Reasons for Peace

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I propose a stylized reputational bargaining model of war where two combatants split a surplus while they fight. Although fighting allocates resources, it inflicts significant and unequal costs and can destroy both the surplus and the means through which offers are exchanged. Combatants may also enter war due to non-strategic motives, such as vengeance or ethnic tensions, leading to inflexible demands. The model has a unique equilibrium explaining key trends in modern warfare. From the outset, the weaker combatant concedes to avoid conflict. If not, a war-of-attrition ensues until rare, battlefield information arrives. Upon its arrival, one side concedes immediately, or a renewed war-of-attrition follows with different concession dynamics. The model further predicts a partial and inverse relation between military and bargaining power. Lastly, the model suggests that ceasefire‘-like policies increase the ex-ante probability of war and prolongs armed conflicts. These predictions are further tested using a detailed panel of wars which occurred over the last 200 years.

Despite common agreement that wars must be diminished in scale, occurrence, and duration, third-party interventions into armed conflicts became less effective post-1914. Peace negotiations became more numerous, frequent, and lasted longer, but I estimate that wars were 29 percent less likely to end post-negotiation. At the same time, on average, the amount of time spent fighting increased by 142 days and each army suffers 40-78 more casualties per day. Moreover, I find that 25 percent of wars pit combatants facing foes with ten times their expected military capacity—an observation that cannot be readily accounted by a "rationalistic" theory of war. In such context, I present a stylized bargaining model of war where, with a small probability, combatants may not be strategic. Such model yields a unique, robust, and detailed prediction accounting for many trends discussed above.

The model extends a standard, reputational bargaining setting in several ways. Combatants exchange (and commit to) potential peace agreements until communication stochastically breaks down. Such risk is a reduced-form way to model how third parties and nature limit combatants' ability to negotiate. For example, fighting may destroy the goodwill needed to keep the lines of communication open or the physical means combatants have to communicate with each other.

Before a decisive victory arrives or communication breaks down, combatants negotiate in periods of active or paused fighting. When combatants fight, they incur costs; face the risk of surplus destruction; and either side can decisively win battle. Costs are assumed to be sufficiently large so that combatants do not outright benefit from fighting without negotiating in earnest. Additionally, one combatant is

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known to be stronger than his foe. This means that he inflicts higher costs and is more likely to attain a decisive victory than his opponent. In contrast, not fighting avoids the costs and risks of fighting, but communication can still break down. Note that the timing of when combatants fight is a way to test the effect of ceasefire-like policies—a key way that third-party interventions attempt to bring an end to an active conflict.

Lastly, combatants may be obstinate (i.e., non-strategic) with a small probability. An obstinate combatant goes to war driven by non-strategic motivations (e.g., vengeance or ethnic tensions [1]) and is therefore resolute in fighting and makes large, intransigent demands. A salient example is provided by border disputes. One expects combatants to fight over the disputed territory´s resources. But combatants often state that they fight to restore their homeland's integrity. Giving up control of the disputed territory thus fractures a key pillar in a nation's national identity. This second rationale for fighting is often seen as highly improbable, but (crucially) not impossible. Therefore, when a combatant incurs large costs for a long time and remains intransigent in his demands, he gradually convinces his foe about his improbable intentions.

A benefit from assuming that combatants are imperfectly informed about their peer's type (i.e., strategic or obstinate) and not their military capacity is that one can account for conflicts between highly unequal opponents. For example, most civil wars; the US versus Vietnam, Afghanistan, or Iraq; Israel versus Hamas; the UK versus Argentina; etc.. On one hand, most models of war assume that both combatants are strategic and they go to war because they are ill-informed about either their relative, military capacity or costs of fighting. Neither side concedes, because they both expect to have a significantly large probability of winning the war without having to incur too many costs. This hypothesis is highly problematic, because 25 percent of wars (as in the examples provided above) pit a combatant against a foe having ten times their military capacity. Additionally, the weak combatant often extracts large concessions from his strong foe e.g., North Vietnam and the Taliban ended up in government in spite of the US' wishes. These examples further clarify that the weaker party is often able to impose their will without ever attaining a clear military victory. My model rationalizes the weak combatant's choice to fight as a credible way to extract rents from the stronger foe.

Alternatively, one can rationalize wars between highly unequal combatants in other ways, but (unlike my model) they crucially depend on the historical context leading to war. These alternative explanations are rich in context and excel in clarifying a particular conflict's resolution. My model results can and are empirically tested using day-level information for conflicts fought since the early 1820s. In contrast, these alternative hypotheses require amassing large amounts of granular information, which is untenable to attain in a large scale. For example, one such hypothesis posits that a strong combatant goes to war with a weaker foe, because the strong combatant is waning in power and the weak is becoming stronger[2] This hypothesis rationalizes the Austro-Prussian war of 1866 in which an established weakening Austria faced and was promptly defeated by the rising, Prussian Kingdom.

[1]Jackson and Morelli (2009).

[2]Some articles positing this hypothesis includes Schub (2017), Monteiro and Debs (2020), among others.

However, this hypothesis does not fit very similar conflicts. For instance, 20th and 21st century Afghanistan, Iraq, and Vietnam were not rising military powers when they faced the US. In turn, it is difficult to systematically establish that the US´ military power was waning when it faced these weaker opponents. Likewise, the UK´s leaders were unlikely to perceive the Zulus, Boers, Ashanti, Irish, Egyptians, or the Argentinians as rising military powers when they faced them. Consequently, this hypothesis (and many others) have trouble accounting for general trends in warfare, which limits their ability to guide foreign policy.

This framework has two additional advantages over most bargaining models of war. First, the model makes a unique prediction that is robust to possible timing or bargaining protocol misspecifications.[3] Many pre-existing war models have multiple equilibria. In addition, these equilibria make predictions that are qualitatively changed even by modest changes in the timing of play, the set of actions allowed, or the information that combatants held before fighting. Indeed, my model is robust to these specifications and allows me to concentrate in a restricted set of actions, although the model can be easily extended, which enhances its tractability. Second, the model delivers simple, precise predictions pertaining to how battlefield specific outcomes affect a war's resolution. Additionally, the model provides a theory for why combatants go into and out of a war at the same time. This matters, because the factors prompting a strategic combatant to fight is likely to influence their choice to delay exiting the conflict.

The unique equilibrium proceeds as follows. The weak combatant concedes (with a positive probability) from the outset i.e., fighting is deterred. Otherwise, a war-of-attrition ensues until the surplus is destroyed, communication breaks down, or either side attains a decisive victory. Crucially, during the war-of-attrition phase, the strong combatant makes gradual concessions faster than his weaker opponent. Additionally, one of the combatants concedes immediately when the surplus is destroyed. If not, a new war-of-attrition phase ensues in which concession dynamics are expedited.

From the outset, the weak combatant is made indifferent between conceding and fighting. Conceding avoids fighting costs but allows the strong combatant to impose their will. Fighting, on the other hand, is costly and can lead to military defeat, but it is a costly way to signal obstinance. This is why the strong combatant responds to his weak opponent by making gradual concessions at a faster rate than his opponent.

Next, I conduct a comparative statics exercise clarifying the effects of ceasefire-like policies. Decreasing the time combatants spend fighting or the difference in either dimension in military capacity (i.e., the costs and arrival rate of victory), delays the arrival rate of an agreement. It does so because the speed of concessions and the probability of an initial concession decrease. This result implies that ceasefire-like policies increase the probability that an interstate dispute leads to war and extends the duration of wars. On the other hand, decreasing the time spent fighting after the surplus falls decreases the probability of the weak combatant conceding immediately but *increases* the probability that the strong combatant conceded. Consequently, these policies have a biased effect on the way the war ends.

[3]This result follows from Abreu and Gul (2000).

It is further the case that increasing the difference in military capacity[4] lowers the initial probability of fighting. That being said, I find that (conditional on fighting) military capacity does not translate to a combatant's ability to impose his will in a war i.e., bargaining power. This is not an immediate implication of the results discussed above, because combatants can also win the war in the battlefield. Formally, I define a combatant's bargaining power as the probability that he imposes his will as the model frictions vanish in a war not resolved in the outset. These model frictions are the probability that combatants are obstinate and the probability that the surplus is destroyed or communication breaks down. I find that bargaining power is inversely proportional to the costs that a combatant imposes on their foe and no other factor plays a role. Therefore, having more military capacity avoids conflicts, but said resources may not be useful when war does break out.

The paper concludes by testing the model predictions using large-N analysis. I expand Min (2021)'s panel of wars fought since the 1820s with granular and disaggregated data on military capacity and detailed fight timing information. The results test each model prediction in turn. First, I study how the frequency in which combatants go to war and their relative military capacity at the beginning of the conflict. To do this, I use a panel on interstate disputes (i.e., not only wars) using data from Reiter et al. (2016) and combine it with data on military capacity. I find that the aggressor in a dispute is likely to have a military advantage and that this advantage is smaller in disputes that ended in war. Moreover, the difference in standard measures of military capacity declined after 1914: especially, for conflicts ending up in war. In addition, the probability that a dispute leads to war fell by 70 percent during the same period.

Using data from the war panel, I find that 35 percent of wars pitted a weak combatant against a foe who had (at least) 10 times their military capacity. This share fell to 23 percent after 1914. Such trend and the declining probability that disputes lead to war is predicted by the model, because technological progress since 1914 makes small differences in relative military capacity translate to large differences in absolute differences in capacity. For example, a 10 percent military capacity advantage for the British over the French in 1815 translates to couple thousand more troops with muskets. In contrast, a 3 percent advantage for the Germans over the French in 1914 is likely to translate to a similar number of soldiers, but these soldiers are much better equipped and can be deployed faster than before.

Next, I use the panel to test whether pauses in fighting prolong the time combatants spend fighting. A basic panel regression shows that a day that combatants spend negotiating is associated with an increase subsequent time spent fighting; meanwhile, the opposite association holds between spending a day in a negotiation and the subsequent amount of time spent fighting. I further find that a day in a negotiation coinciding with a pause in major battles is associated with an increase in the subsequent amount of time spent fighting.

By themselves, these correlates is not particularly informative since the line of causality is not empirically clear. For this reason, I propose an instrument which suggests that the direction of these

[4]Note that a combatant's military capacity is defined as the costs that they inflict on their opponent and the rate at which they attain a decisive victory in battle.

correlates is correct, but the magnitudes of the effect happen to be orders of magnitude larger than previously expected. Said instruments consider the change in a nation's resource that cannot be directly influenced by the combatants e.g., a nation's demographics and its industrial capacity.

Of course, one might argue that in large and long-lasting conflicts, combatants may end up expanding their nation's military capacity rather than simply shifting said capacity to aid the war effort. In practice, ramping up production is very time consuming and costly. This casts doubt on this possibility being relevant in most cases of note. For example, to ramp up a nation's oil production one must increase a nation's capacity to refine it; otherwise, said oil cannot be put to use. Group (2024) points out that a single refinery can take 4 to 5 years to construct and costs billions of USD. I further find no dynamic correlation between a nation preparing to enter a conflict and an increase in its industrial capacity. In fact, the World Wars were associated with a *destruction* (and not an *increase*) in said capacity.

The model further suggests that a decline in resources ought to increase the probability that combatants negotiate. In practice, one also expects that such declines in resources should also lead to an increase in the probability that combatants go to war. For example, one expects a combatant to exit a war when they face a natural disaster.Egorova and Hendrix (2016), however, finds evidence suggesting that natural disasters are associated with an *increase* in the amount of time spent fighting i.e., not only increasing the a war´s duration. Meanwhile, Kreutz (2012) further finds that (in the related case of civil wars) combatants are more willing to negotiate, but he also finds no evidence that these negotiations end up translating in a quick end to an active conflict.

