions due to war (Fearon 1995, Powell 2006). The common mechanism that causes inefficiency in all four is a rapid shift of power in the future, and fighting today may eliminate this future power shift. Although A's action can potentially shift power, and the unobservable nature of A's action makes it impossible for A to commit to not distorting the power distribution, none of the commitment problems listed above exist in my model. For example, in the efficient equilibrium, B knows that A will take an unobservable action in all future periods. That will potentially shift power distribution in favor of A in all future periods. Even then B does not fight with A in the efficient equilibrium. Moreover, fighting in the inefficient equilibrium does not physically eliminate any future threat, that is A will survive the fight with the same ability to distort power distribution in the future.

Powell (2006) provides a general inefficiency condition that explains various commitment problems that cause war before the realization of a rapid power shift. In this model, inefficient fighting is not a consequence of the inefficiency condition identified by Powell (2006), and it occurs after a power shift.

It is also important to note that, with the exception of Slantchev (2003a), earlier arguments explain war by showing why efficient equilibrium may fail to exist and why players cannot locate mutually beneficial bargains ex ante. In contrast, both an efficient equilibrium and an inefficient one exist in this model. War breaks out in the inefficient equilibrium despite that players can identify mutually beneficial bargains ex ante. Therefore, two questions are in order before I can provide a complete account of this new rationalist explanation for war.

The first question concerns, as pointed out by Fearon (see Powell 2006, p. 180, footnote 35), coordination failure as a possible cause of inefficiency when there are multiple equilibria. For example Slantchev (2003a) provides one such explanation in a complete information crisis bargaining game. However, Fearon notes that (1995, page 404), "it seems farfetched to think that small numbers of states (typically dyads) would have trouble reaching the efficient solution here, if coordination were really the only problem."

Despite the existence of multiple equilibria in the model, my explanation does not rest on coordination failure. Although efficient equilibrium always exists in the model, an inefficient equilibrium that is not Pareto ranked against the efficient equilibrium may also exist. Here, in contrast to Slantchev (2003a), one of the players prefers the outcome of the inefficient equilibrium to the efficient equilibrium outcome, and thereby they cannot avoid inefficiency by mutually agreeing to switch to the efficient equilibrium.

The second question concerns the possibility of renegotiating inefficiencies: When a power shift is observed on the inefficient equilibrium path, B knows that A did not do anything behind the scenes. Then why does B fight with A? Can't they simply avoid costly conflict by renegotiating at that point for a better continuation equilibrium? For example, both A and B can benefit from going back to the negotiation table today without changing the equilibrium behavior from tomorrow on. An equilibrium that does not generate such renegotiation opportunities on or off the equilibrium path is called renegotiation proof (Bernheim and Ray 1989, Farrel and Maskin 1989). In this model, the unique efficient equilibrium of the game is also the unique renegotiation proof equilibrium. Recall that A always takes the unobservable action and the players always reach a peaceful settlement in this equilibrium, and it is A's most preferred equilibrium. However, B prefers the inefficient equilibrium to the efficient one. In other words, it is optimal for B to risk war and commit to not renegotiating inefficiencies in case war breaks out. This final argument completes the new rationalist account of war based on unobservable actions.

This work differs from previous formal models of crisis bargaining that incorporate endogenous armament decisions. Powell (1993) establishes sufficient conditions to ensure the existence of peaceful equilibrium in an infinitely repeated game in which states can observe each other's military investment and sequentially decide allocating their limited resources between their intrinsically valued ends and the means of military power. Jackson and Morelli (2009) study a similar model with simultaneous armament decisions. In their model, peace is not sustainable via pure strategies with any levels of armament. Mixed strategies over armament levels may result in a hawkish player with high armament levels facing a dovish one with low armament levels, and war breaks out between the two.

There is also some recent work that incorporates unobservable actions. Meirowitz and Sartori (2008) show that uncertainty about military strength may emerge endogenously when armament is costly and unobservable. In their model, a state wants to avoid the cost of armament but does not want to be caught without any military power. Then strategic uncertainty emerges in an equilibrium with mixed strategies on armament levels. Baliga and Sjöstrom (2007) argue that strategic ambiguity on one's military power may arise endogenously in an incomplete information model. Debs and Monteiro (2011) study a model of nuclear proliferation with preventive war. In their model, a state may make unobservable investment in nuclear technology. However, it takes a period for the investment to produce the technology. Hard evidence on adversary's investment may arise randomly. The opponent may prevent the development of nuclear weapons by attacking the adversary in the first period. Fearon (2011) studies a model of democracy in which individual citizens observe government performance with noise and can overthrow an autocratic regime by a costly uprising only if they can overcome a coordination problem. He shows that when there are organizations in society that can observe and announce a signal of the extent of the popular discontent, fair elections are sustained in equilibrium.

In contrast to these works, in my model, only the action that affects the stochastic process of the power distribution is unobservable but its final impact on the power distribution is perfectly observable. Furthermore, war does not eliminate any player and their ability to shift power in the future.

The paper that is closest to mine is Yared (2010), who provides a dynamic theory of war based on asymmetric information and limited commitment. His explanation is similar to Green and Porter's (1984) explanation of price wars in oligopoly markets. In his model, an aggressor repeatedly seeks concessions from an adversary over an infinite time period. Concession may be prohibitively costly. This cost is drawn randomly every period and it is the adversary's private information. The aggressor can either fight or seek a peaceful concession. In a static one-period game, war breaks out in the unique equilibrium. Total war, that is fighting forever, is an equilibrium of the repeated game and it is also the unique renegotiation-proof equilibrium. There does not exist any peaceful equilibrium. However, some inefficiency may be avoided in a dynamic crisis relationship. Under certain conditions, there exists equilibria that both players prefer to total war. Such a Pareto dominant equilibrium involves escalating demands by the aggressor in periods following a failure of concession by the adversary and it involves periods of temporary war when demand escalation no longer provides incentives for concession from the low-cost adversary. In other words, risk of temporary war in the future may help extract concessions from the low-cost adversary today and keep the players away from the total war equilibrium.

My theory is fundamentally different from Yared (2010). Asymmetric information is a fundamental cause of war and players cannot avoid fighting in Yared (2010). In contrast, my theory is based on unobservable actions. In the static one-period version of my model, the conflict is resolved peacefully and efficiently in the unique sequential equilibrium, so unobservable action does not lead to war in the static model. In the repeated model, there exist a unique efficient equilibrium, which is also the unique renegotiation-proof equilibrium, as well as an inefficient equilibrium. The inefficient equilibrium provides a higher payoff for one of the players, so the players do not renegotiate inefficiencies on the inefficient equilibrium path. In other words, introduction of the dynamic interaction causes inefficient fighting in my model, while it reduces the extent of inefficiency associated with total war in Yared (2010) (see Figures 2 and 3). The underlying mechanisms are also different. In Yared (2010), periods of temporary war in the future provide incentives for concessions today. In contrast, in my model, fighting today provides future incentives for the adversaries' unobservable actions in the future.

The paper proceeds as follows. Section 2 introduces the model. Section

3 presents the equilibrium analysis. Section 4 discusses the new rationalist account of war and provide empirical evidence in the example of the Kurdish problem in Turkey. Section 5 concludes.

2 Model

Time horizon is discrete and infinite, $t = 0, 1, ..., \infty$. There are two players, A(he) and B(she). They are risk neutral and discount future payoffs by $\delta \in (0, 1)$. They play the following extensive form stage game every period: There is a flow of a pie of size 1 that A and B negotiate over. They can either fight over it or share it through peaceful negotiations. Figure 1 summarizes the stage game.

