Reassessing the Informational and Ripeness Theories of War

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Abstract

Extant scholarship on both interstate war and conflict resolution has predominantly relied on formal models and case studies to assess the impact of battlefield activity on efforts to terminate hostilities. As such, longstanding theories of war have not been tested in a systematic manner using intra-conflict measures. I address this by creating a new daily-level dataset on battlefield activity across 83 interstate wars since 1823. I harness this resource to test the implications of two major theoretical frameworks of conflict: the informational model of war, which emphasizes convergence in beliefs through patterns of unexpected battlefield activity; and Zartman's ripeness theory, which focuses on the existence of costly stalemates in fighting. Using a series of competing risk models, I find strong evidence in favor of the bargaining model of war, and less compelling support for ripeness theory. Battlefield outcomes inconsistent with prior beliefs promote the termination of war, but mutually hurting stalemates do not. These data and findings have significant implications, highlight important future research topics, and establish the foundations for a renewed research agenda on the empirical study of conflict.

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When, why, and how do belligerents choose to end wars? Despite the substantive importance of understanding motivations behind the choice to continue or stop fighting wars, international relations (IR) scholars have made relatively little progress in quantitatively exploring how hostilities on the battlefield dynamically influence this choice.

Data limitations represent the clearest obstacle to this research. Without precise intra-war data on battlefield activity, most IR literature linking fighting and bargaining has relied on case studies and formal models. These works have generated a wealth of intuitions that paint war as a rational if costly manner to resolve uncertainty about relative power and interests. Many of these theoretical underpinnings, which emphasize the role of hostilities as a source of reliable information, have not been rigorously tested across multiple conflicts.

A parallel set of conflict resolution literature has sought to understand what conditions best promote the peaceful settlement of hostilities. Influenced by policymakers and practitioners, this scholarship stresses that battlefield events and circumstances affect the choice to come to the table. In particular, Zartman's well-known ripeness theory suggests that costly stalemates should convince belligerents to look for a way out of fighting. Evidence for this mechanism predominantly comes from case studies. While this permits rich and nuanced analysis of individual wars, findings and definitions of key concepts tend not to be provided in generalized terms.

Both streams of scholarship therefore propose a close link between fighting on the battlefield and decisions to terminate hostilities. However, neither has clearly assessed whether their predictions about the nature of this connection are borne out systematically across a wide range of wars.

This paper makes such an effort. I present a new dataset that tracks battlefield outcomes at the daily level for two centuries of interstate wars. I use this to empirically analyze the relationship between fighting and belligerents' decisions to conclude wars. Harnessing a series of competing risk models, I find support for tenets of the informational theory of war and less evidence in favor of ripeness theory. Consistent disparities between prior beliefs and observed battlefield outcomes, which oblige parties to update their beliefs, expedite the conflict termination by a negotiated settlement. Meanwhile, stalemates appear not to hasten negotiated settlements and may even undermine them. These data and results attest to the importance of analyzing intra-war dynamics to fully tackle questions of war termination.

Two Different Views

Distinct sets of literature have examined how fighting shapes belligerents' interest in seeking a settlement to conflict. We focus on two predominant views here: the informational theory of war and ripeness theory.

Given the vastness of these research agendas, my discussion inevitably sands away some details and exceptions. Nevertheless, doing so clarifies similarities and dissimilarities between the two perspectives.

Informational Theory of War

In seminal work, Blainey (1988) contends that wars start when two nations disagree on their relative strengths—for example, when they have incompatible prior beliefs about p, the probability that one side will win. Mutual optimism or incongruous expectations borne of private information, nationalist fervor, or psychological dispositions can explain why states fight even when a mutually beneficial and peaceful bargain hypothetically exists (Altman 2015; Levy 1983; Morrow 1989; Ramsay 2017; Slantchev and Tarar 2011). The resolution of uncertainty and revision of beliefs about relative strength or cost tolerance is at the heart of war initiation and termination.

Decades of work have explored this information-based perspective. If hostilities begin over a disagreement about p, then the conduct of the war itself is critical to understanding how "rival expectations, initially so far apart, are so close to one another that the terms of peace can be agreed upon" (Blainey 1988, 56). Several historical analyses have traced the interaction between battlefield outcomes and changes in belligerents' war demands (Goemans 2000; Reiter 2009; Shirkey 2009; Weisiger 2013). Furthermore, numerous formal models have carried substantial weight in broadly analyzing how information is revealed and interpreted through the course of conflict (Filson and Werner 2002, 2004, 2007; Leventoğlu and Slantchev 2007; Powell 2004; Slantchev 2003a; Smith 1998a; Smith and Stam 2004; Wagner 2000).

A key mechanism driving most models is convergence of beliefs through fighting. Hostilities provide an objective and commonly observed indicator of both sides' relative capabilities, which allows belligerents to update their beliefs and potentially open a tractable bargaining range.[1] A

[1] Not all models predict this behavior. Wittman (1979) and Wolford et al. (2011) suggest that fighting may make demands diverge. Ramsay (2008) finds weak evidence of fighting serving as information.

common theme across informational theories is that belligerents are likely to become further entrenched in their prior beliefs when fighting outcomes are consistent with them. In those cases, bargaining positions remain inflexible and a negotiated settlement is unlikely. Parties are instead more likely to update their beliefs in the face of outcomes that are surprising, unexpected, and inconsistent with their priors. If some belligerent exceeds pre-war expectations, it will become more demanding while its opponent will make more generous offers that stronger parties would be willing to accept. If a belligerent falls far short of pre-war expectations, its opponent will become more demanding and force the belligerent to make more generous offers that would be accepted by stronger parties. Either way, the likelihood of a negotiated settlement increases (Reiter 2009; Shirkey 2016; Slantchev 2004; Weisiger 2016).

In a true learning process, information culled from initial hostilities should be more volatile and less reliable than information collected over the course of hostilities. Belligerents are not likely to win or lose a single battle and believe that p is 0 or 1. Yet if a pattern of unexpected outcomes persists after many battles have been fought, combatants will be forced to take the mounting set of information seriously and to revise their beliefs and offers to settle a conflict. In his discussion of surprise as a factor behind war termination, Slantchev (2004) presents the Battle of Könngrätz (July 3, 1866) during the Seven Weeks' War as an example of a shocking Prussian victory that pushed the Austrians to offer a favorable deal to its weaker opponent. However, Könngrätz was a decisive link in a chain of Prussian victories, including those in Podol (June 26), Tratenau (June 27), Skalitz (June 28), Schweinschadel (June 29), and Gitcshin (June 30). The amassing of outcomes inconsistent with prior beliefs, culminating at Könngrätz, forced Austria to negotiate on Prussia's terms.

The bargaining model of war thus predicts that *battlefield outcomes that are inconsistent with prior beliefs should increase the likelihood of settlement, particularly as the amount of past fighting increases.* Note that this involves two dimensions: dissonance between prior beliefs and actual fighting outcomes, as well as higher quantities of signals from an accumulation of fighting. Scant quantitative scholarship has assessed this direct implication.

Ripeness Theory

Scholars and practitioners of conflict resolution have conducted careful studies to analyze when and why belligerents would be most amenable to entering negotiations to peacefully terminate hostilities.