The rest of the paper proceeds as follows. Section 1 literature review. Next, I present the model and its formal definitions in section 2. Section 3 then characterizes the model's unique equilibrium. Next, I present my results, which are important comparative statics. Next, section 4 presents the empirical results testing the hypotheses derived by the model. Section 5 concludes the paper, while proofs other materials are delegated to the appendix available in a separate document.

LITERATURE REVIEW

Since Schelling (1967), war has been viewed as a costly bargaining process. Since other forms of negotiation exist, this view of war raises the question as to why wars ever take place. Brito and Instriligator (1985) explains that if combatants have perfect information and can transfer resources, war can be avoided. However, with imperfect information, war may occur. Fearon (1995) suggests that wars are primarily driven by uncertainty regarding an opponent's costs of fighting and military power i.e., ability to win the war in the battlefield. Combatants overestimate their strength, believing they can win decisively without incurring significant costs. When costs of peacefully negotiating become too high, war becomes unavoidable.

This perspective has influenced many subsequent studies. However, two limitations arise: First, it is questionable that combatants are unaware of their opponents' superior military strength, as seen in the Falkland Islands' War or the Israel-Hamas conflict. It is difficult to suggest that the Argentinians and Hamas were unaware that they faced a much stronger foe. Second, existing models often assume fixed timing in negotiations. For example, in Leventoglu and Stanchev (2007) and Fearon (2013), combatants exchange offers before fighting. The nature of these offers would change depending on whether combatants first observe each other's intentions to fight or negotiate. Indeed, a conflict may first begin with a skirmish which prompts combatants to negotiate, a non-military dispute leading them to skirmish or negotiate, or as a result of a failed negotiation. Consequently, a model whose predictions depend on a given set of timing assumptions has little applicability in a general context.

A further limitation highlighted by Baliga and Sjöström (2004) is that wars stem from coordination failures: fighting occurs when both sides choose to engage, while conflict is avoided when neither does, creating multiple potential equilibria that complicate dispute resolution. The key issue with such type of model multiplicity is that it is not clear how to consistently assign a probability to each possible equilibrium. Indeed, issues of model selections have their only, rich literature, but it is preferable to avoid the matter entirely if one wishes to test model predictions.

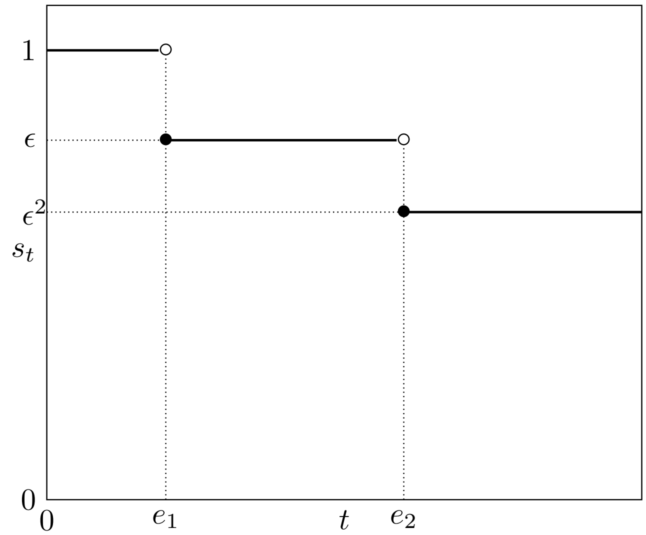
To bypass these technical issues, I propose a reputation-based bargaining model building up on Abreu and Gul (2000). In this setting, players may act obstinately with a small probability, making large, unchanging demands that strategic players are incentivized to mimic (i.e., they posture), leading to a unique equilibrium independent of bargaining protocols. In addition, combatant's incentive to posture greatly simplifies that types of actions that must be modeled. Any observable action that deviates from what an obstinate combatant reveals that a combatant is strategic. Hence, only unobservable actions could matter. Previous versions of this paper allowed for unobserved actions, but said dynamics only made the equilibrium more intricate without qualitatively changing the model predictions. Consequently, I present the simplest setting positing a unified hypothesis for why combatants go to war (even if they are known to be highly unequal); how battlefield information and events affect the war´s resolution; what factors deters wars from starting; how to set up policy interventions; and the relation between military and its ability to impose their will in a conflict.

MODEL SETUP

Surplus and the effect of Fighting Two combatants (i and j) bargain over a surplus (s_t). $s_0 = 1$ and at times $t \in (0, \infty)$, it transitions from $s_{t^-} \equiv \lim_{\tau \nearrow t} s_\tau$ to $s_t = s_{t^-}\epsilon$ for $\epsilon \in (0, 1)$. It does so at a (Poisson) rate of $\psi_t \lambda$. $\lambda > 0$ is a constant and $(\psi_t) \subset \{0, 1\}$ is an (s_t)-adopted process describing when combatants are fighting ($\psi_t = 1$) or not ($\psi_t = 0$). In particular, if the surplus falls at some time $t \geq 0$, the ψ_{t+s}, for $s \geq 0$, is a deterministic function of s until the surplus falls again. Figure 1 plots a sample path for the surplus. At time e_1, the surplus falls from 1 to ϵ, meanwhile, at time e_2, the surplus falls from ϵ to ϵ^2. This process for the surplus in dispute is useful, because it is a very tractable and simple process allowing us to characterize how a war evolves after surplus destruction.

Each $k = i, j$ can further win s_t at time t at a rate of $\psi_t \nu_i$ where $\nu_i \geq 0$ is a constant modeling i's

Figure 1. Surplus Sample Path. Times e_1 and e_2 is when part of the surplus gets destroyed.



ability to attain a decisive, military victory. [5] Moreover, the line of communication breaks down at time $t \geq 0$ at a constant rate of $\phi > 0$. From a technical perspective, allowing the lines of communication to break allows embeds a cost from fighting. It also models, for example, the risk that a lack of agreement breaks the goodwill needed for additional negotiations.

Reputational Types I now describe the reputational type and actions. Each combatant $k = i, j$ demands a surplus share $\omega_{kt} \in [0, 1]$ at each time $t \geq 0$ or concedes to his opponent´s demands provided that communication lines remain open. Note that combatants have no strategic decision to make once the lines of communication break down.

Next, each k is obstinate with a small probability $\mu \in (0, 1)$. If k is obstinate, $\omega_{kt} = 1$ at each time t i.e., they are intransigent and unwilling to make concessions. Intuitively, an obstinate combatant was motivated to fight by non-strategic reasons and (therefore) he is unwilling to end the war with any agreement in which the remaining surplus is split with his opponent.

This assumption further ensures that the equilibrium is unique. Additionally, it ensures that we can limit the number of choices that strategic combatants make. In equilibrium, strategic combatants strictly benefits from mimicking the observable behavior of the obstinate type. This implies that adding actions that will be directly observed from the opponent would only serve to obfuscate the model´s presentation. In contrast, strategic combatants may benefit not mimicking the obstinate combatants actions when said behavior is imperfectly observed. Indeed, previous versions of the model included these sort of choices. It turns out that the resulting equilibrium is more technically complicated, but it is not qualitatively different from the one presented here.

[5]One can extend the model to assume that a combatant's strength is unknown, but, unlike Fey and Ramsay (2011), I find that this sort of uncertainty only plays a minor role.

Payoffs Next, I define payoffs. The costs incurred by $k = i, j$ by time t are

$$C_{kt} \equiv -c_{-k} \int_0^t \psi_s e^{-rs} \mathrm{ds}. \tag{1}$$

where $r > 0$ is the common discount factor and $c_k > 0$ is the flow cost that k inflicts on $-k$. I assume that $c_{-k} > v_k$ for each k. This assumption implies that fighting is a costly way to allocate resources, so combatants make an agreement from the outset if the rationality of all combatants' was common knowledge. I further assume that (c_i, c_j, v_i, v_j) are common knowledge i.e., combatants are cognizant of each other´s military capacity. This is a significant departure from standard models of war, because these models *assume* that each combatant k does not know (c_{-k}, v_{-k}) before opting to fight and war results from these sort of imperfect information.

The model can be extended to account for this source of asymmetric information without much technical issue. However, combatants do end up fighting with a positive probability, k learns c_{-k} as soon as he starts fighting with his opponent, and learns v_{-k} from a lack of military victory. Therefore, this source of imperfect information may seem relevant, but I find that it is not needed for a robust model of war. In addition, I assume that $c_i > c_j$ and $v_i > v_j$ i.e., i is stronger than j. The equilibrium can be characterized without making this assumption, but it becomes difficult interpreting who is i or j.

Next, the war ends at time t in one of two ways: a combatant attains a unilateral victory or an agreement is reached. If k wins at time $t \geq 0$, then k's payoff if $e^{-rt}s_t - C_{kt}$, meanwhile, $-k$ nets a payoff of $-C_{-kt}$. In contrast, if combatants reach an agreement at time t giving k a share ω_{kt} of s_t, then k nets a payoff of $e^{-rt}s_t\omega_{kt} - C_{kt}$ and $-k$'s payoff is $e^{-rt}s_t(1 - \omega_{kt}) - C_{kt}$.

Next, if an agreement is reached at the same time that the surplus is destroyed, when one party reaches a decisive victory, or when communication is severed, the agreement takes precedent. Conversely, if both combatants concede at the same time when the surplus and line of communication remain intact, they both net surplus share of $1/2$.

Definitions

Next, I present the formal definitions. Abreu and Gul (2000) already points out that a strategic combatant's payoff from making demands differing from those made by an obstinate combatant lead to them revealing themselves to be strategic and their subsequent payoff is not larger than what he attain by conceding immediately. This implies that a strategic combatant's strategy boils down to a decision of when to stop making demands and concede. Moreover, at time $t \geq 0$, the only events that strategic combatants could have observed—without losing the ability of making a strategic decision—is the times when the surplus was destroyed.

Consequently, let h_0 be arbitrarily defined initial history; meanwhile, at each time $t > 0$, a history $h_t = \{e_1, \ldots, e_n\}$ is a finite sequence of time n times when the surplus fell i.e., $0 \leq e_1 < \ldots < e_n \leq t$. A strategy for $k = i, j$ is then a function H_k such that at each time $t \geq 0$ and history h_t, $H_{kt}(h_t)$ denotes the probability that strategic k concedes at or before time t. Next, $-k$ expects that k is obstinate at time

t with a probability of $\mu_{kt}(h_t) \in [0, 1]$. This probability is denoted as $-k$'s belief. Lastly, I study the perfect Bayesian Equilibrium and suppress history whenever doing this does not lead to confusion.

Base Result

Before characterizing the equilibrium, I provide a closed-form expression for the payoffs attained by combatant when communication breaks down. I state the lemma below.

Lemma 1 *If communication broke down by time t when the surplus already fell $n = 0, 1, \ldots$ times, then $k = i, j$'s payoff is $-B_{kn}$ where*

$$B_{kn} = \underbrace{\frac{c_{-k}}{r + \sum_{k'} \nu_{k'}}}_{\textit{Fighting Cost}} - \underbrace{\left[\frac{\nu_k}{r + (1-\epsilon)\lambda + \sum_{k'} \nu_{k'}}\right]\epsilon^n}_{\textit{Risk of losing}} > 0. \tag{2}$$

The derivation is standard. Once communication breaks down, neither combatant makes a strategic decision, so the payoff attained is just the present discounted value of the surplus that k attains when the war ends minus the flow costs from fighting. Moreover, neither the surplus dynamics or the arrival rate of victories depends on time, so the payoff is time-invariant. I then conclude the proof via guess and verify.

It is worthwhile noting what this lemma entails. For combatant k, B_{kn} describes the loss incurred from fighting without conceding. Since i is stronger than j (i.e., $(c_i, \nu_i) \gg (c_j, \nu_j)$), the j incurs a higher loss from fighting without being able to exchange offers than i. Moreover, these losses are ever larger as the number of times that the surplus is destroyed increases.