Fighting is a costly lottery. Let $p \in [0, 1]$ represent A's relative military advantage or power in a fight. When war breaks out, A obtains the entire pie with probability p and pays a cost of c_A, and B obtains the entire pie with probability $1 - p$ and pays a cost of c_B. The war payoffs for A and B are $p - c_A$ and $1 - p - c_B$, respectively. War destroys $c_A + c_B$ of the flow.

I model peaceful negotiations as an efficient black-box process. In other words, the only source of inefficiency in the model is fighting. Peaceful negotiations generate a surplus of $c_A + c_B$. A peaceful bargain gives each player at least his war payoff and allocates the surplus of $c_A + c_B$ between the two players.

Other states and international organizations can potentially play a role in peaceful negotiations. That and other factors determine a player's bargaining power, and conseqently even a militarily weak player may have some bargaining power in negotiations. Let $\pi \in [0, 1]$ be A's relative bargaining power in that process. Then A receives his war payoff plus $\pi(c_A + c_B)$ from the surplus and B receives the remainder. That is,

$$b_A = p - c_A + \pi(c_A + c_B), \text{ and}$$
$$b_B = 1 - p - c_B + (1 - \pi)(c_A + c_B)$$

are A and B's share from a peaceful settlement, respectively.[3]

[3] Alternative bargaining processes can produce that outcome. For example, suppose one of the players is chosen randomly to make a take-it-or-leave-it offer. War breaks out if the offer is rejected. Let π be the probability that A makes the offer. This bargaining process produces the same payoffs for the players.

The assumptions I have made so far are fairly standard (Fearon 1995, Powell 1996). I incorporate unobservable actions to this otherwise standard model as follows: At the beginning of each period, A decides whether to take an action that would potentially change the power distribution in his favor. Let $a \in \{0, 1\}$ denote A's action, where $a = 0$ and $a = 1$ represent not taking the action and taking the action, respectively. Once A moves, nature determines randomly whether the power has shifted in favor of A in the given period. The likelihood of the shift depends on A's action as follows: p can be high or low, $p \in \{p_H, p_L\}$, $p_H > p_L > c_A$ and the probability that p is high is larger when A takes the action. For example, when the adversary is a terrorist organization, p_l may represent a weak and dormant organization and p_h may represent a strong and active organization. Formally, let α_a denote the probability that $p = p_h$ when A's takes the action $a \in \{0, 1\}$ and $\alpha_1 > \alpha_0$.

B cannot observe A's action. However, both A and B can observe the realized value of A's relative military power, p. Once B observes the value of p, she decides between negotiating peacefully and fighting. The stage game ends accordingly.[4]

I make the following assumption on A's bargaining power.

Assumption: $\pi \geq \pi^* = \frac{p_H - p_L}{c_A + c_D}$

This assumption ensures that, ceteris paribus, A would prefer a peaceful negotiation under weak military capability to fighting under strong military capability. That is,

$$p_L - c_A + \pi(c_A + c_B) \geq p_H - c_A$$

where the left hand side is A's payoff from a peaceful bargain when he is militarily weak and the right hand side is his war payoff when he is strong. This assumption stacks my model against fighting by making peace more desirable for A.

I predict the outcome of the repeated game by pure strategy sequential equilibrium (Kreps and Wilson 1982).

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[4] A's actions could be a source for additional inefficiency. For example, taking the unobservable action may be costly for A; or p_H may be realized as a sequence of successful terrorist attacks, which may destroy some of B's resources. In order to focus on the inefficiency puzzle, I abstract away from such costs. In this model, A's choice of action creates a zero-sum situation both in peace and war for both players. The only source of inefficiency is fighting. However, similar results would obtain in the presence of such costs with similar substantive interpretation, at least when the costs are close to zero.

3 Equilibrium Analysis

Let b_i^t be the payoff of player $i \in \{A, B\}$ from a peaceful negotiation given $p_t \in \{p_H, p_L\}$:

$$\begin{aligned} b_A^t &= p_t - c_A + \pi(c_A + c_B), \\ b_B^t &= 1 - p_t - c_B + (1 - \pi)(c_A + c_B). \end{aligned}$$

b_i^t depends on the realized value of p_t. A obtains a bigger share of the pie if $p_t = p_H$, that is, $b_A^H > b_A^L$. I will refer to b_A^H as A's larger share.

There is an efficient equilibrium, at which players solve every conflict peacefully. Given that there will be no war, then it is optimal for A to take the unobservable action since that will increase the likelihood that A will obtain his larger share in the negotiations. More formally, if A takes action $a \in \{0, 1\}$, his expected payoff from a peaceful bargain is

$$\alpha_a b_A^H + (1 - \alpha_a) b_A^L = b_A^L + \alpha_a (b_A^H - b_A^L)$$

which is increasing in α_a. Since $\alpha_1 > \alpha_0$, $a = 1$ is optimal for A when there is no prospect of war. Given that A will always choose $a = 1$, resolving conflicts peacefully is optimal for B since fighting will only create a cost for B without changing A's choice of action. Also B correctly believes that A has chosen $a = 1$. I summarize this in the following lemma.

Lemma 1 *In the unique efficient equilibrium of the game, A always takes the unobservable action, and parties resolve every conflict peacefully.*

Given this uniqueness result, the following result follows immediately as a corollary, which I will return to in Section 4.

Corollary 2 *Any equilibrium that B prefers to the efficient equilibrium involves inefficient fighting.*

Does there exist such an equilibrium and what is the mechanism that yields equilibrium inefficient fighting? Now, I will describe one such equilibrium.

Consider the following strategy and belief profile σ: Define two types of periods, efficient period and inefficient period. A chooses $a = 0$ in every inefficient period and $a = 1$ in every efficient period. In an inefficient period,

B chooses to settle peacefully if $p_t = p_L$ and she fights if $p_t = p_H$. B chooses to settle peacefully in an efficient period. The game starts with an inefficient period. The next period is inefficient if B has followed her prescribed strategy in all previous inefficient periods. The game switches to and remains efficient forever if B ever deviates in an inefficient period. In an inefficient period, B believes that A has chosen $a = 0$. In an efficient period, B believes that A has chosen $a = 1$.

Define

$$\pi^{crit} = \frac{1 - \delta(1 - \alpha_0)}{\delta \alpha_0} - \frac{\alpha_1 - \alpha_0}{\alpha_0} \frac{p_H - p_L}{c_A + c_B}$$

Theorem 3 *If $\pi \geq \pi^{crit}$, then the strategy and belief profile σ is an equilibrium of the repeated game. B prefers the outcome of σ to the efficient equilibrium outcome.*

I defer the proof of this theorem to the appendix. The condition of the theorem holds for large enough δ. In particular, $\pi^{crit} < 1$ if and only if $\pi^* > \frac{1-\delta}{\delta(\alpha_1 - \alpha_0)}$ and $\pi^* \geq \pi^{crit}$ (so that $\pi \geq \pi^*$ implies $\pi \geq \pi^{crit}$) if and only if $\pi^* \geq \frac{1-\delta(1-\alpha_0)}{\delta \alpha_1}$. Both conditions are satisfied when δ is large enough.