Zartman's ripeness theory represents the leading framework in this tradition and is more common to studies of civil war mediation (Zartman 1989, 2001).[2] Ripeness theory suggests two necessary but not sufficient conditions for belligerents to seek a negotiated settlement. First, the parties must feel as if they are stuck in a costly deadlock that cannot be pushed to a complete victory. This is called a mutually hurting stalemate, and it presses actors to reassess the viability of fighting through severe losses for little anticipated gain. Second, the belligerents must perceive a "way out" of their deadlock. This is the general perception that a negotiated and mutually acceptable settlement might exist. The Korean War is often presented as an example of this dynamic. It was only after lines of control stabilized at the 38th parallel that both sides realized complete victory was impossible, and thus stepped away from their original demands and agreed to negotiate in July 1951 (Holsti 1966).

The notion of a "way out" is difficult to define and remains a matter of subjective perceptions that can be shaped by outside actors (Zartman and de Soto 2010). It accordingly does not generate a set of consistent or concrete conditions for empirical assessment. However, mutually hurting stalemates, which provide a backdrop for belligerents to consider a way out, point to two objective battlefield dimensions. The first, which covers the terms "mutual" and "stalemate," is stagnation. The longer that neither side makes progress in fighting, the more likely it is that both seek a settlement. The second, which addresses "hurting," is past fighting. Stasis early in a conflict is less likely to be discouraging enough to stop fighting compared to stagnation after many battles, and thus costs, have accrued. Therefore, ripeness theory mainly predicts that *stagnant battlefield outcomes should increase the likelihood of settlement, particularly as the amount of past fighting increases.*

Ripeness theory has seldom been tested in a systematic manner. The qualitative nature of the evidence makes it difficult to clearly define key concepts, while also inviting studies that select on

[2] Findley (2012) and Walter (1997) are useful examples from the civil war context.

the outcome and create ex post rationalizations for what qualifies as a mutually hurting stalemate or way out (Kleiboer 1994; Licklider 1993). The handful of quantitative studies involving stalemates rely on entire conflicts as the units of analysis, precluding the investigation of how changing fortunes on the battlefield can dynamically affect the possibility of settlement (Findley 2012; Werner and Yuen 2005).

In sum, informational and ripeness theories predict different ideal conditions for the settlement of war. The informational perspective suggests that battlefield outcomes inconsistent with prior beliefs will cause parties to change their beliefs about p and open a bargaining range. Ripeness theory asserts that stagnant battlefield outcomes will make belligerents lose interest in continued and costly fighting. Both predictions become stronger as the amount of past fighting, which can either represent more information or more costs, accumulates.

Data

Tests of the aforementioned implications require measures of unexpected battlefield outcomes, stagnation, and accumulation of past fighting. To address these needs, I create daily-level data on battles and battlefield activity across 83 interstate conflicts between 1816 and 2003. I use the Interstate War Dataset (IWD) for my baseline list of conflicts (Reiter et al. 2016a,b). The IWD makes several important corrections on Correlates of War (COW) datasets, particularly in the addition and removal of conflicts from the primary list.[3]

The new data on battles during these conflicts allow for a unique granular analysis of intra-war dynamics that has thus far been intractable.[4]

Prior Beliefs

To gauge the extent to which observed outcomes are inconsistent with prior beliefs, we need a measure of baseline beliefs about a war's outcome. There is no foolproof way to do so. Nevertheless, if we believe that wars begin over disagreements over relative capabilities and that each side's

[3] While COW uses a 1,000-casualty threshold for inclusion, the IWD uses 500. I continue to use the 1,000-casualty standard. Four wars are removed due to lack of reliable data on battles: the 1890 Central American War (an IWD addition), the 1968-1973 Second Laotian War, the 1970-1971 Communist Coalition War, the Sino-Vietnamese Border War of 1987. See Appendix A for details.

[4] Appendix G redoes the analysis using COW data. Appendix J shows that disaggregating multilateral wars, as the IWD does, is unlikely to change these findings.

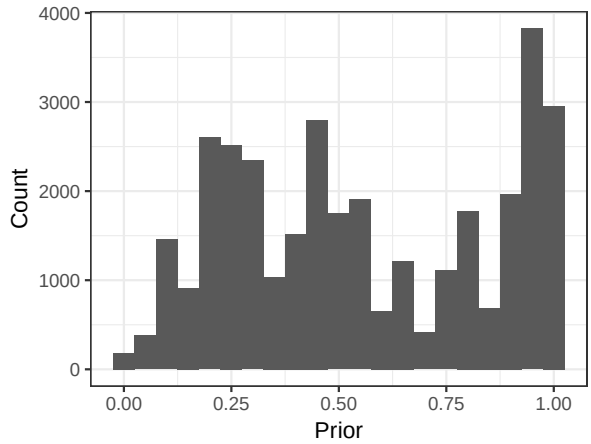


Figure 1: Distribution of *Prior* measure.

capabilities are roughly observable to both sides at the outset of conflict, then the Composite Index of National Capability (CINC) measure from the National Material Capabilities dataset presents a reasonable proxy (Singer 1987).

For a war w, I add together the CINC scores of all states on each side, accounting for the entry and exit of individual states on each day t. This produces daily measures $CINC^A_{w,t}$ and $CINC^B_{w,t}$ for the war initiator and target, respectively. I use these to create a measure of prior or baseline beliefs:

$$Prior_{w,t} = \frac{CINC^A_{w,t}}{CINC^A_{w,t} + CINC^B_{w,t}}$$

This measure is bounded between 0 and 1. Higher values indicate a more capable war initiator that is likelier to prevail in the conflict; lower values suggest a more capable target. These features make the variable a useful counterpart for the p found in most formal models of war. Figure 1 illustrates the distribution of this measure.

Importantly, I do not claim that the belligerents precisely know or share these beliefs. If both sides did, then they should reach a peaceful bargain because their priors p and $1 - p$ would sum to 1 (Fey and Ramsay 2007). I also do not contend that observable factors fully constitute prior beliefs. I only presume that ratios based on observed capabilities likely shape the range of plausible but uncertain priors, which in turn provide a reasonable reference point or anchor for observed battlefield activity. Evenly matched belligerents should both have beliefs closer to 0.5 than to more extreme values, and battlefield activity that heavily favors either side should be surprising.

Imbalanced belligerents should have prior beliefs closer to 0 or 1 than to 0.5, and fighting that is balanced or heavily favors the weaker side should be unexpected.[5]

Battlefield Activity

Equipped with a measure of prior beliefs, we require information on the observed outcomes and accumulation of fighting. Past works analyzing battlefield outcomes have utilized the U.S. Army's Concepts Analysis Agency Database of Battles, Version 1990 (CBD90) (Ramsay 2008; Reiter and Stam 1998). The CDB90 records 660 battles across 65 wars from 1600 to 1982, but suffers several flaws regarding coverage, consistency, and bias toward Western conflicts (Desch 2002).

I therefore amass a new dataset of 1,656 battles from 83 interstate wars.[6] Before discussing the measures created for the analysis, it is worth spending some time to explain the rationale, sources, and definitions I utilized to create these initial battle data.

Battles Instead of Casualties

Definitions of battles are broad. My operational definition, based on multiple entries in the literature, is a clash between organized forces of combatants over a contested strategic objective.[7] A contested strategic objective can be a hill, a fort, a city, or any other unit that the belligerents each hope to attack or defend, can exchange hands, and that affects each side's ability to continue the war (Smith and Stam 2004). No battle-based data can capture all war activity that fits that criterion. Recent work by Weisiger cites these reasons to justify the use of casualties instead of battles to measure intra-war activity (Weisiger 2016). Even so, there are several reasons why casualties are not a substitute for battles.