EQUILIBRIUM

This section characterizes the unique equilibrium and derives its comparative statics.

Beliefs converge to 1 at the same time I first establish that both combatants become certain that their peer is obstinate at the same time.

Lemma 2 *Fix some PBE. If strategic $k = i, j$ expects that $-k$ is obstinate with probability 1, i strictly prefers to concede immediately. Intuitively, no strategic combatant benefits from fighting against an opponent that will never make concessions.*

The proof is straightforward. Suppose, for contradiction, that $k = i, j$ is certain that $-k$ is obstinate at time t, the surplus already fell $n = 0, 1, \ldots$ times, and he weakly prefers to not concede immediately. Then at time $t + s$, for $s > 0$, he expects that the payoff from not conceding did not change from what it was at time t. Therefore, k would also opt tp fight at time $t + s$. However, k´s payoff from never conceding is the same as high payoff from not fighting due to communication breaking down i.e., $-B_{kn} < 0$. k´s payoff from conceding at time t, however, is 0. This is a contradiction since k strictly prefers conceding at time t. Moreover, this observation immediately implies the following corollary.

Corollary 3 (Beliefs converge to 1 simultaneously) *If at some time $t \geq 0$ and history h_t, there exists some $k = i, j$ such that $\mu_{kt}(h_t) = 1$, then $\mu_{-kt}(h_t) = 1$ i.e., beliefs converge to 1 at the same time.*

This technical result, combined with (s_t)'s being a continuous-time, Markov chain will allow me to succinctly characterize the discontinuous concession probabilities. Suppose that the surplus falls at some time t when beliefs have yet to converge to one. Then the probability that no additional event takes place by some time $t + s$ (where $s > 0$) is less than $1 - e^{-(\xi_i+\xi_k+\phi+\lambda)s} > 0$. Hence, a lack of concession will eventually reach a time $t + T^*$ in which beliefs converge to one at the same time. In turn, if I know the beliefs right before the surplus fell (i.e., μ_{kt^-} for each $k = i, j$) and I know T^*, then deriving any discontinuous jump in either belief can be derived from the observation that $1 = \mu_{it+T^*} = \mu_{jt+T^*}$.

The discontinuous jump in beliefs is a point mass in the probability of concession and can be retrieved by using Bayes rule. In particular, the obstinate combatant never makes a concession, but a strategic combatant might. The last point of contention is deriving an expression for T^*. It turns out that, at most, one combatant would discontinuously concede; otherwise, both have the incentive to wait for the opponent's concession rather than conceding: hence, neither ends up conceding. T^* is then determined by the earliest time that one of the beliefs converges to 1 without jumping at time t.[6]

In absence of news, a war-of-attrition ensues.

Next, I show that combatants concede gradually at time $t > 0$ if combatants are uncertain about their opponent's obstinance and the surplus remains intact. Define, for each time $t > 0$ and history h_t, the history $h_{t^-} \equiv \cap_{s<t}\{h_s \mid h_s \subset h_t\}$. I characterize concessions below.

Lemma 4 *Fix a PBE and time $t > 0$. If $h_t = h_{t^-}$, then $\dot{H}_{kt+s}(h_{t+s} \mid h_{t+s} = h_t) \geq 0$ at each $s \geq 0$ is well-defined and if* $\max_k\{\mu_{kt}(h_{t+s})\} < 1$*), then $\dot{H}_{kt+s}(h_{t+s} \mid h_{t+s} = h_t) > 0$. Heuristically, after the war begins or surplus is destroyed, the conflict proceeds as a ar-of-attrition.*

This result implies that, if no event takes place at some time $t > 0$, concession behavior is gradual. Intuitively, the probability that combatant $k = i, j$ concedes before time t must be a strictly increasing function until $-k$ is certain that k is obstinate. The argument for this observation is standard and uninteresting. In addition, this function cannot include point masses at times $t > 0$ if no event takes place. This is because if k is going to concede at time t with a strictly positive probability, then $-k$

[6] This is logic is nearly identical to the one presented in Abreu and Gul (2000) referring to the initial concession probability. Indeed, the main benefit from assuming a continuous-time Markov chain surplus process is that this logic can be extended.

strictly prefers not to concede in the time interval $[t - \Delta_t, t]$ for some small time interval Δ_t. Such realization would imply that $H_{-kt-\Delta_t}(h_t) = H_{-kt}(h_t)$ i.e., the cumulative probability of a concession would not be strictly increasing for $-k$. In the subsequent subsections, I characterize these concession rates, beliefs, and who and with what probability a combatant concedes at time 0 or when the surplus is partially destroyed.

Ceasefires

For exposition, I first illustrate the special case where combatants negotiate without fighting i.e., at each time t, $\psi_t = 0$ if communication has yet to break down. This implies that the surplus never gets destroyed and neither combatant attains a unilateral victory until communication breaks down.. For this reason, I summarize the equilibrium by an initial probability of no concession q^* and for each $k = i, j$ a belief $\mu_{kt} \in [0, 1]$ as well as the rate at which $-k$ expects that k concedes $c_{kt} \equiv (1 - \mu_{kt})\dot{H}_{kt}$.[7]

Concessions

I now derive an expressions for c_{kt} and μ_{kt}. Let k's equilibrium payoff at time $t > 0$, when $\max_k\{\mu_{kt}\} < 1$, be W_{kt}. Since the risk that communication breaks down are a pair of Poisson processes that are independent of each other and the concession behavior of strategic combatants, then W_{kt} satisfies an ODE derived from an application of the Feynman-Kac formula stating that

$$rW_{kt} = \overbrace{\phi[-B_{k0} - W_{kt}]}^{\text{Communication breaks}} + \overbrace{c_{-kt}(1 - W_{kt})}^{j \text{ concedes}} + \dot{W}_{kt} \tag{3}$$

Indifference between conceding (netting a payoff of 0) and making demands (lemma 4) implies that $W_{kt} = 0$. Moreover, when combatants are certain that their opponent is obstinate, they concede immediately. This implies that their payoff remains equal to 0 in those histories as well i.e., $\dot{W}_{kt} = 0$. Plugging these observations into equation 3 immediately yields an expression for the concessions rates described below.

Lemma 5 *Fix a PBE, time $t > 0$, and assume that combatants negotiate during a ceasefire. If $\max_k\{\mu_{kt}\} < 1$, then $c_{kt} \equiv \phi B_{-k0}$. Heuristically, the rate at which combatants make concessions depends on the rate at which communication breaks down and the costs that the opponent incurs from fighting without negotiating.*

[7]The probability of no concession is more insightful than the probability of a concession, because it represents the probability that combatants go to war.

Beliefs

Next, I derive $-k$'s beliefs. Suppose that $-k$ expects that k is obstinate with probability $\mu_{kt} \in (0,1)$ at time t. If k does not concede by time t+dt (for small dt>0), $-k$ updates his beliefs via Bayes rule as

$$\mu_{kt+\mathrm{dt}} = \frac{\mu_{kt} \times \overbrace{(1-0)}^{\text{No Concession, obstinate}}}{(1-\mu_{kt}) \times \underbrace{[1-(H_{kt+\mathrm{dt}} - H_{kt})]}_{\text{No concession, strategic}} + \mu_{kt} \times (1-0)}. \tag{4}$$

Note that $-k$ expects strategic k to concede during the interval $[t, t+\mathrm{dt}]$ with a probability of $(1-\mu_{kt})(H_{kt+\mathrm{dt}} - H_{kt}) = c_{kt}\mathrm{dt} + o(\mathrm{dt})$. This implies that the change in beliefs (i.e., $\dot{\mu}_{kt}\mathrm{dt} = \mu_{kt+\mathrm{dt}} - \mu_{kt}$) can be linearly approximated as

$$\dot{\mu}_{kt}\mathrm{dt} = \mu_{kt} - \mu_{kt}[1 - c_{kt}\mathrm{dt}] + o(\mathrm{dt}) = \mu_{kt}c_{kt}\mathrm{dt} + o(\mathrm{dt}). \tag{5}$$

Dividing both sides of this expression by dt and taking the limit as dt goes to 0, it holds that

$$\frac{\dot{\mu}_{kt}}{\mu_{kt}} = c_{kt} = \phi B_{-k0} \tag{6}$$

This ODE is standard and its solution is $\mu_{kt} = \min\{1, \mu_{k0^+}e^{\phi B_{-k0}t}\}$ where for each $k = i, j$, μ_{k0^+} is unknown.

Deriving the initial concession I now find the values $\{\mu_{k0^+}\}_{k=i,j}$ and the time T when beliefs first converge to one. First, at most, one combatant concedes at time 0 with a positive probability. For contradiction, suppose that both concede at time 0 with a strictly positive probability. If $k = i, j$ concedes at $t = 0$, he nets a payoff of 0. Otherwise, k nets a payoff of 1 with a strictly positive probability. Thus, neither combatant gains from making a time 0 concession, which is contradiction.

Second, lemma 2 implies that there exists an earliest time $T > 0$ where $\mu_{iT} = \mu_{jT} = 1$. If k does not concede at time 0, then $\mu_{k0^*} = \mu$ and at time $T_k > 0$, $e^{\phi B_{-k0}T_k}\mu = 1$ or (equivalently) $T_k = (-\ln\mu)/\phi B_{-k0}$. If $T = T_k > T_{-k}$, then μ_{-kt} converges to 1 strictly earlier than μ_{kt} which contradicts lemma 2. As a consequence,

$$T^* = \frac{-\ln\mu}{\phi} \times \min\{1/B_{i0}, 1/B_{j0}\}) = \frac{-\ln\mu}{\phi B_{j0}} \tag{7}$$

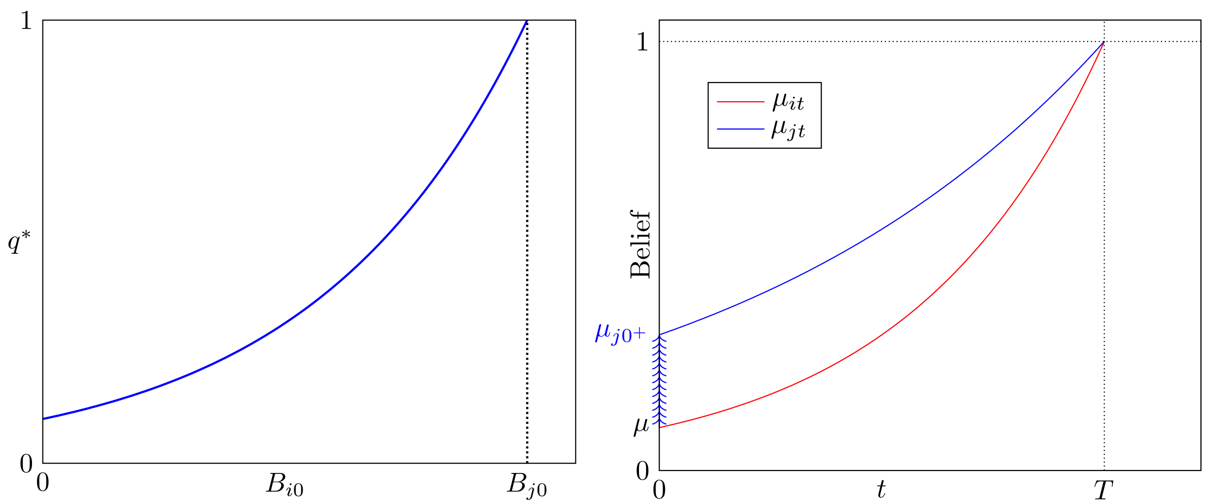
or that the weaker combatant concedes at time 0 i.e., $\mu_{i0^+} = \mu$. Moreover, μ_{j0^+} ensures that both beliefs converge to one by time T^*, so $1 = \mu_{j0^+}e^{\phi B_{i0}T}$ or that $\mu_{j0^+} = \mu^{\frac{B_{i0}}{B_{j0}}} (> \mu)$.