The theorem is intuitive. Player A faces a trade-off in the game. A favorable power shift helps A in war time. But given B's strategy, it hurts him by reducing the likelihood of peace. If A has sufficient bargaining power, that is if π exceeds π^{crit}, then A's share from a peaceful bargain is large enough that A prefers to lower the risk of war, which he can do by not taking the unobservable action. If A does not have sufficient bargaining power, for example when $\pi = 0$, the efficient equilibrium is the unique equilibrium of the game and the players avoid costly conflict. However, then A invests in power by taking the unobservable action in order to improve his peaceful share on the negotiation table.

π^{crit} is derived from B's indifference condition when choosing between a peaceful resolution and war after observing $p_t = p_H$. σ prescribes that B fights after observing $p_t = p_H$. Alternatively, she could try to secure a better bargain with A. In that case, the most she can secure in the given period is $1 - p_H + c_A$. Then the game switches to efficient periods, in which there is no more fighting. For B to optimally choose to fight after observing $p_t = p_H$, it must be the case that π exceeds that critical value.

If α_1 gets closer to α_0, B's loss from a power shift in favor of A gets smaller in a peaceful bargain. Then it is less worthy to fight in order to keep

A's unobservable action in check. For example, if α_1 is close enough to α_0, then $\pi^{crit} > 1$ and σ is not an equilibrium.

I will develop the new rationalist account of the inefficiency puzzle and give a substantive discussion in the next section.

4 Discussion

Unobservable action

The unobservability assumption is critical for my main argument. Corollary 2 states that B has to engage in costly conflict at an equilibrium that she prefers to the efficient one. This result is a consequence of A's unobservable actions and breaks down if B can observe A's actions. In the latter case, B can achieve a better equilibrium payoff by conditioning her fighting decision on A's action instead of conditioning it on the realization of p_t.

When A's action is observable for B, the following is an efficient equilibrium and it provides the best outcome for B: Define two types of periods, A-efficient and B-efficient. In a B-efficient period, A chooses $a = 0$ and B fights if A chooses $a = 1$; in an A-efficient period, A chooses $a = 1$ and B does not fight. The game starts in a B-efficient period. If B ever deviates in a B-efficient period, all future periods become A-efficient. Notice that there will be no inefficient fighting and A will choose $a = 0$ on the equilibrium path.

War as a Stick: Fighting to Keep Adversary's Unobservable Actions in Check

The literature identifies informational and commitment problems as main sources of war. The informational problem concerns incomplete information, under which parties do not know the type of adversary they are negotiating with, for example whether they are negotiating with a high-resolve or low-resolve opponent, or with a militarily strong or weak one (Fearon 1995). There is no such information problem in this model. Players know each other's payoffs. Both players observe the power distribution, so there is no information asymmetry when B decides to fight. In addition, despite the unobservable nature of A's action, B is certain at every point on the inefficient equilibrium path that A did not and will not take an action to distort the power distribution.

The literature also identifies several commitment problems that cause war: preventive war, preemptive attacks, conflicts resulting from bargaining over issues that affect future bargaining power and shifting of power between domestic factions due to war (Fearon 1995, Powell 2006). The common mechanism that causes inefficiency in all four is rapid shift of power in the future, and fighting today may eliminate such rapid power shift in the future.

Although A's action can potentially shift power, and the unobservable nature of A's action makes it impossible for A to commit to not distorting the power distribution, none of the commitment problems listed above exist in this model. For example, in the efficient equilibrium, B knows that A will take action $a = 1$ in all future periods. That will shift the odds of power distribution in favor of A in all future periods, however even then B does not fight with A in the efficient equilibrium. Moreover, fighting in the inefficient equilibrium does not physically eliminate any future threat, that is A will survive the fight with the same ability to distort power distribution in the future.

There is an incentive mechanism at work here. Fighting occurs after, not before, a power shift in the equilibrium of Theorem 3. When a power shift occurs in the equilibrium, B knows that this shift is due to random nature of the game and not due to A's past power shifting actions. However, B rationally and correctly predicts that A will avoid distorting power distribution in the future only if B fights with A today. When the benefit of providing A with these "future incentives" exceeds the costs of war for B, B rationally chooses to fight. Therefore, the inefficiency is a consequence of providing A with the incentives to stay away from possible power shifting actions in the future.

Powell (2004, 2006) provides an inefficiency condition that ensures that all of the equilibria of a stochastic game, in particular of a complete information crisis bargaining game, are inefficient. To rephrase, let $M_i(t)$ be the payoff that player i can lock-in in period t. That is, $M_i(t)$ is player i's minmax payoff in period t. Powell (2004) shows that all equilibria of a stochastic game are inefficient if the following condition holds somewhere along every efficient path:

$$\delta M_A(t+1) - M_A(t) > \text{ Efficient surplus } - [M_A(t) + M_B(t)] \qquad (1)$$

The left hand side of this inequality measures the size of the shift in the power distribution between periods t and $t + 1$. The right hand side is the bargaining surplus generated by avoiding inefficient minmaxing. Both sides are measured in period t terms.

In my game, the minmax payoffs are obtained when $a = 1$ and the players fight forever:

$$M_A(t) = \frac{\alpha_1 p_H + (1-\alpha_1)p_L - c_A}{1-\delta} \text{ and}$$
$$M_B(t) = \frac{1 - \alpha_1 p_H - (1-\alpha_1)p_L - c_B}{1-\delta}$$

The total surplus on any efficient path is given by $\frac{1}{1-\delta}$ in the game. The left hand side of (1) is negative since $M_A(t+1) = M_A(t)$ and $\delta < 1$, and the right hand side is positive since $M_A(t) + M_B(t) < \frac{1}{1-\delta}$. In other words, Powell's condition is violated on every efficient path in the game so his condition is not the main source of inefficiency in Theorem 3.

Coordination

As pointed out by Fearon (see Powell 2006, p. 180, footnote 35), coordination failure may also lead to inefficiency. For example, consider the following game between a row and a column player, where (x, y) represents a payoff of x for the row player and a payoff of y for the column player:

	Left	Right
Up	3,3	0,0
Down	0,0	1,1

There are two equilibria in this game, (Up,Left) and (Down,Right). The first one provides better payoffs for both players so the second equilibrium is inefficient.

Slantchev (2003a) offers one such explanation. In his complete information game, players are expected to arrive at a resolution only after fighting for a number of periods. The mechanism that keeps the players fighting is that, if a player deviates from fighting before the deal is reached, then the players switch to an efficient equilibrium that makes the deviating player worse off.

In a completely rational world, nothing prevents players from talking each other into a better equilibrium. For example, if players are supposed to play the inefficient (Down,Right) equilibrium above, they can potentially agree to switch to the Pareto dominant equilibrium (Up,Left). Therefore, without explaining why players do not talk each other into the better equilibrium, such equilibria cannot provide a fully rational account for the inefficiency.

One potential explanation is due to Aumann (1990):[5] Even if one extends a coordination game with cheap talk, cheap talk does not guarantee coordination on an efficient equilibrium. However, as noted by Fearon (1995, page 404), "it seems farfetched to think that small numbers of states (typically dyads) would have trouble reaching the efficient solution here, if coordination were really the only problem."

I also have multiple equilibria in my set up, but my argument does not rely on coordination failure. In contrast to Slantchev (2003a), the coordination game induced in my set up is a battle-of-sexes game:

	Left	Right
Up	4,2	0,0
Down	0,0	1,3

A battle-of-sexes game involves elements of both coordination and competition between players. (Up,Left) and (Down,Right) are both equilibrium profiles in this game. (Up,Left) produces a surplus of $4 + 2 = 6$, which is greater than the surplus created by (Down,Right), which is $1 + 3 = 4$. That is, (Down,Right) involves inefficiency. However, (Up,Left) no longer provides better payoffs for both players than (Down,Right) does and the column player prefers the inefficient equilibrium to the efficient one. Thus, the players cannot mutually agree to switch from one equilibrium to the other. This is not the case in Slantchev (2003a).