First, battles are an undeniably important unit of analysis, and a standard lens through which leaders interpret the trajectory of military situations (Dupuy 1987; Eggenberger 1985). Second, many battles are clearly identified across sources and raise little controversy. Differences between reference materials concern depth of coverage, and not fundamental debates about what constitutes

[5] Some may question whether pre-war measures are a relevant gauge of prior beliefs after fighting occurs and allows for updating. In Appendix E, I perform analysis where beliefs adjust in response to battles, and any movement away from this updated belief represents an unexpected outcome.

[6] Appendix A provides a comparison with the CBD90.

[7] This is largely a synthesis of definitions from Dupuy (1987); Eggenberger (1985), and Jaques (2007). Appendix B contains full definitions.

a battle.[8] Many battles also do not have reliable or accessible measures of troop strengths on each side. For example, historians' casualty estimates for the Battle of Tuyutí during the War of the Triple Alliance range from 7,000 to 16,000. Estimates for the Battle of Manila in the final months of WWII span an enormous range from 100,000 and 500,000.[9] Third, contemporary IR theories of war often focus on the exchange of "forts," or military objectives, over the course of fighting (Slantchev 2003b; Smith 1998b; Smith and Stam 2004). Battles are a much closer approximation to the concept of a "fort" than casualties, and thus allow for a more proper test of these ideas. Fourth, casualties often represent a concerted decision by leaders to gain or defend strategic objectives that they feel are vital to bargaining. States may be entirely willing and ready to suffer immense costs if they believe those potential losses to be worthwhile (Castillo 2014; Gelpi et al. 2009; Hanami 2003). Casualties are a less convincing proxy for exogenous information than the observed gains and losses of military objectives.

None of this suggests that casualty data are unimportant or not worth further research. My battle data simply provide an alternative and complementary path to understanding wartime activity.

Identifying and Coding Battles

The backbone of this dataset is based on a compendium by (Jaques 2007). I cross-reference and supplement this initial list of battles using a host of additional reference materials, including those by Clodfelter (2008), Eggenberger (1985), and Showalter (2014).

Each volume I have mentioned is comprised of narratives. Some include narratives of individual battles, while others are longer narratives of entire conflicts with discussions of battles interspersed throughout. None are formatted as quantitative or computer-ready data.

To create useful data, I only record characteristics that can be consistently determined for every battle using their qualitative descriptions. This results in two main pieces of information: the date(s) on which the battle took place, and the outcome of the battle. I address each in turn.[10]

[8] See Appendix B.
[9] See Reiter et al. (2016b) for other examples.
[10] Appendix B includes several examples coded using these criteria.

Dates Battles begin when hostilities break out and end when at least one side has succeeded or failed at its original intent—that is, when the outcome of the battle (defined below) becomes apparent (Dupuy 1987). Historians readily agree on the start dates of battles, but the use of different standards, such as the last advance versus the last day of actual fighting, can lead to debate about end dates.

Approximately 75% of battles in the dataset are less than two weeks long, and 33% last one day. These battles are well-defined and have a broadly accepted start and end dates with some minor discrepancies. I defer to Jaques's coding to resolve most inconsistencies while best ensuring the data's internal consistency. For a handful of battles without clear start or end dates, I refer to war-specific resources.

Outcome The notion of "victory" can be a highly subjective, context-dependent, and retrospective. Casualties do not necessarily reflect victory or loss.[11] Battles that are won tactically could simultaneously be considered a strategic defeat.[12]

I circumvent these complications by defining battle outcomes using a more minimal and tactical standard involving the gain, maintenance, or loss of the objective disputed in a battle. This is a result that belligerents can immediately observe during the war, as opposed to definitions that are more retrospective, strategic, or based on prior expectations that we cannot accurately assess for each battle.

Attackers win when they seize the objective. This can involve pushing out, obtaining the surrender of, or destroying the defending forces. Defenders win when they maintain the objective. At minimum, this involves repelling the enemy attack and retaining occupancy of the objective. The defending side may also be so successful that they launch a counterattack to eliminate the fleeing enemy forces. If a battle lacks information on occupation, the side that retreats is coded as the loser of the battle.

[11] In discussing decisive battles, Creasy (1851) emphasizes that "it is not the number of killed or wounded in a battle that determines its general importance" (vii).

[12] For instance, the loss at Kiev at the expense of 600,000 casualties is often considered the worst defeat Russia experienced in the entire Second World War. However, Stalin held Kiev as long as possible to delay the Germans' advance to Moscow, which turned the momentum against the Germans (Glantz and House 2015). Kiev was a tactically decisive German victory, but would prove to be a major strategic loss.

	Battle Victor		
	War Initiator	**Inconclusive**	**War Target**
Battles	782	70	804
Proportion	(0.472)	(0.042)	(0.486)
Score	+1	0	−1

Table 1: Distribution of all 1,656 battles.

Using these criteria, battles won by war initiators get a positive score of +1, and battles won by war targets get a negative score of −1. A few battles deemed inconclusive according to these criteria and are coded as 0. Table 1 shows the breakdown of these battles.[13]

Battlefield Measures

These battle scores are used to make four daily-level measures of battlefield activity that will be relevant in my analyses: observed battlefield outcomes, inconsistent battlefield outcomes, battlefield stagnation, and completed battles.

Observed outcomes I convert the raw battle data into a variable that tracks observed fighting in manner analogous to the p found in most formal models of war. For each day t in war w, $b_{w,t} \in \{0, 1, 2, ...\}$ indicates the cumulative number of completed battles. $o_{w,t} \in \mathbb{Z}$ is the sum of outcomes for any and all battles that concluded on day t in war w. If one battle ends on day t, then $o_{w,t} = -1$ if the war target won, 0 if indecisive, and +1 if the war initiator won. If two battles took place, $o_{w,t}$ could conceivably range between −2 and +2.

We then define observed fighting outcomes as:

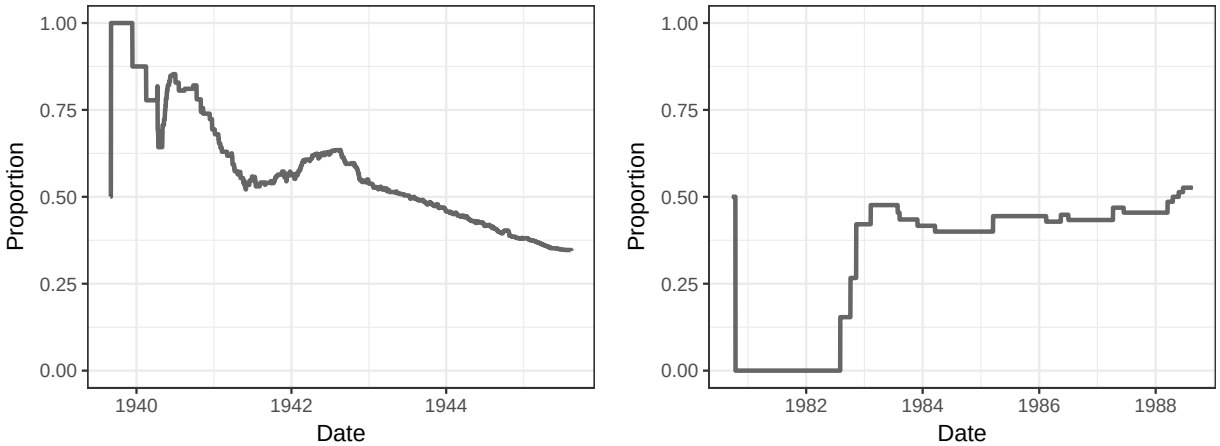
$$Observed_{w,t} = \frac{\sum_{s=1}^{s=t} \mathbb{1}\{o_{w,s} > 0\}}{b_{w,t}}$$

Values near 1 indicate that the war initiator has won almost all battles thus far; values near 0 indicate resounding success for the war target; and values near 0.5 indicate equitable outcomes. Note that this measure cannot be created for war-days before at least one battle is completed. For those initial days, I use $Prior_{w,t}$.[14] Figure 2 illustrates this measure for two important conflicts.[15]

[13] In Appendix I, I use a variety of others strategies to re-weight individual battles and show that my findings robust to these refinements.