Next, I find the probability that j does not concede at time 0—unconditional on j being strategic. Call this probability q^*. By Bayes rule, $\mu/q^* = \mu_{j0^+} = \mu^{\frac{B_{i0}}{B_{j0}}}$ and if one re-organizes, it holds that $q^* = \mu^{1-\frac{B_{i0}}{B_{j0}}}$. Lastly, note that the concession rates and beliefs are the same in every equilibrium, so the equilibrium is unique. I characterize the result below.

Lemma 6 (Ambiguous Benefit of Deterrence) *Suppose that the negotiation coincides with a cease-fire. Then j concedes to i at time 0 with a probability of $1 - q^*$ where $q^* = \mu^{1-\frac{B_{i0}}{B_{j0}}}$. Otherwise, each $k = i, j$ concedes gradually at a constant rate of ϕB_{-k0} until (at most) time $T = \frac{-\ln \mu}{\phi B_{jk}}$. Intuitively, either the weak acquiesces to his stronger foe or war proceeds as a war of attrition.*

Figure 2 plots the initial concession probability as B_{i0} varies. Note that as $B_{i0} \to B_{j0}$, the probability of an initial concession goes to 0. Intuitively, since B_{k0} is the expected costs that k incurs if he gets stuck fighting a costly war without the opportunity to diplomatically exit, then (in effect) it models k's ability to posture. As a consequence, the probability of an initial concession depends on the combatant's relative ability to posture.

Figure 2. Belief dynamics and the probability of an initial concession as a function of $B_{i0} \in [0, B_{j0}]$



(a) Initial concession probability **(b) Belief dyanmics**

General Case

I now re-do the exercise above but for the general case. Fix some $t > 0$ and history h_t where $h_t = h_{t^-}$, $\max_k\{\mu_{kt}(h_t)\} < 1$, and the surplus already fell $n = 0, 1, \ldots$ times i.e., $\#h_t = 1$.

Concession behavior

Let $k = i, j$'s equilibrium payoff from making demands be W_{knt}, his concession rate is c_{knt}, and beliefs be μ_{knt} .[8] Since $-k$'s concession behavior is independent of the exponentially distributed event arrivals, then W_{knt} satisfies the following Feynman-Kac formula:

[8]This notation is somewhat abusive, because (for example) the beliefs at time depend on when the surplus fell and how combatants responded to said destruction. Nonetheless, history notation makes the exposition more difficult.

$$rW_{knt} = \overbrace{\phi - B_{kn} - W_{knt}]}^{\text{Communication breakdown}} + \overbrace{c_{-knt}[\epsilon^n - W_{knt}]}^{j \text{ concedes}} - \overbrace{\psi_t c_{-k}}^{\text{Costs}}$$
$$+ \underbrace{\psi_t \lambda [W_{k(n+1)t} - W_{knt}]}_{\text{Destruction}} + \underbrace{\psi_t \nu_k [\epsilon^n - W_{knt}] + \nu_k [0 - W_{knt}]}_{\text{Battle Outcome}} + \dot{W}_{knt} \quad (8)$$

where the remaining surplus is $s_t = \epsilon^n$. A similar argument as provided above implies that $W_{knt} = \dot{W}_{knt} = 0$, so re-organizing equation 8 immediately yields a unique expression for c_{-knt} described below.

Lemma 7 *Fix some PBE, time $t > 0$, and history h_t such that $h_t = h_{t^-}$, $\max_k\{\mu_{kt}\} < 1$, and the surplus fell $\#h_t = n = 0, 1 \ldots$ times. The unconditional rate at which $-k$ expects $k = i, j$ to concede is*

$$c_{knt} = \frac{B_{-kn}}{\epsilon^n} + \psi_t \Delta_{kn} \quad (9)$$

where $\Delta_{nk} \equiv c_k/\epsilon^n - \nu_{-k}$. Intuitively, combatants concede faster when they fight as they negotiate. Additionally, the rate at which combatants make concessions increases with the number of times that the surplus was destroyed.

This result implies that fighting expedites the arrival of peace agreements. In equilibrium, however, each k's concession behavior fully accounts for the rate in which $-k$ attains a decisive victory. Moreover, since i is stronger than j (i.e., $(c_i, \nu_i) \gg (c_j, \nu_j)$), the following lemma holds.

Corollary 8 *For every PBE, time $t > 0$, and history h_t such that $h_t = h_{t^-}$, $\max_k\{\mu_{kt}\} < 1$, and the surplus fell $\#h_t = n = 0, 1 \ldots$ times, then*

$$c_{int} - c_{jnt} = \left[\frac{1}{r + \sum_{k'} \nu_{k'}}\right] \frac{c_i - c_j}{\epsilon^n} + \frac{(\nu_i - \nu_j)}{r + (1-\epsilon)\lambda + \sum_{k'} \nu_{k'}} + \psi_t \left[\frac{c_i - c_j}{\epsilon^n} + (\nu_i - \nu_j)\right]$$

Heuristically, the difference in the rate at which combatants make concessions increases when combatants actively fight. It is further the case that this difference in concession rates increases in the number of times that the surplus fell.

Equilibrium beliefs and the probability of a concession

I now derive belief dynamics (for each $k = i, j$,$\mu_{knt} = \mu_{kt}(h_t)$) and the probability of a discontinuous concessions (call it $q(h_t)$). Suppose that at time $t > 0$, $h_t = h_{t^-}$ and $\#h_t = n = 0, 1, \ldots$: surplus already fell n times but nothing happened at time t. Then beliefs only update following a lack of a concession as before until the surplus falls.[9] Bayes rule implies that if $\mu_{knt} < 1$ (for $k = i, j$), then

[9]Notice that once a concession arrives, communication breaks down, or either side wins, the game ends, so deriving beliefs in such cases is moot.

$$\forall k = i, j, \quad \frac{\dot{\mu}_{knt}}{\mu_{knt}} = c_{knt} = \frac{B_{-kn}}{\epsilon^n} + \psi_t \Delta_{kn}. \tag{10}$$

Next, I solve the belief process. To do so, I need to also derive beliefs at time 0 and at times $t > 0$ when the surplus gets destroyed (i.e., $h_t > h_{t^-}$) right after neither combatant concedes immediately. Let for each $k = i, j$, $\mu_{kt}(h_{t^-}) \in (0, 1)$ be $-k$'s belief that k is obstinate and define μ_{knt+s}, for $s \geq 0$, be $-k$´s beliefs conditional on $h_t = h_{t+s}$ i.e., no additional event takes place between time t and $t + s$. Since victories, additional surplus destruction, and the probability of communication breaking down are events that are exponentially distributed, μ_{knt+s} converges to 1 with a positive probability. Since μ_{knt+s} further solve ODE 10, it admits a well-known solution:

$$\mu_{knt+s} = \min\{1, \mu_{knt^+} e^{B_{-kn}\epsilon^{-n}s + \Delta_{kn}\int_0^s \psi_{t+s}\mathrm{ds}}\}. \tag{11}$$

As before, there exists some earliest time $t + T(h_t)$ such that beliefs converge to one i.e.,

$$1 = \mu_{int^+} e^{B_{jn}\epsilon^{-n}T(h_t) + \Delta_{in}\int_0^{T(h_t)} \psi_{t+s}\mathrm{ds}} = \mu_{jnt^+} e^{\phi B_{in}\epsilon^{-n}T(h_t) + \Delta_{jn}\int_0^{T(h_t)} \psi_{t+s}\mathrm{ds}}. \tag{12}$$

Define $T_k(h_t)$ as the earliest time when μ_{knt+s} converges to 1 if it begins from its prior $\mu_{kt}(h_{t^-})$ i.e.,

$$-\ln \mu_{kt}(h_{t^-}) = B_{-kn}\epsilon^{-n}T_k(h_t) + \Delta_{kn}\int_0^{T_k(h_t)} \psi_{t+s}\mathrm{ds}. \tag{13}$$

The same argument derived in the ceasefire case clarifies that the earliest time when beliefs converge to one is $T(h_t) = \min_k T_k(h_t)$. Next, I claim that j is the one who concedes with a positive probability (i.e., $T_i(h_t) \leq T_j(h_t)$) if $\mu_{it}(h_{t^-}) \leq \mu_{jt}(h_{t^-})$.

Lemma 9 *In every PBE and time $t \geq 0$ such that $t = 0$ or $t > 0$, $h_t \neq h_{t^-}$, and $\mu_{jt}(h_{t^-}) \leq \mu_{it}(h_{t^-}) < 1$, $T(h_t) = T_i(h_t) \leq T_j(h_t)$. In particular, j (the weaker combatant) concedes at time 0 with a positive probability.*

I lastly derive the probability of no concession at time t: $q(h_t)$. Suppose that $-k = i, j$ is the one who concedes at time t, then $T(h_t) = T_k(h_t)$ and Bayes rule implies that $\mu_{-knt^+} = \mu_{-knt^-}/q(h_t)$. Taking logs in equation 12 then implies that

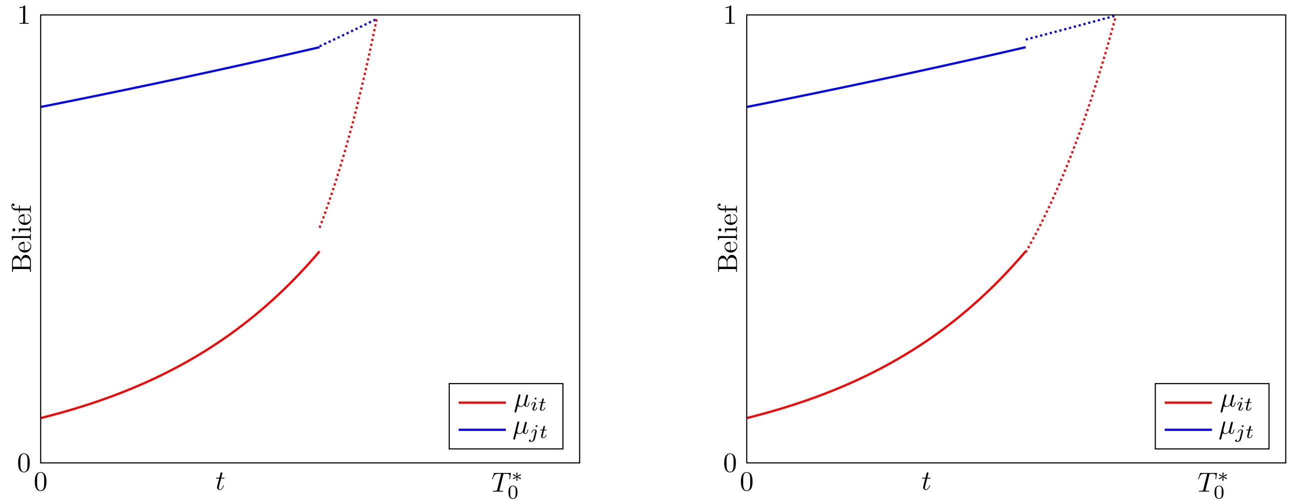
$$\ln q(h_t) = \ln \mu_{-kt^-}(h_{t^-}) + \phi B_{kn}\epsilon^{-n}T(h_t) + \Delta_{-kn}\int_0^{T(h_t)} \psi_{t+s}\mathrm{ds}$$

and replacing $\int_0^{T_k(h_t)} \psi_{t+s}\mathrm{ds}$ for the expression in 13, it holds that

$$\ln q(h_t) = \ln \mu_{-kt^-}(h_{t^-}) - \ln \mu_{kt^-}(h_{t^-})^{\frac{\Delta_{-kn}}{\Delta_{kn}}} + \left[\Delta_{kn}B_{kn} - \Delta_{-kn}B_{-kn}\right]\frac{T(h_t)}{\Delta_{kn}\epsilon^n} \tag{14}$$

Lastly, note that neither the concession behavior or beliefs depend on which equilibrium one selects, so it is unique. I summarize the equilibrium below

Figure 3. Equilibrium beliefs when the time spent fighting changes after the surplus is destroyed for the first time.