Renegotiation

Having observed a power shift in favor of A on the inefficient equilibrium path, both players know that the shift was not due to A's past actions. Why do they end up in a costly fight then? If B unilaterally deviates from her equilibrium strategy by avoiding war, she is punished by a lower equilibrium payoff in the future. But that does not prevent A and B from getting together to reassess the situation. They can mutually agree to going back to the negotiation table without changing their future behavior. Such mutually agreed deviation would benefit both players. Then what prevents A and B from going back to the negotiation table?

[5] I thank Jim Fearon for pointing out this explanation by Aumann (1990). Also see Arvan, Cabral and Santos (1999) who provide conditions for cheap talk to improve equilibrium payoffs. Slantchev's construction can be regarded similar to Aumann's game but it does not escape Fearon's criticism for coordination failure as an explanation for inefficiency in the context of international relations.

To address this question, we first need to understand what the players can achieve without committing to not renegotiate inefficiencies. Formally, this is equivalent to finding all renegotiation-proof sequential equilibria (Bernheim and Ray 1989, Farrel and Maskin 1989).

Consider an equilibrium $\hat{\sigma}$. If players find themselves in a situation where they both can get better off by switching to another continuation equilibrium play, then $\hat{\sigma}$ is prone to renegotiation at that point. If players do not commit to not renegotiating, then they will mutually agree to deviate from $\hat{\sigma}$ to another equilibrium at that point. An equilibrium that is immune to such renegotiation is called a renegotiation-proof equilibrium. Renegotiation-proofness does not directly imply efficiency. It requires that at every node of the game, the continuation equilibrium cannot be renegotiated for a mutually beneficial alternative.

In this model, if an equilibrium carries some risk of war, it cannot be renegotiation-proof. Because if the players arrive at a node of fighting, the following alternative will be mutually beneficial for both, which is an equilibrium from that node onward: Go back to the negotiation table now, but play the same continuation equilibrium from tomorrow on. Thus, renegotiation-proofness implies efficiency, in other words, peace, in this model. Given that there will be no fighting and all conflicts will be resolved peacefully, it is optimal for A to choose $a = 1$ in a renegotiation-proof equilibrium. That is, the unique efficient equilibrium of the game is also the unique renegotiation-proof equilibrium of the game.

Since B prefers the outcome of the inefficient equilibrium, B has the incentive to commit to not renegotiating. This final argument completes my theory as a fully rational account of the inefficiency puzzle.

Slantchev (2003a) does not take renegotiation into account. If players are in an inefficient equilibrium in his model, both players know that they both can do better in another equilibrium and there is nothing in his model that prevents the players from renegotiating to move to a better equilibrium. For example, as noted by Slantchev, the players could in principle consider agreeing to the final split without any fight. Slantchev states that such considerations would constitute a deviation from the equilibrium strategies.

Renegotiating for a better equilibrium does not necessarily constitute a deviation from equilibrium strategies especially when renegotiation is mutually voluntary. In general, a fully rational account of inefficiency should take renegotiation into account and provide an explanation for why players do not renegotiate inefficiencies whenever they arise.[6]

Unobservable Action vs Information Asymmetry
Yared (2010) provides a dynamic theory of war based on asymmetric information and limited commitment. His explanation is similar to Green and Porter's (1984) explanation of price wars in oligopoly markets. My theory is fundamentally different than Yared (2010) in several dimensions.

In Yared (2010), an aggressor repeatedly seeks concessions from an adversary over an infinite time period. Concession may be prohibitively costly. The cost is drawn randomly every period and it is the adversary's private information. The aggressor can either fight or seek a peaceful concession. In a static one-period game, war breaks out in the unique equilibrium. Total war, that is fighting forever, is an equilibrium of the repeated game and it is also the unique renegotiation-proof equilibrium. There does not exist any peaceful equilibrium in Yared's model. However, some inefficiency may be avoided in a dynamic crisis relationship. Under certain conditions, there exist equilibria that both players prefer to total war.

Yared's theory can be visually represented as in Figure 2. Suppose that the size of the pie is 1. Then the players can achieve the efficient surplus by dividing the pie between themselves peacefully. If they achieved the efficient surplus in every period, then the total surplus in the infinitely repeated game would be $\frac{1}{1-\delta}$. If we normalize the payoffs by multiplying them with $1-\delta$, then the -45^o line of $u_A + u_B = 1$ represents players' payoffs from efficient allocations. The point TW represents the players' expected payoffs from the total war equilibrium. The set of players' sequential equilibrium payoffs is given by the concave curve and the area below it.

The $u_A+u_B = 1$ line does not intersect with the set of equilibrium payoffs, that is, players cannot avoid fighting in Yared (2010). TW also represents the unique equilibrium of the static one-period game. The introduction of a dynamic relationship cannot move the players all the way to the line of $u_A + u_B = 1$, however it can move them from TW to a better equilibrium, for example to (u_A^*, u_B^*).

Such a Pareto dominant equilibrium involves escalating demands by the aggressor in periods following a failure of concession by the adversary and it involves periods of temporary war when demand escalation no longer provides incentives for concession from the low-cost adversary. In other words, risk of

[6] See Leventoğlu and Slantchev (2007) for an account of renegotiation in a complete information model with commitment problems.

temporary war in the future may help extract concessions from the low-cost adversary today and keep the players away from the total war equilibrium.[7]

Asymmetric information is a fundamental cause of war and fighting is unavoidable in Yared (2010). In contrast, my theory is based on unobservable actions. In the static one-period version of my model, the conflict is resolved peacefully and efficiently in the unique sequential equilibrium, so unobservable action does not lead to war in the static model. In the repeated model, there exist a unique efficient equilibrium, which is also the unique renegotiation-proof equilibrium, as well as an inefficient equilibrium. The inefficient equilibrium provides a higher payoff for one of the players, so the players do not renegotiate inefficiencies on the inefficient equilibrium path. In other words, introduction of the dynamic interaction causes inefficient fighting in my model, while it reduces the extent of inefficiency associated with total war in Yared (2010). The underlying mechanisms are also different. In Yared (2010), periods of temporary war in the future provide incentives for concessions today. In contrast, in my model, fighting today provides incentives for the adversaries' unobservable actions in the future.

My theory can be visualized as in Figure 3. The $u_A + u_B = 1$ line represents players' payoffs from efficient allocations. The curve represents the Pareto frontier of the equilibrium payoffs. The -45^o line and the Pareto frontier of the equilibrium payoffs intersect at the point EE. That is, EE is an efficient equilibrium. EE is also the unique sequential equilibrium in the static one-period game and it is the unique renegotiation-proof equilibrium in the repeated game. In other words, unobservable action by itself is not the cause of war in my model. However, introduction of a dynamic relationship can move the players away from the efficient equilibrium EE to an inefficient one, for example (u_A^{**}, u_B^{**}) on the Pareto frontier. This is in contrast to Yared (2010), where a dynamic relationship moves players away from the most inefficient total war equilibrium.[8]

[7]In Green and Porter (1984), firms can benefit from collusive behavior but the unique equilibrium of the static oligopoly game is competitive. Introduction of repeated interaction makes firms achieve higher profits by playing collusively for certain periods and engaging in temporary price wars.