[14] In Appendix H, I show that results are robust to removing these early observations.

[15] Appendix D contains plots for several more wars.



(a) World War II (1939 – 1945) **(b)** Iran-Iraq War (1980 – 1988)

Figure 2: *Observed* for two wars.

Inconsistent outcomes This main measure of battlefield outcomes can be compared with the *Prior* belief measure to create a measure of *inconsistency*:

$$Inconsistency_{w,t} = |Prior_{w,t} - Observed_{w,t}|$$

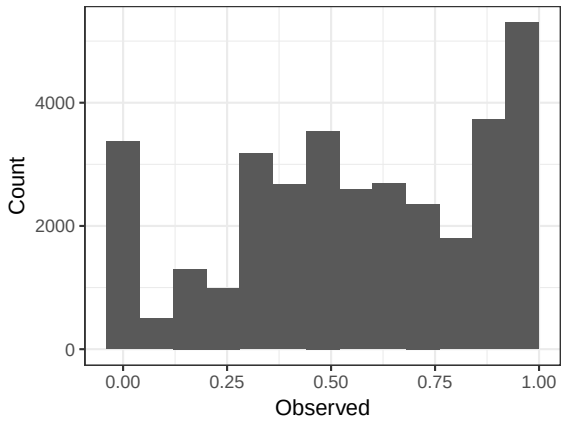
Values near 1 suggest that information from the battlefield thus far and prior beliefs about the war are diametrically opposed, while values near 0 suggest that fighting and prior beliefs are quite close.

Stagnation I measure *stagnation* on the battlefield by counting the number of days that have elapsed without a change in the *Observed* variable. This value is then log-transformed.

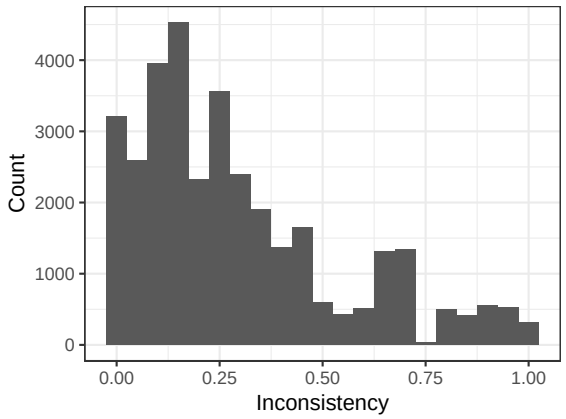
Completed battles To track *completed battles*, I count the total number of battles that have come already come to a conclusion on each war-day, and then take the log of this number.[16]

Figure 3 presents histograms that reflect the distribution of the key battlefield variables.

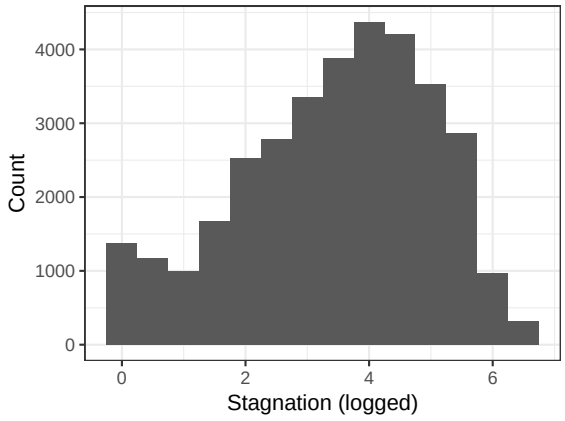
[16]Logged values help deal with the two World Wars, which have far more battles. Logged values also align with our intuition that later battles likely have a smaller marginal impact on changing beliefs.



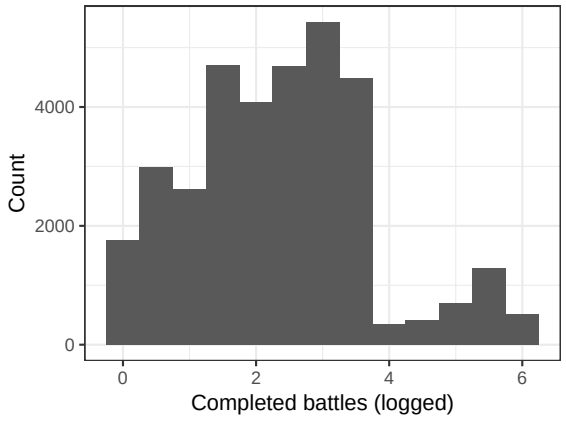
(a) Observed outcomes. Higher values indicate success for war initiator.



(b) Inconsistency. Higher values indicate disparity between *Prior* and *Observed*.



(c) Stagnation. Higher values indicate longer periods without change in *Observed*.



(d) Completed battles. Higher values indicate a greater number of ended battles.

Figure 3: Histograms of main battlefield variables.

Analysis

My overall outcome of interest is the termination of conflict, which occurs in one of two ways: a negotiated settlement, or military victory/defeat. Pooling these two forms of termination may lead to erroneous results and also preclude proper tests of both informational and ripeness theories, which focus on negotiated settlements. To allow the possibility that wars may end in one of two ways, I use a competing risks model with time-dependent covariates.[17] A competing risks model allows each covariate to have different impacts on the likelihood of a war ending in a negotiated or military-based manner.

If active fighting ceases through an armistice, ceasefire, peace preliminary, peace protocol, peace treaty, or a truce, the conflict ends through a negotiated channel. If fighting ends through a defeat, surrender, or withdrawal, the conflict ends through military means. Of 83 total wars, 53 end by diplomatic agreement.[18]

Note that war termination is defined by the cessation of hostilities. For example, consider the Mexican-American War of 1846-1847. The two nations signed a formal peace treaty on February 2, 1848. However, this agreement merely codified Mexico's military loss on September 14, 1847. I therefore classify the war as ending on September 14, 1847 through military means.

I include a series of control variables to capture potential confounders that could simultaneously impact battlefield outcomes and war termination. I mention them briefly here.[19]

Conflicts over more serious matters may invite harsher fighting or recalcitrance. I capture *issue salience* using Holsti's classification scheme, which identifies a party's most serious war aims on a three-point scale (Holsti 1991). I add together the two sides' points to make the measure. I account for *geographic contiguity*, which can influence the ease or difficulty of combat, using COW's Direct Contiguity dataset (Stinnett et al. 2002). I only include direct land contiguity. A series of variables record whether each side features at least one *democracy* and/or a *major/nuclear power*.[20] These characteristics could affect a belligerent's effectiveness, resolve, or ability to coerce the opponent.