(a) Path 1 **(b) Path 2**

Lemma 10 *There exists a unique PBE characterized as follows. The weak combatant concedes at time* 0 *with a positive probability* $1 - q(h_0)$*; otherwise, a war-of-attrition ensues until communication breaks down, part of the surplus is destroyed, combatants become certain that their foe is obstinate, or either party attains a decisive victory.*

Next, if part of the surplus is destroyed at time $t > 0$ *at some history* h_t *where no combatant is certain that their opponent is obstinate, then (at most) one combatant concedes immediate with a probability* $1 - q(h_t)$ *where* $q(h_t)$ *solves equation 14. Otherwise, a new war-of-attrition ensues.*

Lastly, Figure 3 illustrates how beliefs evolve in two scenarios. Before the surplus is destroyed, both scenarios are identical. But once the surplus is destroyed, each example proceeds differently. In case 1, fighting is paused until beliefs converge to one or communication breaks down. In contrast, fighting is never paused in the second case.

The role of the time spent fighting

I now discuss the effect of changing the time when combatants fight i.e., the role of (ψ_t). In particular, if one increases the time spent fighting, how are equilibrium dynamics affected? I present the results in turn.

First, it is immediately clear that the rate at which combatants make concessions increases when they fight ($\psi_t = 1$) relative to when fighting is pause ($\psi_t = 0$). This implies that prompting combatants to fight expedites when combatants reaching an agreement. Next, I find that increasing the time spent fighting reduces a war's duration. Fix a pair of (s_t)-adapted processes (ψ_t) and $(\hat{\psi}_t)$, a time $t \geq 0$, and history h_t. Then define $(\psi_t \circ_{h_t} \hat{\psi}_t)$ at each $s \geq 0$ as $\psi_s \circ_{h_t} \hat{\psi}_s(h_s) = \hat{\psi}_s(h_s)$ if $h_t \subset h_s$; otherwise, $\psi_s \circ_{h_t} \hat{\psi}_s(h_s) = \psi_s(h_s)$. Intuitively, the time when combatants fight is (ψ_t) until some history h_t and then it switches to $(\hat{\psi}_t)$.

Suppose that $t = 0$ or $t > 0$, $h_t \neq h_{t^-}$, and $\max_k \mu_{kt}(h_{t^-}) < 1$. Let $T(h_t)$ be the earliest time when beliefs converge to one when the time when combatant's fight is given by an (s_t)-adapted process (ψ_t). Likewise, let $\hat{T}(h_t)$ be the earliest time when beliefs converge to one when the time combatants' fight is given by an alternative process (s_t)-adapted process $(\psi_t \circ_{h_t} \hat{\psi}_t)$.

I claim that $\hat{T}(h_t) \leq T(h_t)$ i.e., increasing the amount of time spent fighting reduces the time until an agreement arrives. In addition, it affects the probability of an initial concession. The statement of the result is given below.

Lemma 11 *Suppose that one shifts from (ψ_t) to $(\hat{\psi}_t \circ \psi_t)$ where $(\hat{\psi}_t) \geq (\psi_t)$ after some time $t \geq 0$ history h_t such that $t = 0$ or $t > 0$, $h_t \neq h_{t^-}$, and neither combatant is certain that their foe is obstinate. Then the probability that the weak (strong) combatant concedes immediately increases (decreases). Also, concessions arrive sooner i.e., $\hat{T}(h_t) \leq T(h_t)$.*

The proof clarifies that the opposite argument follows when $(\hat{\psi}_t) \leq (\psi_t)$. The following corollary follows.

Corollary 12 *Any policy designed to decrease the expected amount of time combatants spend fighting increases the probability that combatants go to war and is expected the prolong the resulting conflict.*

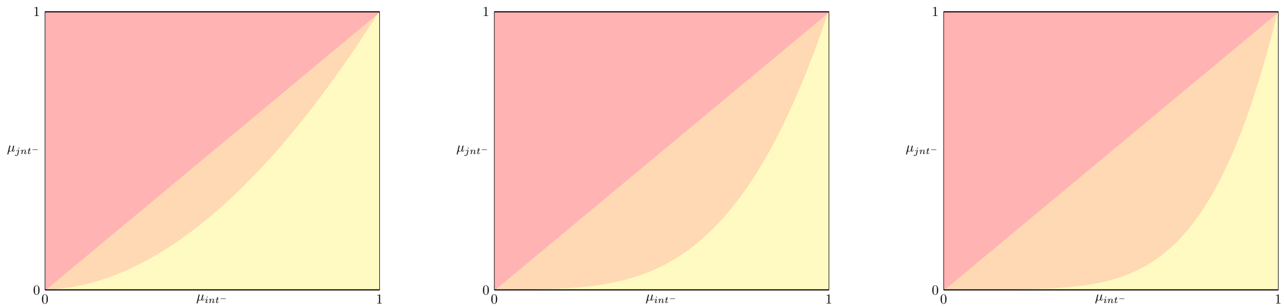
Who concedes?

An issue that has yet been clarified is which party makes a concession when the surplus falls at time $t > 0$ when part of the surplus is destroyed. I provide a sufficient condition when each combatant concedes right away. In what follows, I assume that the surplus fell at some time $t > 0$ (i.e., $h_t \neq h_{t^-}$) when neither combatant is certain that their foe is obstinate: $\max_k \mu_{kt}(h_{t^-}) < 1$ i.e., when the surplus is partially destroyed in the war. Further note that these conditions do not depend on (ψ_t). The statement is below.

Lemma 13 *i must concede at time t with a positive probability if $[B_{jn} + \Delta_{in}\epsilon^n] \ln \mu_{it^-} \leq [B_{in} + \Delta_{jn}\epsilon^n] \ln \mu_{jt^-}$. Meanwhile, j must concede with a positive probability if $\mu_{jt^-} \geq \mu_{it^-}$. Heuristically, i is only required to concede with a positive probability (regardless of (ψ_t)) when the difference in beliefs is too large. Otherwise, there exists a continuation (ψ_t) in which i does not have to concede.*

Figure 4 plots the space of beliefs (μ_{int}, μ_{jnt}) and colors three regions. The red region plots the pairs of beliefs where j must concede. On the other hand, the yellow region plots the pair of beliefs where i must concede. Lastly, the orange region plots the sets of beliefs for which the combatant of concedes depends (ψ_t). This observation further clarifies that a war's outcome is highly path dependence even in a highly stylized model with very limited, actionable information.

Figure 4. Equilibrium beliefs when the time spent fighting changes after the surplus is destroyed for the first time.



(a) $n = 0$ **(b)** $n = 1$ **(c)** $n = 2$

From military to bargaining power

The previous results clarify that the weak combatant concedes from the outset with a positive probability i.e., military strength deters weak combatants from attacking a stronger foe. But if combatants choose to fight, does military power translates to bargaining power? If one defines bargaining power as the limiting probability that a given combatant wins the surplus as the model frictions vanish, then the answer is no.

I now present the appropriate definitions below. Let $p_{\mu\rho\phi nt}$ be the $\rho > 0$ discounted probability that $k = i, j$ wins the war conditional on the war continuing to time t conditional on the surplus already been destroyed n times[10] i.e., if $\tau \geq t$ is the stochastic time when the war ends, then

$$p_{\mu\rho\phi nt} \equiv E_{nt}[e^{-\rho(\tau-t)}\chi(k \text{ wins or } -k \text{ concedes})]. \tag{15}$$

Define k's bargaining power as $p_k^* \equiv \lim_{\mu\searrow 0\lambda\searrow 0\rho\searrow 0,\phi\searrow 0} p_{\rho\phi n0^+}$ i.e., the probability the strong combatant wins the surplus in a negotiation when the war does not conclude at time 0 and the war related frictions vanish. I now state my result.

Theorem 14 *Combatant $k = i, j$'s bargaining power is*

$$p_k^* = \frac{c_{-k}}{c_k + c_{-k}}. \tag{16}$$

Intuitively, a combatant´s bargaining power only depends on the costs that they incur while fighting.

The proof is technical and uninformative, but the result matters since it implies that a combatant´s ability to win the war in the battlefield is fully internalized by bargaining behavior. Hence, in terms of bargaining power, the ability of attaining a decisive victory is inconsequential.

[10]In principle, this belief is a function of the history.

EMPIRICAL SECTION

I now examine key empirical patterns in wars and negotiations since the 1820s. Before discussing general trends pertaining to interstate disputes and wars, I outline the data sources and structure. Since 1914, the most salient pattern in wars is that combatants have increasingly comparable, military capacity and spend more time fighting.

I then analyze the dynamics surrounding peace negotiations over time. When do they occur, how long they took place, and what happened on the battlefield? While panel regressions cannot establish a causal link between negotiations and the duration of wars due to obvious issues of endogeneity, they suggest that negotiations correlate with reduced fighting time, except when coinciding with ceasefires. I then propose a plausible identification strategy and find that, in as far as the identification is sensible, the panel estimates get the effect direction correct but the effect magnitude is orders of magnitude too small.

Data Sources and panel construction

The core of the panel consists of day level data of 92 interstate conflicts held from 1823 to 2003 from Min (2020). From Min (2021), I then match battle-specific information i.e., precisely when combatants are involved in major, recorded battles.

I then compiled the dates historians state that wars started and ended from Sarkees and Wynman (2010). This step filters out fighting taking place after a war officially ends. It is key to exclude this observations since such outcomes cannot influence how the war ended or the agreement signed. Additionally, said battles have taken place in the past. For example, the battle for New Orleans between Andrew Jackson and Edward Pakeham took place on January 8^{th}, 1815 .[11] This battle was associated with the War of 1812, but it took place $after$ both signed a treaty bringing the war to an end. Note that I disregard the fact that there may be disputes among historians regarding to each potential date. This is potentially problematic, but I decide to do so to avoid imposing my judgment in discussions that I lack the proper training to satisfactorily resolve.

Next, I merge in each combatant's year level measurement of military ability made standard in Singer et al. (1972) and Singer (1987) using data from Reiter et al. (2016). The Composite Index of National Capability (CINC) as a descriptor of a nation's capacity to wage a war. The CINC of a given country A is a simple average of the share of the world's total population, urban population, military expenditure, military personnel, production of iron and steel, and energy production held or produced by country A.

This measure can be highly problematic in a rather obvious manner. If country A has an advantage over country B in 1820 of 0.01, then it may translate to several thousand soldiers with muskets. In contrast, the same difference in 1920 may translate to several thousands of soldiers with semi-automatic

[11] Maclemore (2016).

weapons, tanks, airplanes, and significantly improved access to communication and food.[12]

General War and interstate trends

I now delineate the evolution of wars since 1823. Table 1 partitions 41 conflicts taking place in the Early (1823-1913) and the 51 conflicts in the Modern (1914-2003) periods into four categories: border disputes, regime change disputes, foreign conquest, and commercial/"other". Border conflicts involve disputes over territorial control between neighboring nations. Wars initiated by nations without a shared border are labeled as wars of foreign conquest. Regime change wars aim to alter a nation's government, while commercial wars arise from conflicting economic interests. Conflicts not fitting into these categories are classified as "other."

Why and which type of wars are prevalent?

In the Early period, wars of foreign conquests accounted for 46 percent of all wars , with border disputes and regime changes accounting for an additional 51 percent. In contrast, wars of conquest become 41 percent less common in the model era while commercial/"other" conflict became 1,900 percent more common in the Modern period.