[8]Although I provide a visual discussion on the Pareto frontier, Corollary 2 applies more generally for any equilibrium that B prefers to the efficient equilibrium. Then I do not need to characterize the Pareto frontier of the equilibrium payoffs for the main argument. The equilibria on the Pareto frontier may provide interesting dynamics and I leave this technical exercise for future work.

Reputation

My theory also applies to situations where a state expects to have one-time negotiations with different adversaries over time. For example, suppose that δ is the probability that B is going to meet with a new adversary A in every period. When B meets with a new adversary, they play the stage game once and then the adversary disappears forever. For instance, A could be a new violent separatist group or a new international terrorist organization. In that set-up, an equilibrium similar to that of Theorem 3 still obtains. Moreover, the equilibrium behavior has a substantive interpretation for the "We don't negotiate with terrorists" strategy.

In equilibrium, B commits to fighting whenever her adversary turns out to be a strong one, that is $p_t = p_H$, and B resolves the conflict peacefully otherwise. The adversary checks the history of B's past moves. If B has ever deviated from the strategy of fighting with strong opponents in the past, the adversary chooses $a = 1$, otherwise he chooses $a = 0$. If B ever avoids war with a strong opponent, she does not fight any longer.

In other words, B builds her reputation for future opponents by fighting with the strong ones today. If she ever deviates and "negotiates with terrorists", she loses her reputation, which encourages future potential adversaries to invest in growing in power.

Sartori (2005) provides a reputational theory of diplomacy when players are uncertain about each other's type. Accordingly, to maintain their ability to use diplomacy in future disputes, state leaders often speak honestly. The reputation story in this paper is different than Sartori (2005). There is no room for diplomacy and bluffing in this model, because players know each other's type. Player B builds reputation for toughness. In contrast to Sartori's incomplete information model, B's toughness is not her intrinsic type. It is an equilibrium property that can be sustained endogenously only if B fights whenever she has to according to her equilibrium strategy.

The mechanism of fighting to build reputation to avert future conflicts can be seen in the unfolding of the events in the wake of 9/11. Following September 11, 2001, President Bush issued an ultimatum by demanding that Taliban turn over Osama bin Laden and shut down the terrorist camp operating in Afghanistan. The Bush administration refused to negotiate with Taliban despite Taliban leader Mullah Mohammed Omar's statement that "if the American government has some problems with the Islamic Emirate of Afghanistan, they should be solved through negotiations" (Mnookin, 2003). The Bush administration's strategy not to negotiate was justified, among other things, on the ground of maintaining credibility and deterring future terrorists and those who might harbor them (Mnookin, 2003). When bin Laden offered a truce on undefined terms on January 19, 2006, Vice President Dick Cheney told Fox News that "We don't negotiate with terrorists."[9]

A similar mechanism can be seen at work in Slantchev's (2003) account of the Vietnam war. Accordingly, the U.S. administration believed that quitting war and leaving Communist aggression unchecked would damage the international status the US holds and encourage similar movements elsewhere.

The Kurdish Problem in Turkey

Although no single model may suffice to explain the dynamics of a costly conflict due to the complexity of real-world settings, the mechanism of providing incentives for adversaries' unobservable actions manifests itself in the Kurdish problem in Turkey and potentially in other armed conflicts elsewhere.

The Kurdistan Workers' Party (PKK) was founded as a Kurdish separatist group in 1974 by Abdullah Öcalan, now imprisoned in Turkey. The PKK is active primarily in northern Iraq and southeastern Turkey. The organization began armed violence in 1984. The conflict resulted in more than 30,000 deaths on both sides, including killings of thousands of civilians by both the PKK and Turkish military and security forces.

The PKK's survival rests crucially on the political and financial support they receive from the population. However, the legal system, especially the infamous Anti-Terror Law, made even the discussion of the Kurdish problem a punishable act, let alone any non-violent support for the Kurdish cause.[10]

[9] *New York Times*, January 20, 2006, "U.S. Rejects Truce Offer From bin Laden."

[10] Article 8 of the Anti-Terror Law defined terrorism as "any kind of action conducted by one or several persons belonging to an organization with the aim of changing the characteristics of the Republic as specified in the Constitution, the political, legal, social, secular and economic system." This broad definition made it possible to convict, for example, someone who peacefully pressed for changes in the economic or social system of Turkey. Despite its name, many pacifists and non-violent offenders were imprisoned under Article 8. The law was enacted on April 12, 1991 by the Turkish Parliament. See Human Rights Watch, World Report 1992 for more information. The article was repealed in 2004, however the Anti-Terrorism Act continues to apply "with a view to prosecuting and convicting persons who have expressed non-violent opinions, in particular in cases where the opinions expressed relate to the situation of the Kurdish minority in Turkey or the ongoing conflict mainly in south-east Turkey", according to the European Council report by Thomas Hammarberg, Commissioner for Human Rights of the Council of Europe, July 2011, available online: https://wcd.coe.int/ViewDoc.jsp?Ref=CommDH(2011)25&Language=lanEnglish&Ver=

Therefore, aside from some political activists openly supporting the PKK and being repeatedly punished by the Turkish legal system, the public support for the PKK has not been observable for the Turkish government on an individual basis. Many unlawful acts against the Kurdish population by the Turkish military and security forces can be attributed to their effort to curtail such public support.

Thousands of Kurdish villagers with no apparent ties to the PKK have been detained, tortured and imprisoned in southeastern Turkey since 1980s. Instead of capturing and questioning people suspected of illegal activities, Turkish security forces have been repeatedly reported to kill civilians in house and village raids. The military stepped up its attacks in 1992, killing civilians, destroying their homes and even bombing villages from air. A sample of these incidents can be found in the Human Rights Watch World Reports.[11][12]

The mechanism is also evident in the recent "KCK case." Since April 14, 2009, Turkey has arrested more than 3,200 people for their alleged membership of the Union of Kurdistan Communities, known as KCK (Koma Civakên Kurdistan) and connected with the PKK. These people include 1,483 members of The Peace and Democracy Party (BDP; "Barış ve Demokrasi Partisi" in Turkish), 7 democratically elected mayors in southeastern municipalities (Çandar 2011) and many journalists.

The cost of these arrests on the population is obvious. Unreasonably long detention periods and a very slow judicial process effectively turn these arrests and imprisonments into punishment without trial. The arrests are also costly for the Turkish government, which has been losing the support of domestic liberal factions and international organizations it has been enjoying since 2002. For example, according to Thomas Hammarberg, Council of Europe's Commissioner for Human Rights, "the situation in Turkey is very bad as more than 70 journalists have been arrested and seven members of Parliament are in prison... Arresting people under the banner of KCK membership is an extrajudicial act. For this reason we have prepared a detailed report that will be presented to the European Council."[13]

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[11] See their web page http://www.hrw.org/ for more information.

[12] The PKK has also tried similar tactics by killing civilians and suspending their bodies from telephone poles with notes indicating that they had been killed because they were informers (World Report 1993, Human Rights Watch). This clearly indicates that the PKK wanted to scare off future potential informants.

[13] For Hammarberg's statement, see http://www.rudaw.net/english/news/turkey/4215.html.

The KCK is a social contract structured by the PKK in 2005.[14] It proposes a new system of Kurdistan Democratic Confederation. It argues that the confederation is not a separate Kurdish state but a new democratic system within the unitary states of Turkey, Iran, Iraq and Syria. It proposes new institutions for social and economic structures, including a new judicial system, a new economic system that rejects capitalism and a new militia organization for the purpose of self defense. The new institutions are intended to replace the institutions of the unitary state in parts where Kurds reside. The contract proposes three laws: The EU law, the law of the unitary state and the law of the confederation. However, it states that Kurds will recognize the law of the unitary state as long as the state recognizes the confederal law, and that the confederation has the right to guerilla warfare for self defense if the unitary state imposes its law without recognizing the confederal law.