[17] I utilize the *msm* package in R Jackson (2011). Both survival and competing risks models are simpler versions of multistate models (Metzger and Jones 2016). The *msm* package is designed to analyze panel data, and thus, time-varying data within subjects.

[18] Appendix A features these classifications.

[19] Appendix C features descriptive statistics of these variables.

[20] I use the Polity IV (Marshall et al. 2016), COW State System Membership, and Nuclear Production Capabilities (Jo and Gartzke 2007) datasets, respectively.

To capture fighting in progress, which may impact both conflict termination and my key battle-related measures, I include a running count of *active battles* on each war-day. I also add a running count of the number of *active belligerent states*. Lastly, I include dummy variables for *post-1945* and *post-Cold War* periods to account for other systemic changes that may impact geopolitical conditions for conflict (Goertz et al. 2016; Gowa 2000; Mearsheimer 1990).

Inconsistent Outcomes and War Termination

Recall that informational theories and ripeness theory produce discrepant predictions about how battlefield outcomes influence war termination. The former suggests that large gaps between prior beliefs and observed outcomes are likely to make belligerents update their offers and come closer to settlement. The latter suggests that stagnation on the battlefield will push parties to escape a costly stalemate and agree upon a way out. In both cases, these effects should intensify as more battles take place.

I test for this relationship by interacting the number of completed battles and the inconsistency measure described above. Table 2 shows the results from a series of competing risks models. Positive coefficients represent a higher likelihood of termination at any given time (a shorter war), while negative coefficients represent a lower likelihood (a longer war).

Table 2 displays the results of two competing risks models. Model 1 (the first two columns) look at this interactive effect on its own. The output highlights the importance of distinguishing forms of war termination. We see a positive and weakly statistically significant coefficient for the interaction term with respect to negotiated settlements. As battles accumulate, increased inconsistency between prior beliefs and observed fighting outcomes are likely to help terminate outcomes through a diplomatic settlement. This is consistent with informational theories, which predict that unexpected outcomes are most effective in reshaping beliefs and getting belligerents closer to opening a viable bargaining range. Meanwhile, this same interaction term has no significance in explaining non-diplomatic war termination. Model 2 (the last two columns) includes a series of relevant controls and continues to back implications that emerge from informational theories of war.

The substantive and statistical significance of interactive effects are not meaningful in isolation. This is particularly true when the coefficents of constituent variables differ in sign and/or statistical

Table 2: Results of competing risks models on the relationship between inconsistent outcomes and conflict termination, conditional on completed battles. Standard errors in parentheses, hazard ratios in brackets.

	Termination			
	(1)		(2)	
	Negotiated	Military	Negotiated	Military
Inconsistency × Completed battles	1.125*	−0.321	1.166*	−0.428
	(0.575)	(1.050)	(0.676)	(1.088)
	[3.080]	[0.726]	[3.208]	[0.652]
Inconsistency	−0.649	−1.282	−0.974	−1.247
	(1.017)	(1.560)	(1.294)	(1.653)
	[0.523]	[0.278]	[0.378]	[0.287]
Completed battles	−0.301*	−0.347*	0.166	−0.159
	(0.173)	(0.203)	(0.232)	(0.259)
	[0.740]	[0.707]	[1.180]	[0.853]
Issue salience			−1.054***	0.410
			(0.194)	(0.290)
			[0.348]	[1.506]
Contiguity			0.921**	−1.653***
			(0.400)	(0.587)
			[2.512]	[0.191]
Democracy			0.904**	0.274
			(0.360)	(0.497)
			[2.470]	[1.316]
Major/Nuclear			0.336	−0.373
			(0.384)	(0.548)
			[1.400]	[0.689]
Active battles			−0.386**	0.091
			(0.156)	(0.152)
			[0.680]	[1.096]
Active belligerents			−0.296	−0.941
			(0.481)	(0.839)
			[0.744]	[0.390]
Post-1945			0.111	0.547
			(0.367)	(0.443)
			[1.117]	[1.729]
Post-Cold War			−0.187	0.341
			(0.784)	(0.755)
			[0.829]	[1.407]
Events	53	30	53	30
Observations	34,015		34,015	
Log-likelihood	−626.026		−597.261	

$^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$

significance. I therefore use Models 1 and 2 from Table 2 to calculate the marginal effect of inconsistency on the likelihood of termination, conditional on how many battles have already been completed.[21] The top two plots represent Model 1, and the bottom two represent Model 2. These figures visually bolster the case for informational theories of war. When few battles have occurred, inconsistencies between prior beliefs and observed outcomes are not compelling enough to affect belligerents' interests in a negotiated settlement, and in fact appear to have a statistically significant albeit fleeting negative relationship with war termination by military means. However, if disparities remain or arise as more battles accumulate, then beliefs and bargaining positions shift in the direction of bringing a war to an end through negotiated means.[22]

These impacts are immediate and meaningful. In Model 2 and Subfigure 4c, the marginal effect of inconsistent outcomes on negotiated settlement becomes positive when only two battles have taken place.[23] The first quartile, median, and third quartile for completed battles are 3, 9, and 22. Compared to the baseline hazard, a one standard deviation change in inconsistency increases the likelihood of a negotiated settlement by approximately 17%, 53%, and 95%, respectively.

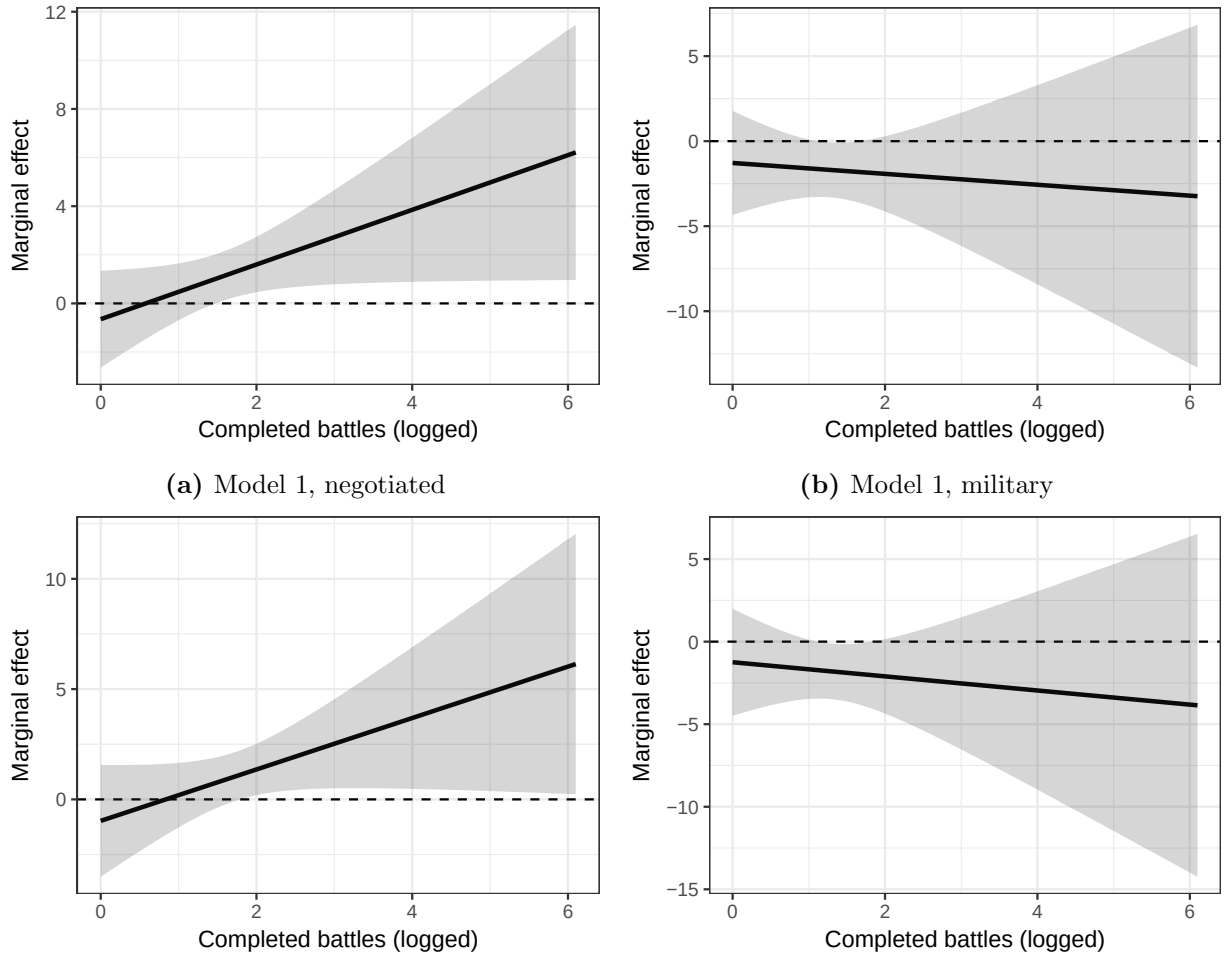
It is worth returning to Table 2 to review the control variables' impacts on different manners of war termination. First, higher issue salience undermines the likelihood of a war terminating through a negotiated settlement, but not through military means. Belligerents will keep fighting as long as circumstances allow when a negotiated settlement is either seen as too grave of a concession or effectively impossible. Higher stakes do not impact how quickly or slowly a war may end through fighting alone.