A similar trend is observed when observing the main issues prompting a war. In the Early period, nearly 60 percent of wars were incited by conflicting territorial claims and an additional 37 percent by a regime's desire to survive. But by the Modern period, both issues accounted for 43 to 45 percent of all conflicts each.

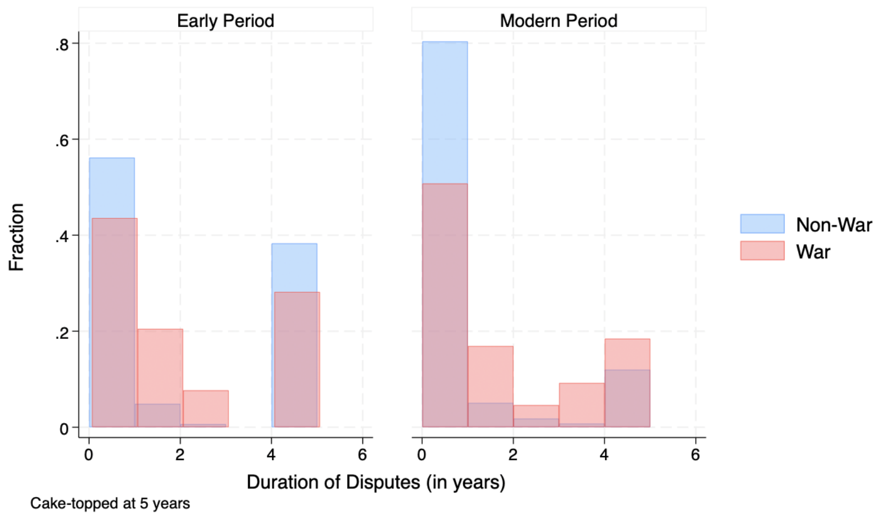
Table 1. Distribution of wars by category and the distribution of issues prompting wars.

	1823-1913	1914-2003
Type of War		
Foreign Conquest	46.3 %	27.5 %
Regime Change	24.4	33.3
Border Dispute	26.8	29.4
Commercial Dispute	2.4	7.8
Other	0.1	2
Leading issue		
Territorial	56.1 %	43.1 %
Survival	36.6	45.1
Commercial	2.4	7.8
None	4.9	4.0

Only looking at wars gives us incomplete information and it is crucial to also observe the trends in interstate disputes i.e., not *only* wars. I use data from Braithwaite (2010): 347 disputes in the Early and 1,900 disputes in the Modern period.

[12] A former critique of this empirical analysis is that the richness of the data could be used to calibrate a full structural model. I argue that such approach is not sensible with the current data and model, because there is not enough data or a clear way to collapse disparate, military technology into the model parameters.

Figure 5. Histogram of interstate dispute duration by period and level of escalation.



Overall, most disputes are driven by foreign policies disagreement—Table2. Meanwhile, territorial disputes accounted for 39 percent of disputes in the Early period and fell to 34 percent post-1914. Hence, territorial disputes are over-represented among interstate wars. Meanwhile, commercial disputes account for a small (but increasing) share of wars. Consequently, the nature of disputes and wars evolved in a slightly different manner since 1914. Figure 5 further illustrates the distribution of dispute duration by period and whether they let to war. Disputes not leading to war were bimodal in the early period, but after 1914 wars simply last longer.

Table 2. Distribution of disputes (i.e., not only wars) by category and the distribution of issues prompting the disputes.

	1823-1913	1914-2003
Type of hostilisty		
Border forticiations, violations, and territory occupation	16.6 %	22.0 %
Seize of assets/ bockades	18.1	13.5
Threats and use of force	65.3	64.5
Type of issue		
Territorial	38.5 %	33.7 %
Foreign Policy	50.3	56.6
Regime Change	6.4	6.5
Other	4.8	3.2

I now study the maximum level of conflict escalation in Table3. 11 percent of Early period disputes escalated to war and it fell by 70 percent in the Modern period. This is in line with the model prediction that an increase in the absolute difference in military capacity ought to reduce the probability of war. Nevertheless, 46 percent of Early period disputes escalated to at least some use of force and this rate *increased* by 48 percent post-1914. This implies that the likelihood that a conflict in which some force was used ends up in war decreased from 19.8 to 4.8 percent.

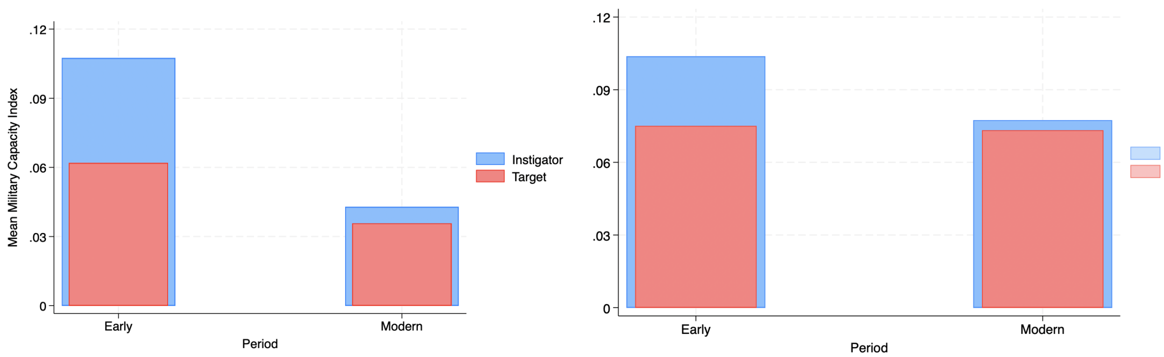
Table 3. Distribution of hostility levels for disputes over time.

	1823-1913	1914-2003
No military action	0 %	0.6 %
threat or display of force	42.9	28.1
Use of force	45.8	67.9
War	11.3	3.4

Relative strength

I now compare the instigating and target coalitions' military capacity by whether or not the interstate dispute led to war—Figure 6. Note that the comparisons used the data from Braithwaite (2010). Unsurprisingly, the instigating coalition tends to have an advantage over their targets, regardless of period or whether the conflict led to war. However, the difference in military capacity is smaller in conflicts ending up in war. The difference in military capacity further declined after 1914 and the decline was more significant for conflicts ending up in war. This observation is in line with the model prediction that as the difference in military capacity increases between combatants, the probability that the weak concedes from the outset increases: thus, war is more likely to be avoided.

Figure 6. Relative Military capacity between a interstate dispute's opposing coalitions decomposed over time. Instigator is in blue and target is in red.



(a) Non-War **(b) War**

Note, however, that the trend in highly unequal wars is ambiguous. Before 1914, the share of wars fought between highly unequal parties (i.e., one side's CINC ratio is more than ten times larger than its opponent) was 18 percent and it rose to 29 percent after 1914. Nevertheless, conditional on an interstate dispute pitting highly unequal parties the share of conflicts leading to war fell. 5.4 percent of highly unequal disputes ended up in war before 1914 and this rate fell to 3.1 percent post-1914. In contrast, disputes pitting less unequal parties ended up in war more frequently: 14.8 percent in the Early period and 3.6 percent Modern period. Note that the trend cannot be more marked in the Modern period, because wars are significantly less common.

Seeing that the difference in military capacity between the coalitions declined in both cases, it is important to clarify whether said trend is specific to disputing countries or belongs to a much larger trend. To answer said question, I plot the 10th to the 90th CINC percentile among *all* independent countries in a given year from 1850 to 2000. Appendix B's figure 1's left-hand panel plots said distribution and clarifies that the variance of the CINC index has been on a clear decline since 1918. This implies that the observed CINC declines post-1914 are likely due to a larger trend.

Meanwhile, the right-hand panel replicates the same exercise but for the absolute CINC index (ACINC). The ACINC index adds up the absolute amount of the CINC's components and takes logs. Such index is a way stylized way to compare the absolute (rather than relative) difference in military capacity. The plot shows that, in absolute terms, differences in military capacity increased. Such observation implies that one *must* analyze trends in absolute resource capacity and not focus exclusively in relative measure of capacity. The importance is made clear when thinking directly in terms of weapons. For example, if Britain had 10 percent more muskets than France in 1815 and Germany had 2 percent more machine guns than Britain in 1915, then it is highly suspect to argue that Britain's advantage was more significant than Germany's.

For this reason, I look at the precise factors associated with military capacity that became more comparable over time. In particular, I look at the log of a nation´s stock rather than the share of global resources in the given year. Such graphs are delegated to the appendix, because they consist of many figures and all but the figures pertaining to explicit military variables suggest that the absolute difference in military capacity (before the beginning of the conflict) fell after 1914. It should be noted that these trends can be rationalized by the model: as the absolute difference in military capacity increases (in absolute terms) weak combatants are less likely to opt to fight.

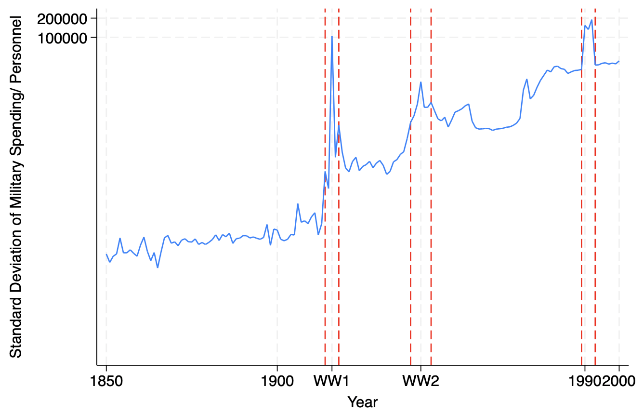
There is further evidence suggesting that this pattern is not associated with combatants who choose to have a dispute. Figure 7 plots the standard deviation in real, military spending per military personnel on a log scale. Before 1914, this measure of dispersion is roughly constant across countries, but it increases markedly after World War 1. Spending falls after both World Wars, but this dispersion proceeds with a positive trend. This suggest that differences in spending on the military rose for reasons beyond a clear and present dispute.

Lastly, Appendix B's Figure 5 plots the distribution of the log-difference between the instigator´s and the target´s resources over time. Note that the blue distribution refers to disputes not ending up in war, while the distributions in red plots disputes that *did*. The figure shows that the blue distribution (in general) looks like a mean-preserving spread of the red-distribution. This observation simply confirms the hypothesis that the combatants ending up fighting have more comparable military attributes than those opting to not do so.

The changing trends in wars

Next, I study the patters of war duration and how said time was spent—Table4. Early period wars lasted (on average) nearly 11 months. Combatants spent 6 months in major battles and a month

Figure 7. Standard Deviation of cross country military spending per military personnel.



negotiating.After 1914, wars lasted an average of 4.5 more months of fighting in which combatants spent 11 months fighting, 4 months between major battles, and 3.6 months in negotiation.

Table 4. General war trends by periods.

	1823-1913	1914-2003
Time Spent		
Overall	331.2 days	456.3 days
Fighting	185.1	327.2
Negotiating	34.1	113.3
How wars ended?		
Post-negotiation (overall)	61.0 %	43.1 %
Post-negotiation (deadlock)	51.2	31.4
After a key battle	14.6	23.5

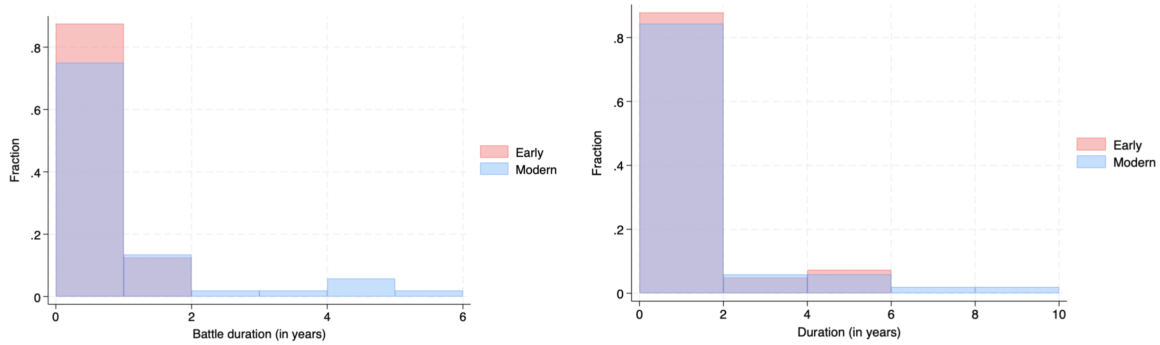
Figure 8 plots the distribution of time spent in major battles over time in the left-hand panel and overall in wars on the right-hand panel.[13]. This figure clarifies that there was a marked increase in the right tail of both distributions post-1914. It further clarifies that the wars lasting longer, on average, is not driven by a couple of particularly long-lasting wars.