Even partial nonviolent implementation of the contract has the potential to undermine state institutions and improve the influence of the PKK in the region. The contract would be successful as long as it was supported by the Kurdish population. Allegedly, the PKK encourages the Kurdish population to avoid the Turkish judicial system and solve their conflicts in the new judicial system that it tries to establish; it also tries to keep the elected officials under its influence through KCK's city, town and village organizations.

Although it is in the interest of the Turkish state to undermine public support for the contract, such support is not observable for the government on an individual basis. The theory predicts that costly punishment inhibits the Kurdish population from supporting the initiative. Therefore, the arrest of more than 3,000 people, including many politicians with visibility but with no direct link to any violent activity can be seen as Turkish government's strategy to curtail non-violent public support for the initiative.[15] Turkish

For his report to the European Council, see https://wcd.coe.int/ViewDoc.jsp?Ref=CommDH(2011)25&Language=lanEnglish&Ver=original&BackColorInternet=DB-DCF2&BackColorIntranet=FDC864&BackColorLogged=FDC864

[14] The full text of the contract in Turkish is available online at: http://tr.wikisource.org/wiki/KCK_S%C3%B6zle%C5%9Fmesi

[15] In order to ward off criticisms, government officials argue that eliminating KCK would provide more room for peaceful political movements. However the legal system continues to arrest members of The Peace and Democracy Party, causing more uproar by liberal factions. For example, see Cengiz Çandar, "Çıkmaz sokağa mayın döşemek", *Radikal*, January 14, 2012, http://www.radikal.com.tr/Radikal.aspx?aType=RadikalYazar&ArticleID=1075557&Yazar=CENGIZ-CANDAR&CategoryID=98

columnist Bayramoğlu notes "the Kurdish political movement confronts [the state] not only through its demands but also as a political center and even as a power house that develops economic policies. The government is reacting to and intervening with this situation" (Bayramoğlu, Yeni Şafak, October 7, 2011).[16]

The workings of the incentive mechanism in Turkish government's strategy finds its clearest interpretation in Abdullah Demirbaş's letters. Demirbaş is one of the political figures arrested in April 2009. He is the democratically elected mayor of the municipality of Sur in the city of Diyarbakir, and a member of the Peace and Democracy Party. In an open letter from prison on December 30, 2009, he writes that "those party members have never used a gun or never connected with violent acts. All we have been trying to do is to solve the Kurdish problem in a democratic way."[17] In a letter dated January 6, 2010, he asks: "What will the youth think when they see us in handcuffs? We the politicians, whose addresses are known to everybody, do we deserve to be removed from our homes in handcuffs? Or is somebody trying to say "don't look for a political solution" to those who are planning to seek a political solution?" (İnsel, Radikal İki, April 18, 2010).[18]

5 Conclusion

The canonical rationalist explanations of war are built on incomplete information and commitment problems (Fearon 1995, Powell 2006, Jackson and Morelli 2009). A fundamental feature of crisis bargaining is that some of its parameters may be determined endogenously by negotiating parties' observable and unobservable actions. Even when parties mutually agree on which action to take, the unobservable nature of actions makes it impossible for parties to commit to certain actions. This defines a new role for war among two rational states.

When players' unobservable actions determine the military power distribution among players, possibility of war may ensure the provision of appro-

[16] Translated by the author from Turkish. See the full article in Turkish at http://yenisafak.com.tr/Yazarlar/?t=07.10.2011&y=AliBayramoglu

[17] Corrected for English grammar by the author. See the original letter here: http://www.kurdishinstitute.be/english/1394.html

[18] Translated by the author from Turkish. See the full article in Turkish at http://www.radikal.com.tr/Radikal.aspx?aType=RadikalEklerDetayV3&ArticleID=992235&Date=09.01.2012&CategoryID=42

priate incentives in equilibrium. The incentive mechanism works as follows. When the likelihood of a power shift is determined by her adversary's unobservable actions, then a player can keep her adversary's future unobservable actions in check by fighting with him today if there is a power shift in favor of the adversary. Here, the possibility of war in case of a power shift creates an ex-ante trade-off for the adversary: Taking a potentially power shifting action increases the adversary's expected payoff from fighting. But it also decreases the likelihood of a peaceful bargaining process, which may provide him with a more favorable deal. If the adversary's trade-off tilts towards peace, the player may use war as a stick to prevent adversary's unobservable actions that may distort power distribution. War may break out in the absence of informational problems between parties and even after a power shift and despite the fact that there always exists a peaceful equilibrium. Parties do not renegotiate inefficiencies when war breaks out because one of the parties prefers the outcome of the inefficient equilibrium, which can be achieved only if she commits to not renegotiating inefficiencies.

This new rationalist account of war is quite different than the ones identified so far in the literature. In particular, players are informed about each other's type and inefficiency is not a consequence of Powell (2006)'s general condition of rapid power shifts in the future. Instead, inefficient fighting today is utilized to sort adversary's incentives over his future unobservable actions.

The theory also provides a reputational explanation for the "We don't negotiate with terrorists" strategy.

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A Proof of Theorem 3

Let $U_i(p_t)$ be player i's continuation payoff from the prescribed strategy profile after the public realization of p_t. Then $U_i(p_t)$ can be computed recursively as follows: If $p_t = p_H$, given B's strategy to fight when $p_t = p_H$, A collects his war payoff $p_H - c_A$ this period. Given his own strategy of choosing $a = 0$ the following period, his continuation payoff from the next period on is $U_A(p_H)$ with probability α_0 and $U_A(p_L)$ with probability $(1 - \alpha_0)$. Then $U_A(p_H)$ can be recursively calculated

$$U_A(p_H) = p_H - c_A + \delta \left[\alpha_0 U_A(p_H) + (1 - \alpha_0) U_A(p_L)\right] \tag{2}$$

Similarly,

$$U_A(p_L) = b_A^L + \delta \left[\alpha_0 U_A(p_H) + (1 - \alpha_0) U_A(p_L)\right] \tag{3}$$

Then

$$U_A(p_L) - U_A(p_H) = b_A^L - (p_H - c_A) \tag{4}$$

First, given B's strategy, A's payoff from choosing action a is

$$\alpha_a U_A(p_H) + (1 - \alpha_a) U_A(p_L)$$

For $a = 0$ to be optimal, it must be that

$$\begin{aligned} &\alpha_0 U_A(p_H) + (1 - \alpha_0) U_A(p_L) \geq \alpha_1 U_A(p_H) + (1 - \alpha_1) U_A(p_L) \Leftrightarrow \\ &(\alpha_1 - \alpha_0)\left(U_A(p_L) - U_A(p_H)\right) \geq 0 \end{aligned}$$

Since $\alpha_1 > \alpha_0$, the last inequality is equivalent to

$$\begin{gathered} U_A(p_L) \geq U_A(p_H) \Leftrightarrow \\ b_A^L \geq p_H - c_A \end{gathered}$$

which holds by Assumption B.