Second, the presence of a democratic belligerent appears to more than double the likelihood of negotiated settlement compared to the baseline hazard. This result is only suggestive and does not identify whether the pattern is a consequence of democracies selecting into wars they believe they can quickly win and settle, a normative preference for diplomacy, or a desire to bow out of protracted conflicts (Bueno de Mesquita et al. 2003; Filson and Werner 2007; Reiter and Stam 2002). Nonetheless, the significant finding does point to the importance of understanding how democracies fight or negotiate differently than non-democracies.

[21] See Brambor et al. (2006).

[22] Note that marginal effects are statistically significant with respect to negotiated settlements, even though the interaction and constituent terms are not strongly significant in Table 2.

[23] The marginal effect changes sign when completed battles equals 0.836, and $\log(0.836) - 1 = 1.307$.



(a) Model 1, negotiated

(b) Model 1, military

(c) Model 2, negotiated

(d) Model 2, military

Figure 4: Marginal effect of inconsistency on war termination, based Table 2. Bands represent 95% confidence intervals.

Third, active battles reduce the likelihood of a diplomatic settlement. Belligerents would less willing to strike any agreement when fighting is ongoing, particularly since the resolution of these battles would yield additional information.

Lastly, contiguity expedites the end of wars by negotiated settlement, echoing past work suggesting that contiguity can literally help conflicts proceed more quickly (Slantchev 2004).[24] However, wars between contiguous states have a lower hazard of ending through military means compared to wars between non-contiguous states. This is unexpected. One plausible explanation for this finding is that wars involving non-contiguous belligerents involve an initiator that wields an overwhelming

[24]Conversely, Weisiger (2013, 2016) sees no statistically significant impact of contiguity on war duration. Perhaps reflecting these incongruous findings, the positive result for negotiated settlements does not exist in some models.

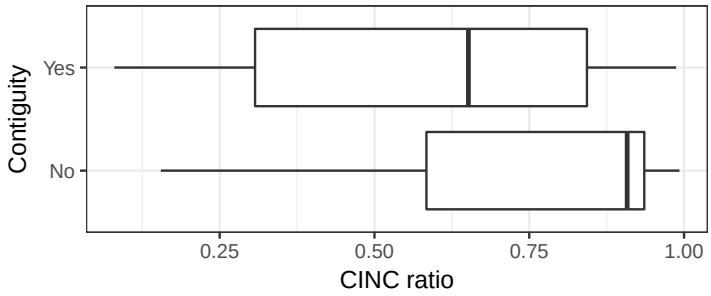


Figure 5: Distribution of CINC ratios on first day of war, conditional on whether belligerents are geographically contiguous

advantage in capabilities over its target, and will therefore win a swift military victory. Indeed, the fact that the initiator is able to move its military forces across land or sea to reach a non-contiguous state already attests to its intentions and war-fighting capabilities. The 1859 Spanish-Moroccan War, the 1882 Conquest of Egypt, the 1935 Conquest of Ethiopia, the 2001 invasion of Afghanistan, and the 2003 invasion of Iraq are five examples that easily fit this description. Figure 5 provides suggestive evidence supporting this idea. Wars involving non-contiguous states tend to feature a disproportionately capable war initiator, while wars between contiguous states are more balanced. By dint of being neighbors with constant interactions, contiguous states may also have more incentives to negotiate. Further work is necessarily to fully unpack this relationship.

This analysis treats all battles as equal units. In the online appendices, I re-weight individual battles using a series of different strategies. These adjustments not only sustain this primary finding, but sometimes strengthen it.[25] The data therefore provide convincing evidence in support of dynamics predicted by informational theories of war. In addition, they suggest that even though pre-war capabilities on their own may be a mediocre predictor of overall war termination or victor (Cannizzo 1980; Carroll and Kenkel 2017), they are far more valuable as a reference point to contextualize observed battlefield outcomes.

Stagnation and War Termination

We now move on to testing a key implication of ripeness theory: Wars should be more likely to end through a negotiated settlement when the battlefield becomes stagnant, especially after substantial fighting has taken place.

[25] See Appendix I.

Following the pattern set to test informational theories, I create an interaction term involving the number of completed battles and the stagnation variable previously described. Table 3 displays those results, but it may be more helpful to immediately turn to Figure 6.

For ripeness theory to find support, the marginal effect of stagnation should increase as battles accumulat and should eventually become positive. It is immediately clear that the results do not support these expectations. When relatively few battles have taken place, stagnation has a negative and statistically significant relationship with the likelihood of either form of war termination. This is perhaps unsurprising, as early inactivity may reflect preparations for further hostilities. However, as more battles occur and we move rightward on these figures, the marginal effect of stagnation remains exclusively negative and also loses its statistical significance. Subfigure 6c indicates that the marginal effect of stagnation on the battlefield is approximately -0.5 regardless of the number of completed battles. We can frame this in more meaningful terms: Compared to the baseline hazard rate, a one standard deviation increase in stagnation decreases the likelihood of a negotiated settlement by about 55%. This ultimately contravenes a key prediction of ripeness theory.