Next, I note that the way wars end has changed. In the early period, 66 percent of wars ended within a week of a peace negotiation, 15 percent after a decisive battle, and 20 percent ended inconclusively. These trends changed markedly after 1914. The share of wars ending post-negotiation fell by 29 percent.

Next, Figure 9 plots the outcomes of interstate disputes by period and whether the conflict escalated to war. I still find that the pattern of disputes ending inconclusively more often after 1914 remains true. In fact, the increase in the share of conflicts ending inconclusively become more common among

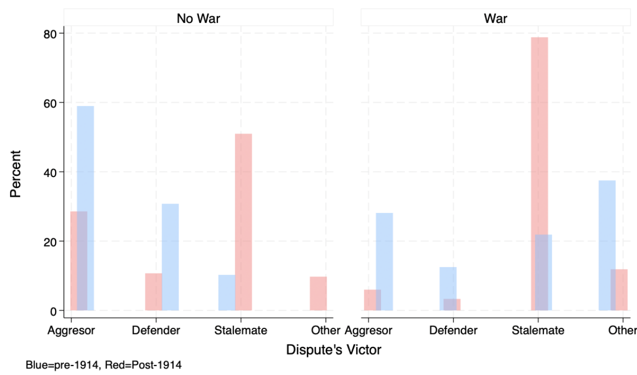
[13] I take the determination of whether a given battle was a major battle and not a small skirmish directly from the history and political science literature. See, for example, Min (2020)

Figure 8. Distribution of time spent in major battles over time.



(a) Battles **(b) Wars**

Figure 9. Histogram of interstate dispute resolutions by period and level of escalation.



conflicts not ending in war.

A significant difference between the two periods is whether a conflicts instigator gets to impose their will. In conflicts not ending in war, the instigator got its way in said conflicts nearly 30 percent of the time, while his opponent 3 times less likely to get its way. In the modern period, instigators are 50 percent less likely to impose their will. Wars are a different story. Attackers used to win nearly 60 percent of wars and twice as often as defenders during the Early period. After 1914, however, the share of wars outright won by the attacker fell by more than 67 percent and are less likely to outright win relative to their opponents.

On Peace negotiations

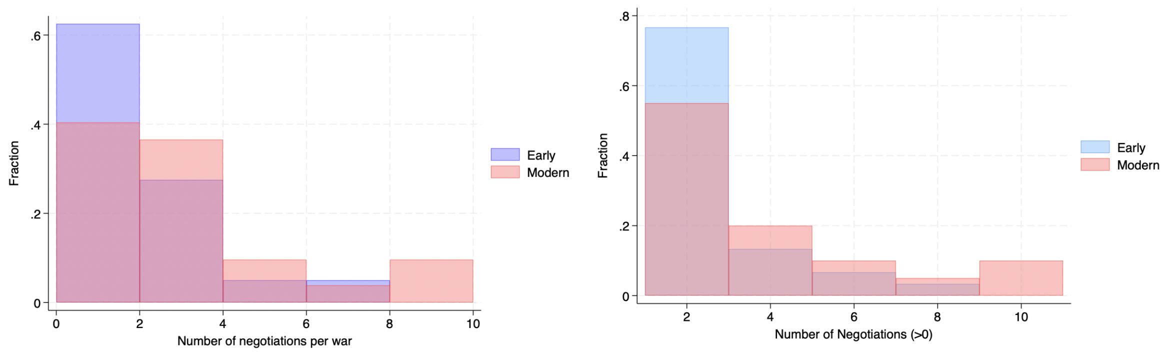
Next, I study how negotiations and their outcomes changed since 1914–Table5. Early period wars had an average of 2.4 negotiations lasting an average of 18 days and wars ended post-negotiation 49.5 percent of the time. After 1914, wars had an average of 5.1 negotiations lasting an average of 31 days, but wars ended post-negotiation 54 percent less often. This implies that the share of negotiations preceding a war's end fell from 20 to 5.6 percent.

Figure 10 further shows the distribution of times a war had a negotiation divided by period. The left-hand panel plots all wars; meanwhile, the right-hand panel excludes wars without any negotiations.

Table 5. Summary Descriptive Statistics of Negotiations during Active Conflicts.

	1823-1913	1914-2003
Number of negotiationa		
Mean	2.4	5.1
Median	2.0	2.0
Effectiveness		
Share successful (overall)	3.1 %	1.4 %
Effectiveness rate (overall)	49.5	22.9
Effectiveness rate (deadlock)	43.1	18.7

Figure 10. Distribution of number of formal, peace negotiations per war over time.



(a) All wars **(b) Wars with negotiations**

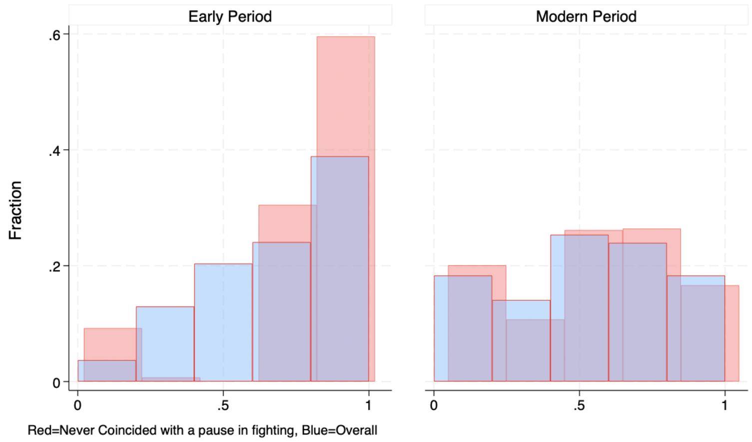
In either case, the relation is clear: the number of negotiations per war is distributed given a Pareto distribution and the modern period distribution has a fatter tail.

Next, Figure 11 takes the day number in which a negotiation ended and divided by the war's total duration—in days. Intuitively, negotiations are positively correlated with a war's end if the resulting histogram looks like a staircase increasing as one moves to the right. Each sub-figure further splits the data by period. The blue histogram illustrates that the staircase is only visible in the Early period. Modern period negotiations were held closer to the middle and beginning of the conflict. The red histogram then illustrates that each period distribution shifted to the right (i.e., closer to the war's end) when the negotiation fully took place as combatants fought,

Panel Regression Results

I now present the correlates between the time spent in a war/time spent fighting and the war correlates. I argue that, in absence of data on day level deaths in battle, these are the most salient dependent variables as the more time combatants spend fighting (usually) the more combatant deaths are reported as well as more death of innocent bystanders. Such an approach has limitations. A day spent fighting could see hundreds or many thousands of dead, so the amount of time spent fighting is but a limited

Figure 11. Distribution of the point in a war when a negotiation encounter took place.



proxy for the cost of war.

The average number of dead, however, can be estimated. Using data from Lyall (2020) on combatant-war level outcomes for battles fought from 1801 to 2011, I estimate the number of deaths per battle before and after 1914. Prior to 1913, the average number of casualties per combatant was between 76-165 deaths per day. This rate increased significantly after 1914. The average combatant lost between 117-243 casualties per day. It is important to note that once one accounts for the size of armies, these shares of soldiers killed as a proportion of the army was roughly constant throughout. Appendix B's Figure 6 plots the log of the deaths per day. In the Early period, the distribution is unimodal and nearly symmetric. This distribution shifted to the right after 1914. This suggests that the absolute number of deaths per day increased, but it was proportional to the size of armies fielded. That being said, this is not good enough to estimate the actual number of casualties since one would (ideally) want to know how many soldiers died each day due to the fighting associated in said day.

Next, Table6 presents a redacted version of the panel regression results. For exposition, the full Table is delegated to the appendix. I first find that negotiations are associated with a decrease in the time combatants paused fighting but an increase in a war's total duration. In contrast, a day in which fighting is paused is associated with an increase in the time spent fighting as well as the war's duration. A similar pattern holds for the interaction of the two variables above, but these correlates are not statistically significant.

Such results are in line with what one would expect from the model. The interaction term is associated with $\psi_t = 0$, so it is to be expected that the duration of fighting and war is increased.

Evolution of military capacity components

The previous set of regressions illustrate the association between battle-specific outcomes and the remaining time spent fighting/in a war. However, it is natural to expect that the choice to hold a negotiation as well as to pause a negotiation is correlated with the regressions' error term. This is because both sides to the conflict were likely haggling over the terms of a pause in fighting or a

Table 6. War-related correlates regressed on the subsequent number of days spent fighting.

	(1)		(2)		(3)		(4)	
	Number of days spent fighting remaining				Number of days in war remaining			
Combatants currently in a negotiation?	-8.294	***	-7.699	***	10.421	***	1.158	
Has fighting been paused?	15.068	***	11.044	***	6.210	***	6.984	***
Are combatants negotating as fighting is	3.733		1.028		12.537	***	8.082	
Full controls?	No		Yes		No		Yes	
Observations	36,849		36,849		36,849		36,849	
Number of interstate conflicts	92		92		92		92	

This is a panel regression with fixed effects
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

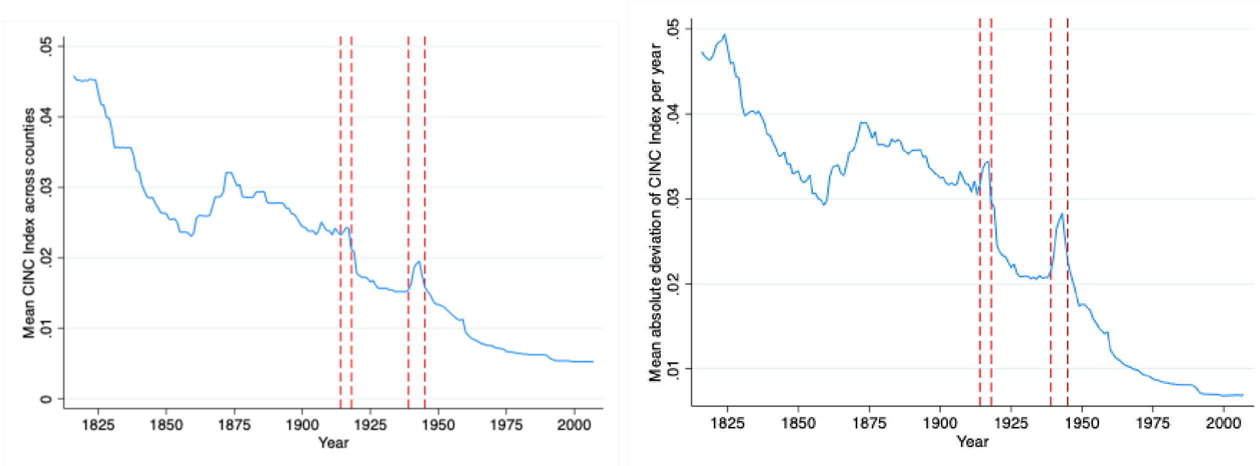
negotiation and variables capturing those talks is difficult to consistently measure for any given war. For these reasons, I construct a set of instrumental variables attempting to correct for the endogeneity that must be expected in these regressions. In particular, I instrument for a day spent holding a negotiation, a paused fighting, and when both events take place with the log-changes in the number of changes in some of a coalition's raw resources entering its military capacity. I only include factors that are not readily controlled by a government i.e., I exclude factors associated with a nation's recruitment of additional armed forced and military expenditure.