Replacing (4) in (2) and (3), we can also calculate

$$\begin{aligned} U_A(p_H) &= \frac{1}{1-\delta}\left[\delta(1-\alpha_0) b_A^L + (1 - \delta(1 - \alpha_0))(p_H - c_A)\right] \\ U_A(p_L) &= \frac{1}{1-\delta}\left[(1 - \delta\alpha_0) b_A^L + \delta\alpha_0 (p_H - c_A)\right] \end{aligned}$$

Similarly, B's payoffs can be computed recursively by

$$\begin{aligned}U_B(p_H) &= 1 - p_H - c_B + \delta\left[\alpha_0 U_B(p_H) + (1-\alpha_0)U_B(p_L)\right] \text{ and} \\ U_B(p_L) &= 1 - b_A^L + \delta\left[\alpha_0 U_B(p_H) + (1-\alpha_0)U_B(p_L)\right]\end{aligned}$$

which give

$$U_B(p_L) - U_B(p_H) = p_H + c_B - b_A^L$$

and

$$\begin{aligned}U_B(p_H) &= \frac{1}{1-\delta}\left[1 - \delta(1-\alpha_0)b_A^L - (1-\delta(1-\alpha_0))(p_H + c_B)\right] \\ U_B(p_L) &= \frac{1}{1-\delta}\left[1 - (1-\delta\alpha_0)b_A^L - \delta\alpha_0(p_H + c_B)\right]\end{aligned}$$

Let EU_i^{eff} be player i's expected payoff at the unique efficient equilibrium before the public realization of p_t. Since A chooses $a = 1$ and they resolve every conflict peacefully at the efficient equilibrium,

$$\begin{aligned}EU_A^{eff} &= \frac{1}{1-\delta}\left[\alpha_1 b_A^H + (1-\alpha_1)b_A^L\right] \text{ and} \\ EU_B^{eff} &= \frac{1}{1-\delta}\left[\alpha_1 b_B^H + (1-\alpha_1)b_B^L\right].\end{aligned}$$

If $p_t = p_H$ and if B deviates by not fighting with A, then the maximum payoff she can secure is

$$\hat{U}_B = 1 - p_H + c_A + \delta EU_B^{eff}$$

where $1 - p_H + c_A$ is the maximum payoff that B can get in period t and the game switches to the efficient period so that EU_B^{eff} is her continuation payoff from next period on. Then it is optimal for B to fight if

$$U_B(p_H) \geq \hat{U}_B$$

equivalently $\pi \geq \pi^{crit}$. This proves the first part of the theorem. The remaining part of the theorem is easily verified by checking

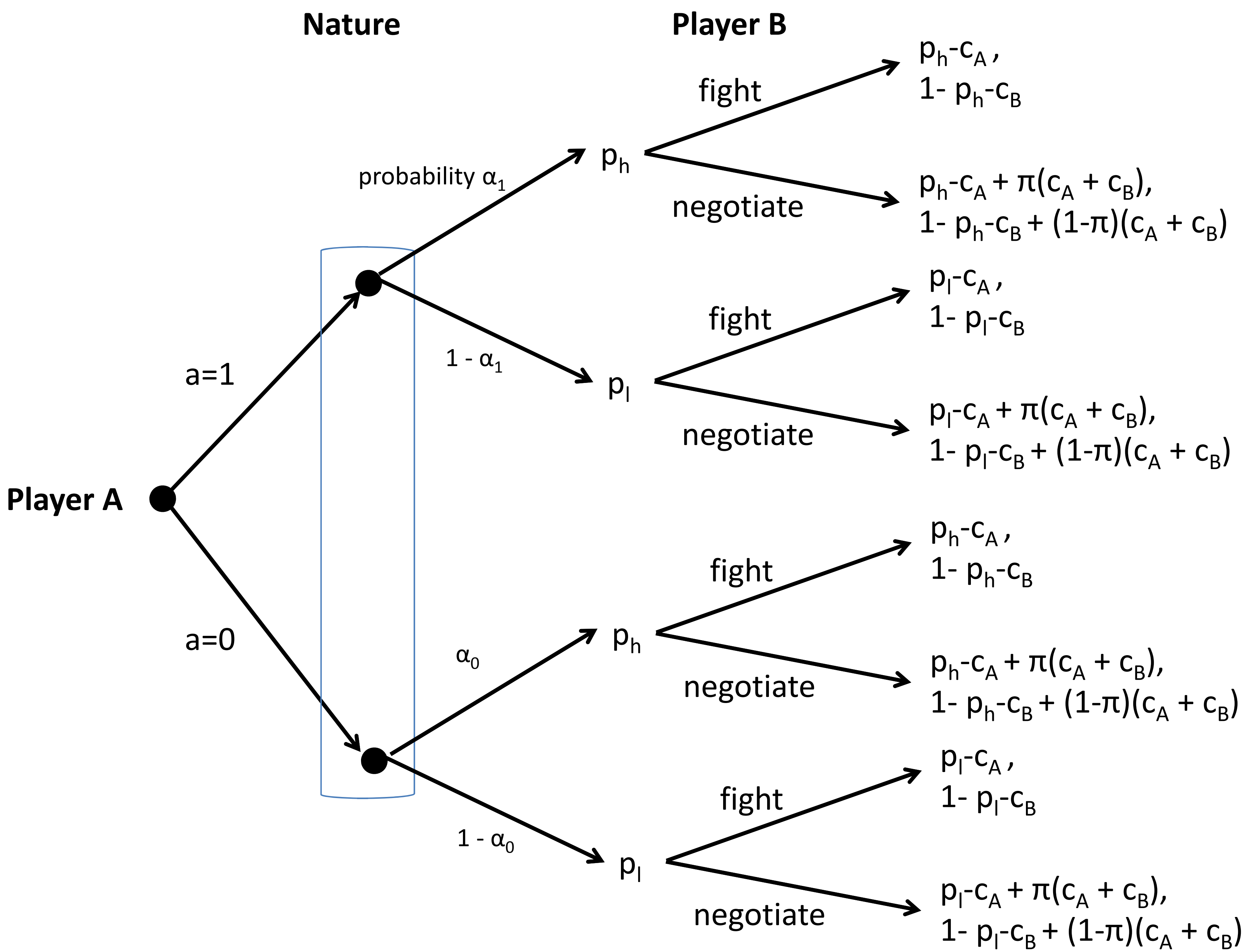
$$\alpha_0 U_B(p_H) + (1-\alpha_0)U_B(p_L) \geq EU_B^{eff}$$

is equivalent to

$$(\alpha_1 - \alpha_0)(p_H - p_L) + \alpha_0\pi(c_A + c_B) + \alpha_0(p_L - c_A) \geq 0$$

which holds since all the terms on the left hand side are positive.

B's beliefs are consistent with equilibrium strategies.