One may believe that ripeness theory is more concerned with recent hostilities rather than the totality of fighting in the entire war. Perceptions of stalemate may be especially strong when a surge of recent fighting yields minimal changes. In the online appendices, I perform an analysis that focuses on recent battles rather than cumulative battles. The results continue to belie the implications of ripeness theory: Stagnation on the battlefield in the wake of recent fighting does not increase, and sometimes decreases, the likelihood of war termination by diplomatic means.[26]

Conclusion

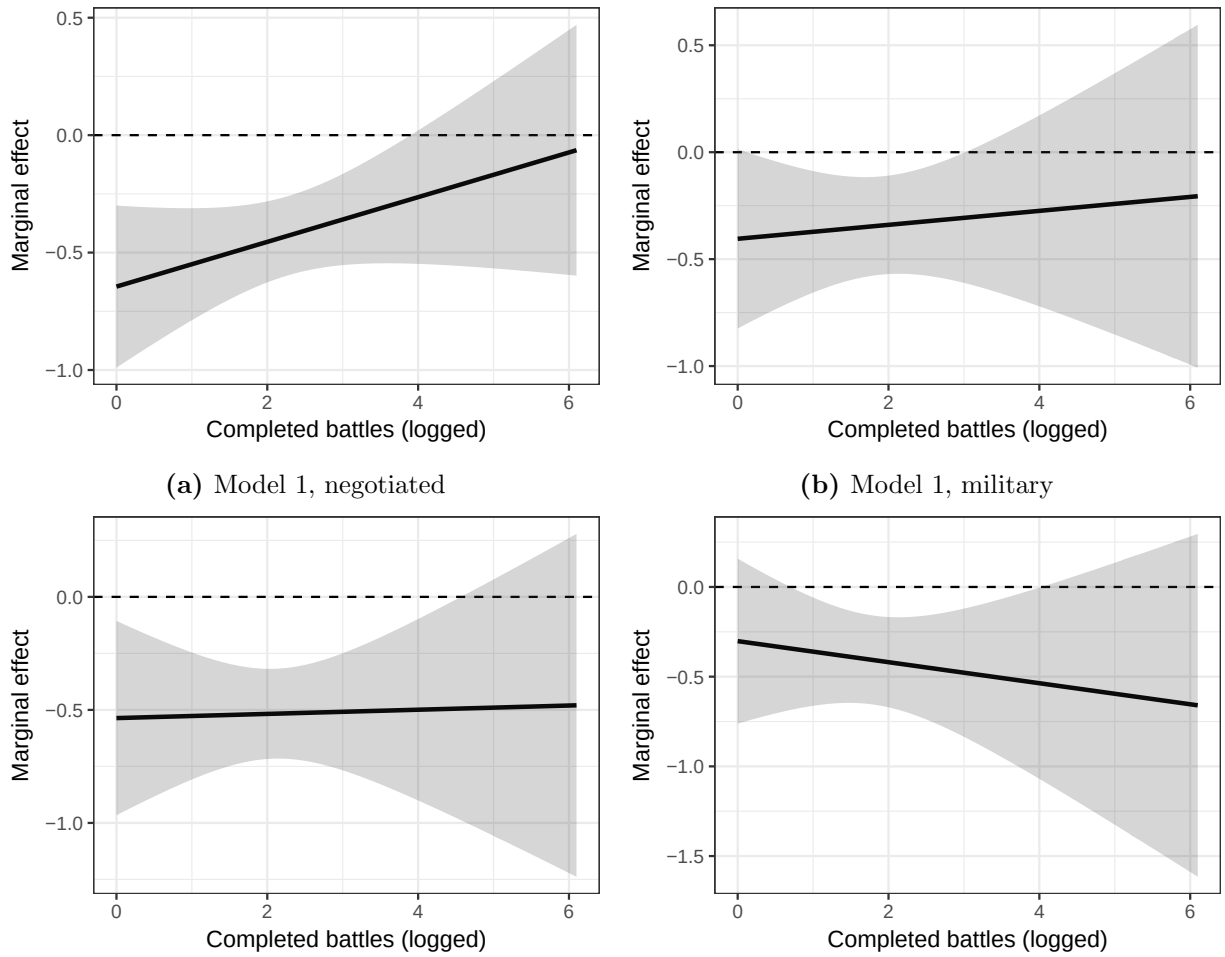
My findings reinforce tenets common to informational theories of war, which predict that a pattern of unexpected outcomes from fighting should compel belligerents to update their positions and move closer toward a negotiated settlement. Ripeness theory, which expects costly stalemates to promote peace, finds scant support and is often contradicted. Crucially, we were only able to ascertain these results by using new daily-level measures of battlefield activity.

[26] See Appendix F.

Table 3: Results of competing risks models on the relationship between stagnation and conflict termination, conditional on completed battles. Standard errors in parentheses, hazard ratios in brackets.

	Termination			
	(1)		(2)	
	Negotiated	Military	Negotiated	Military
Stagnation × Completed battles	0.095	0.033	0.009	−0.059
	(0.068)	(0.094)	(0.093)	(0.110)
	[1.100]	[1.033]	[1.009]	[0.943]
Stagnation	−0.645***	−0.405*	−0.536**	−0.302
	(0.176)	(0.214)	(0.219)	(0.234)
	[0.525]	[0.667]	[0.585]	[0.739]
Completed battles	−0.365**	−0.474*	0.405	−0.002
	(0.160)	(0.254)	(0.267)	(0.340)
	[0.694]	[0.622]	[1.500]	[0.998]
Issue salience			−0.850***	0.457
			(0.183)	(0.286)
			[0.427]	[1.580]
Contiguity			0.590	−1.635***
			(0.384)	(0.562)
			[1.804]	[0.195]
Democracy			0.849**	0.109
			(0.338)	(0.481)
			[2.338]	[1.115]
Major/Nuclear			0.159	−0.439
			(0.364)	(0.530)
			[1.172]	[0.645]
Active battles			−0.553***	−0.080
			(0.176)	(0.187)
			[0.575]	[0.923]
Active belligerents			−0.537	−0.870
			(0.485)	(0.783)
			[0.585]	[0.419]
Post-1945			0.200	0.686
			(0.356)	(0.449)
			[1.221]	[1.985]
Post-Cold War			0.153	0.251
			(0.791)	(0.728)
			[1.166]	[1.285]
Events	53	30	53	30
Observations	34,015		34,015	
Log-likelihood	−615.255		−585.014	

$^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$



(a) Model 1, negotiated

(b) Model 1, military

(c) Model 2, negotiated

(d) Model 2, military

Figure 6: Marginal effect of stagnation on war termination, based on Table 3. Bands represent 95% confidence intervals.

These results do not provide much support for ripeness theory but do not necessarily invalidate it. Zartman is careful to emphasize that hurting stalemates and a way out are necessary but not sufficient conditions to prompt negotiations (Zartman 2001). A way out can also hinge on political, economic, and social factors outside the battlefield. Indeed, practitioners' descriptions of when and how they identified ripe moments involve considerable subjectivity, contextual knowledge, and a "sense of feel" that are difficult to generalize.[27] This suggests that ripeness theory is better thought of as a heuristic, a set of guiding principles, or a minimal set of necessary conditions that

[27] One diplomat's discussion of ripeness proposes that "You have to do the right thing at the right time" (Campbell 1976, 73).

leave an enormous amount of work to forge peace. On that level, ripeness theory appropriately acknowledges the complex and non-deterministic nature of conflict resolution.

It may also not be a coincidence that ripeness theory is mainly in the realm of civil conflicts. The imbalance of capabilities between a government and rebel groups is probably more dramatic than what we see between states. Additionally, unlike states that lose a war, rebels cannot retreat back to their own country; defeat may be tantamount to elimination. Intra-conflict battlefield data for civil wars would help ascertain whether ripeness theory has better explanatory power for these conflicts. In any case, my findings suggest that interstate war scholars should take caution in applying ripeness theory and make great efforts not to produce ex post rationalizations for what constituted a stalemate or a way out of conflict.