Before justifying why these random variables are valid instruments, it is important to describe how relative-military capacity as well as the dynamics of its components evolved over the last two centuries. Figure 12 illustrates the mean and mean deviation of nations' CINC index. The average nations' CINC index as well as the mean deviation of CINC index has consistently declined since 1816. There are three periods in which the decline of these two statistics were reversed: during the 1870s and during the two World Wars. These observations argue one should expect that the decline in the difference in military capacity since 1914 is to be expected from the fact that the distribution in CINC index has less variance than before.

These trends do not imply, however, that nations have fewer resources that are relevant for waging war after 1914. This fact is immediate from going over on how Singer (1987) constructed this index. He first calculates each nation's share of global urban population, total population, production of energy commodity, iron and steel production, military personnel, and military expenditure and takes a simple average of these six fractions. Consequently, the trends discussed above suggests that (in terms of shares), on average, resources are distributed less unequally over time. Appendix B's Figure 1's left-panel plots the region between the 10^{th} and 90^{th} CINC index over time and it confirms this trend above.

The right-hand panel, however, plots the log of the sum of these resource stocks. Such measure provides a rough aggregate estimate of the difference in the stock of resources. Unsurprisingly, I find that, in absolute terms, inequality in resources increased over time. The fact that inequality in the stock of combatant resources, on the whole, declined among combatants then suggests that a systematic,

Figure 12. Mean and absolute mean deviation of CINC ratios across countries over time.



(a) Mean CINC **(b) Mean Deviation of CINC**

endogenous selection into war is possible. That being said, I argue that a government has little capacity to expand the resources it has to start a war. The obvious and clear exception is its military expenditure and personnel, because governments can shift spending to a war effort and can force conscription.

Conversely, economic and demographic factors are much more difficult to directly control. On one hand, finding new natural resource deposits and setting the infrastructure needed to extract and process said resources (usually) takes considerable amount of time and resources. Such time expenditure implies that a war is likely over before a nation can exploit their newly discovered resources. On the other hand, it takes decades to produce new adults that can fill up an army's ranks; meanwhile, migrating rural population to cities requires large investments in housing, public infrastructure, and either a costly set of incentives to elicit the population to move or a diversion of armed forces towards the forced migration of said population.

Table 7. War-related correlates regressed on determinants of military capacity.

VARIABLES	(1) Log change PEC	(2) Log change IRST	(3) Log change Urb. Pop.	(4) Log change Tot. Pop.	(5) Log Change Mil. Per.	(6) Log change Mil Exp.
In a war last year	0.002	-0.004	0.003	0.002	0.041 ***	-0.018
	(0.015)	(0.015)	(0.004)	(0.002)	(0.012)	(0.017)
Lag 1	0.004	0.005	-0.291 ***	0.016 *	-0.129 ***	-0.076 ****
	(0.009)	(0.014)	(0.010)	(0.009)	(0.010)	(0.010)
Lag 2	0.015	-0.048 ***	0.046 ***	0.025 ***	-0.053 ***	-0.049 ***
	(0.009)	(0.013)	(0.011)	(0.010)	(0.010)	(0.010)
Lag 3	-0.03 ***	-0.012	0.099 ***	0.022 **	-0.046 ****	-0.039 ***
	(0.009)	(0.013)	(0.011)	(0.010)	(0.010)	(0.010)
Lag 4	-0.022 ***	-0.014	0.076 ***	0.010	-0.052 ***	-0.078 ***
	(0.008)	(0.013)	(0.013)	(0.010)	(0.009)	(0.010)
year	-0.001 ***	0.000 ***	0.000 ***	-0.000	0.000 ***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
WWI	-0.101 ***	-0.164 ***	-0.012	-0.002	0.134 ***	0.543 ***
	(0.026)	(0.035)	(0.008)	(0.003)	(0.019)	(0.031)
WWII	-0.069 ***	-0.066 ***	-0.009	-0.005 ****	0.213 ***	0.186 ***
	(0.020)	(0.024)	(0.006)	(0.002)	(0.018)	(0.024)
Crimean War	0.006	0.011	-0.011	-0.004	0.012	0.035
	(0.035)	(0.033)	(0.011)	(0.003)	(0.022)	(0.038)
Constant	1.507 ***	0.627 ***	0.305 ***	0.045 **	0.403 ****	-0.099
	(0.189)	(0.197)	(0.055)	(0.018)	(0.128)	(0.210)
Observations	11,288	5,500	10,173	12,969	11,470	9,817
R-squared	0.009	0.010	0.089	0.002	0.033	0.040
Number of ccode	203	111	169	213	190	189

This is a panel regression with fixed effects
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table7 (mostly) corroborates the hypothesis described above. The fact that a nation was at war in a given year is not associated (at an economic or statistic significant level) that any CINC component share increases in the following year. The sole and unsurprising exception in military personnel. On the other hand, the world wars were different. Nations involved in said conflict marked increased their military spending and personnel, while also saw a sharp decline in the other resources. Conversely, no similar pattern can be found when it relates to the Crimean war even though said conflict was also a large, global, and multi-year dispute. Therefore, the hypothesis seems to be confirmed by the correlates described above so long as one excludes the world wars.

IV Panel Regression Results

I now turn attention to the panel instrumental variable estimates. The instrumental variables are a coalitions' day level log-change in the iron and steel as well as commodity energy production and changes in urban and total population during non-all-out-wars. The model suggests that changes in these sub-measurements of military capacity should prompt the combatants to negotiate. But they are unlikely to be associated with the unobserved factors influencing the duration of wars or the duration of wars themselves.

Table8 presents the estimates. The estimates argue that the panel regression results estimated the direction of the effects well, but the magnitude of the effects was far too small. It also suggests that negotiations have a positive effect on the time spent fighting but not a war's duration. Lastly, the interaction between negotiations (i.e., $\psi_t = 1$) and time spent fighting reverses the effect of holding a negotiation in an economically and statistically significant fashion. These results support the idea that the model does a decent job accounting for the war duration trends discussed.

Table 8. War-related correlates regressed on the subsequent number of days spent fighting.

	(1) Number of days spent fighting remaining		(2) Number of days in war remaining	
Combatants currently in a negotiation?	-349.026	***	19.317	
Has fighting been paused?	80.998	**	-229.652	***
Are combatants negotating as fighting is	533.579	***	120.539	**
Observations	36,849		36,849	
Number of interstate conflicts	92		92	

This is an IV panel regression with fixed effects
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

CONCLUSION

This paper presented a reputational model of war yielding a unique, tractable solution that clarifies many long-standing war tends. Rather than if combatants fight because they are ill-informed about each other's relative military capacity[14], the model assumes that combatants might have been prompted to fight due to non-strategic reasons. For example, a desire for vengeance, religious or ethnic tension, a personal vendetta among opposing leaders, etc. Therefore, combatants might fight and make intransigent demands, because they are irrational or are unaware of their opponent's rationality.

Such assumption better justifies why anyone would go to war against modern-day US, 19th -century British Empire, 12th-century Mongols, or the Romans in antiquity. In these cases, it is clear which combatant is most militarily capable and that the weak side's decision should appear as a fool's errand. The model further serves to clarify why military power helped these nations avoid conflict but when war took place, they were seldom successful outside of the battlefield. Moreover, the model predicts (and the quantitative section confirms) that the conditions under which a war takes place affects its duration, effectiveness, and the ex-ante probability that fighting is prevented.

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REGRESSION TABLES

In this section, I present the full panel regression correlates that were not provided in the main text. Both regression tables are presented in full below. Note that that full regressions are not provided in the full text to ease exposition.

Table 9. Full panel regressions of the remaining overall time and time spent fighting and correlates.

	(1)	(2)	(3)	(4)
	Number of days spent fighting remaining		Number of days in war remaining	
Combatants currently in a negotiation?	-8.294 ***	-7.699 ***	10.421 ***	1.158
	(1.845)	(1.810)	(2.081)	(2.103)
Has fighting been paused?	15.068 ***	11.044 ***	6.210 ***	6.984 ***
	(1.271)	(1.208)	(1.433)	(1.404)
Are combatants negotating as fighting is paused?	3.733	1.028	12.537 ***	8.082 **
	(2.874)	(2.717)	(3.241)	(3.158)
Log duration trend	-29.963 ***	-37.065 ***	-30.680 ***	-39.238 ***
	(0.710)	(0.694)	(0.801)	(0.806)
Log year	-396271.093 ***	-370222.036 ***	-656773.886 ***	######### ***
	(925.638)	(1037.629)	(1043.769)	(1205.979)
Some combatant attains a victory		12.793 *		0.090
		(7.452)		(8.661)
Attacker attains said victory		-20.852 **		-3.988
		(9.967)		(11.584)
UN Security Council Member		16.122 ***		13.126 ***
		(1.608)		(1.869)
Either combatant has nuclear weapons		173.383 ***		148.480 ***
		(6.864)		(7.978)
Either country is a democracy		82.760 ***		79.577 ***
		(2.824)		(3.282)
Log number of allies		-26.713 ***		-2.987 **
		(1.186)		(1.379)
Ratio of military expenditure		-62.993 ***		-153.323 ***
		(12.522)		(14.554)
Ratio of military personnel		-223.510 ***		-44.418 ***
		(6.487)		(7.540)
Initiator's CINC		656.309 ***		411.933 ***
		(28.671)		(33.323)
Target's CINC		-438.755 ***		-289.920 ***
		(21.326)		(24.786)
Constant	2997421.690	2800387.674 ***	4967761.005 ***	######### ***
	(6997.362)	(7845.191)	(7890.374)	(9118.039)
Observations	36,849	36,849	36,849	36,849
R-squared	0.915	0.925	0.957	0.959
Number of conflicts	92	92	92	92

This is a panel regression with fixed effects
Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 10. Full IV panel regressions of the remaining overall time and time spent fighting and correlates.

	(1) Number of days spent fighting remaining		(2) Number of days in war remaining	
Combatants currently in a negotiation?	-349.026	***	19.317	
	(32.489)		(29.721)	
Has fighting been paused?	80.998	**	-229.652	***
	(32.648)		(29.866)	
Are combatants negotating as fighting is paused?	533.579	***	120.539	**
	(52.902)		(48.394)	
Log duration trend	-27.006	***	-37.868	***
	(1.636)		(1.496)	
Log year	-384,608.64	***	-627,722.507	***
	(2,005.85)		(1834.943)	
Some combatant attains a victory	29.106	**	-47.614	***
	(14.585)		(13.343)	
Attacker attains said victory	-1.305		-4.967	
	(17.111)		(15.653)	
UN Security Council Member	35.222	***	3.034	
	(3.607)		(3.300)	
Either combatant has nuclear weapons	145.941	***	148.121	***
	(16.235)		(14.852)	
Either country is a democracy	45.450	***	85.883	***
	(9.149)		(8.370)	
Log number of allies	-1.534		-17.732	***
	(3.290)		(3.010)	
Ratio of military expenditure	180.770	***	-284.151	***
	(39.194)		(35.855)	
Ratio of military personnel	-166.979	***	-146.390	***
	(18.731)		(17.135)	
Initiator's CINC	-80.070		1161.975	***
	(155.725)		(142.457)	
Target's CINC	127.503		-923.850	***
	(124.565)		(113.952)	
Constant	2,909,151.67	***	4,748,090.99	***
	(15,162.44)		(13,870.55)	
Observations	36,849		36,849	
Number of wars	92		92	

This is an IV panel regression with fixed effects
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1