Nature
Player B
Player A
a=1
a=0
probability α_1
$1 - \alpha_1$
α_0
$1 - \alpha_0$
p_h
p_l
fight
negotiate
p_h-c_A , $1- p_h-c_B$
$p_h-c_A + \pi(c_A + c_B)$, $1- p_h-c_B + (1-\pi)(c_A + c_B)$
p_l-c_A , $1- p_l-c_B$
$p_l-c_A + \pi(c_A + c_B)$, $1- p_l-c_B + (1-\pi)(c_A + c_B)$
Figure 1

Equilibria in Yared (2010)

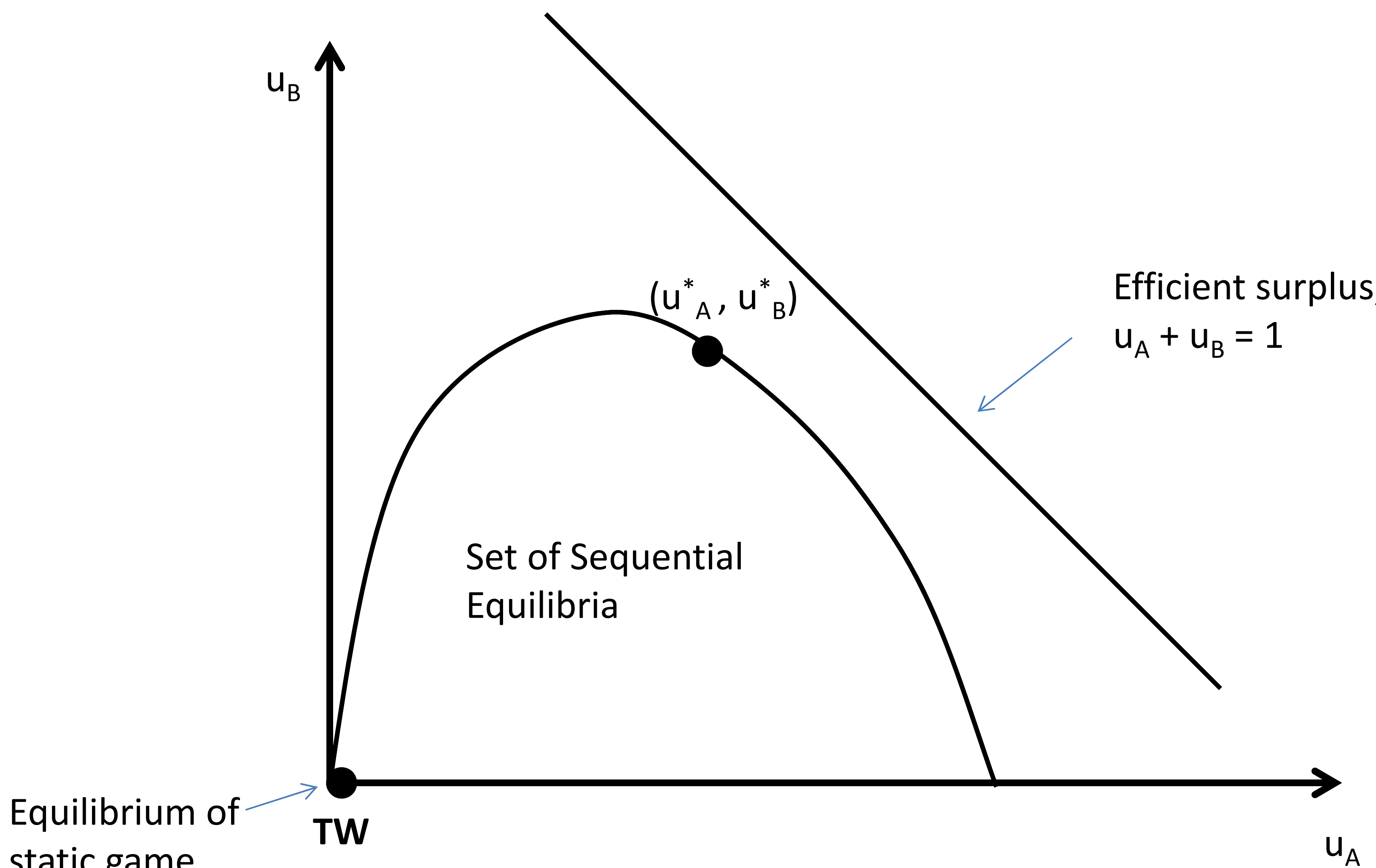


Figure 2

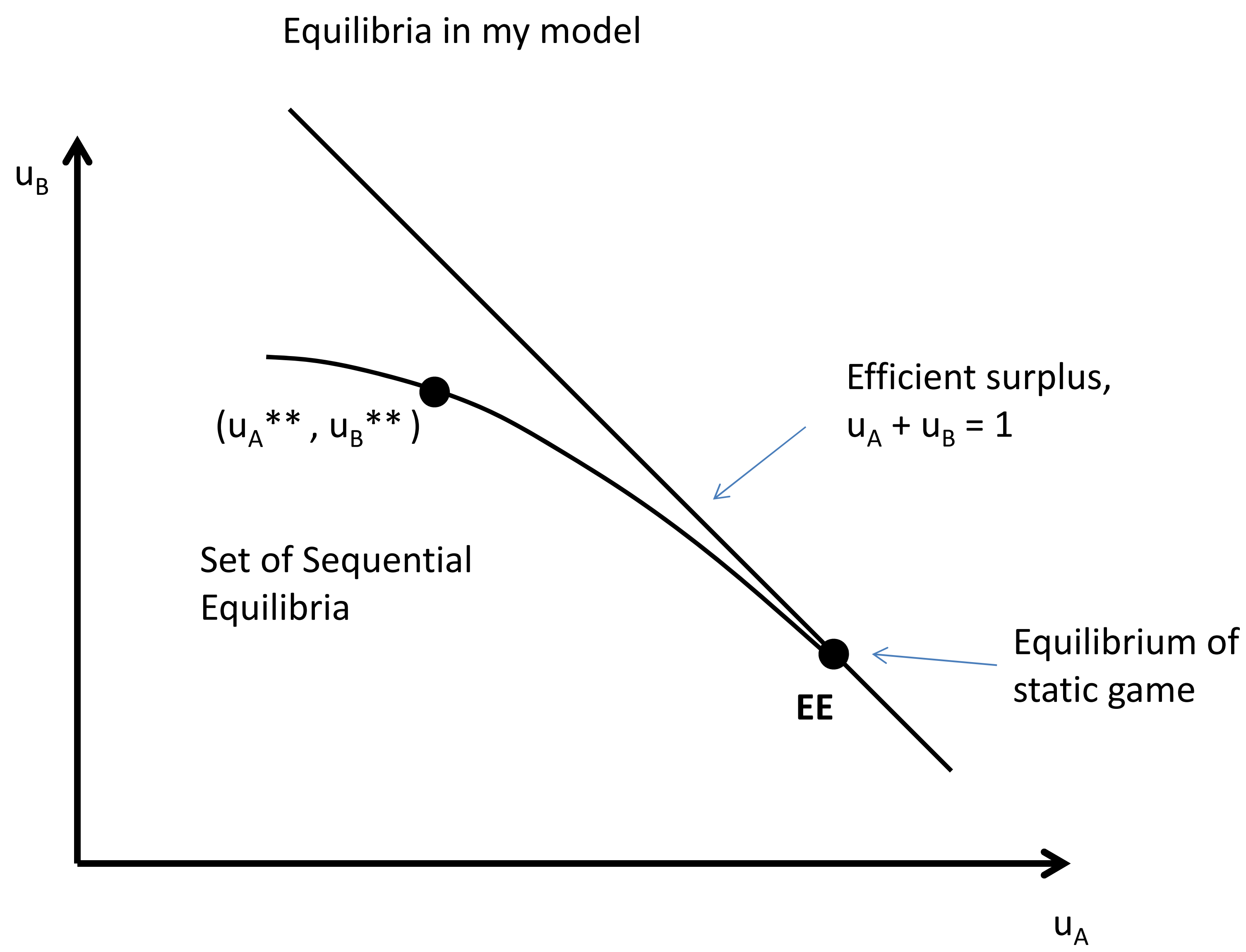

Equilibria in my model
u_B
Efficient surplus,
$u_A + u_B = 1$
(u_A^{**}, u_B^{**})
Set of Sequential
Equilibria
Equilibrium of
static game
EE
u_A

Figure 3