Limitations to this initial study provide a blueprint for a broader research agenda. Estimates of forces and casualties for all battles, even if imprecise, would allow better studies about the impact of costs and resolve on the trajectory of war.[28] Geographic information about battles would help create a more tangible measure of gains and losses from fighting. While my analysis includes a control variable for democratic belligerents, more careful distinctions between democracies and non-democracies could address whether they fight or settle wars differently. Findings would enrich our theories concerning sources of the democratic advantage in war.

Even though I delineate whether or not conflicts end through negotiated settlement, such agreements do not materialize out of thin air. Belligerents must choose when, why, and how they engage in diplomacy during war, and the occurrence of negotiations also does not guarantee a quick resolution—or any resolution at all. In fact, many wars that end through military means also involved failed negotiations. Historical studies of war indciate that decisions regarding negotiations weigh heavily on leaders' minds in a way that contemporary IR literature has yet to fully appreciate. Further research is necessary to understand these dynamics and the strategic role, if any, that lies behind the choice to negotiate while simultaneously fighting.[29] New insights and data from this line of inquiry, especially if paired with the battle data, would deepen our theoretical and empirical ability to continue unpacking the black box of war.

[28] Filson and Werner (2002, 2004); Powell (2004). This would also refine tests about the impact of mutually hurting stalemates on ripeness for negotiations.

[29] Works that begin to tackle this question include Fearon (2013); Kaplow (2016); and Langlois and Langlois (2012).

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Online Appendices

for

“Reassessing the Informational and Ripeness Theories of War”

Appendix A: Data Coverage

Tables 1 and 2 provide several pieces of information about basic war attributes. The first column simply lists the names of wars.

The next two columns help to compare the Correlates of War (COW) dataset with the Interstate War Dataset (IWD) by Reiter, Stam, and Horowitz (2016). Recall that the main results of this paper use the latter. The IWD makes several corrections regarding war initiators, war dates, and whether wars should be included or removed based on COW's 1,000-casualty criterion. Wars without an identification number are those that do not exist in the dataset.

I adopt most of the corrections proposed by the IWD. Two exceptions are worth mention. First, IWD includes wars that feature at least 500 casualties, which I indicate using daggers (†) in the tables. I continue to limit my analysis to conflicts with at least 1,000 casualties. This removes COW interstate conflicts such as the Falklands War and Kargil War from my data. Second, because the Third Sino-Japanese War (1937-1941) later becomes part of World War II, the IWD folds the two conflicts together. This effectively makes World War II a conflict initiated by Japan against China in 1937. This seems historically dubious. As such, I instead remove the Third Sino-Japanese War from my analysis entirely.

The fourth column makes very brief remarks about additional changes the IWD makes in relation to COW. All this said, Appendix G shows that the overall results are largely unchanged using COW data.

The fifth and sixth columns compare the number of battles recorded in my battle dataset with those recorded in the U.S. Army's Concepts Analysis Agency Database of Battles (CDB). Despite its documented flaws, the CDB is arguably the quantitative battle dataset of record. See Appendix B for more information on defining and coding battles.

Lastly, the seventh column indicates whether the war ends through a negotiated or diplomatic settlement (D) or military means (M). Only those wars with D or M are included in my analysis.

Table 1: Several characteristics of pre-1945 interstate wars, including coverage by the Correlates of War (COW) and Interstate War Dataset (IWD), number of battles in my dataset and the CDB, and manner of war termination (diplomatic or military). Note that the CDB90 lists the Balkans Wars as a single conflict with five battles.

War Name	COW	IWD	Changes	Battles	CDB90	End
Franco-Spanish	1	1		2		M
First Russo-Turkish	4	2		6		D
Mexican-American	7	3		27	8	M
Austro-Sardinian	10	4		11	1	D
First Schleswig-Holstein	13	5		7		D
Roman Republic	16	6		3		D
La Plata	19	7		5		M
Crimean	22	8	Initiator changed	30	2	D
Anglo-Persian	25	9		4		D
Italian Unification	28	10		9	2	D
First Spanish-Moroccan	31	11		3		D
Italian-Roman	34	12		2		M
Neapolitan	37	13		7		M
Franco-Mexican	40	14		29		M
Ecuadorian-Colombian	43	15		2		M
Second Schleswig-Holstein	46	16		3		D
Lopez	49	17		32		M
Naval War	52	18		4		M
Seven Weeks	55	19		25	1	D
Franco-Prussian	58	20		57	10	D
First Central American	60	21		5		D
Second Russo-Turkish	61	22		26		D
War of the Pacific	64	23		13		M
Conquest of Egypt	65	24		4		M
Sino-French	67	25		9		D
Second Central American	70	26		1		M
Central American War		89				
First Sino-Japanese	73	27		15		D
Greco-Turkish	76	28		7		D
Spanish-American	79	29		17	1	D
Boxer Rebellion	82	30		15		M
Sino-Russian	83		Folded into Boxer	8		
Russo-Japanese	85	31		18	6	D
Third Central American	88	32		2		D
Fourth Central American	91	33		3		D
Second Spanish-Moroccan	94	34		4		M
Italian-Turkish	97	35		12		D
First Balkan	100	36		11	2.5	D
Second Balkan	103	37		8	2.5	D
World War I	106	38		342	124	D
Estonian Liberation	107	39		4		D
Latvian Liberation	108	40		3		D
Russo-Polish	109	41		8	2	D
Hungarian Adversaries	112	42		5		M
Second Greco-Turkish	115	43		18		D
Franco-Turkish	116	44		5		D
Lithuanian-Polish	117		Removed	5		
Manchurian	118	45		14	5	D
Second Sino-Japanese	121	46		9		D
Chaco	124	47		19		D
Saudi-Yemeni	125	48		1		D
Conquest of Ethiopia	127	49		12	1	M
Third Sino-Japanese	130		Removed (from analysis)	16		
Changkufeng	133			1		
Nomonhan	136			1		
Italo-Albanian		90				
World War II	139	53		453	193	M
Russo-Finnish	142	52		8	1	D
Franco-Thai	145			6		

Table 2: Several characteristics of post-1945 interstate wars, including coverage by the Correlates of War (COW) and Interstate War Dataset (IWD), number of battles in my dataset and the CDB, and manner of war termination (diplomatic or military).

War Name	COW	IWD	Changes	Battles	CDB	End
First Kashmir	147	54		7		D
Arab-Israeli	148	55		25	9	D
China-Taiwan		91		2		M
Korean	151	56		41	11	D
Off-shore Islands	153	57		3		D
Sinai War	155	58		6	4	D
Soviet Invasion of Hungary	156	59		1		M
IfniWar	158			5		
Taiwan Straits	159	60		1		M
Bizerte		93				
Assam	160	61		4		D
Malaysian		94				
Vietnam War, Phase 2	163	62		50	1	M
Second Kashmir	166	63		8		D
Six Day War	169	64		10	22	D
Second Laotian, Phase 2	170	65		1		
War of Attrition	172	66		10	1	D
Football War	175	67		2		D
Communist Coalition	176	68		1		
Bangladesh	178	69		14		D
Yom Kippur War	181	70		11	33	D
Turco-Cypriot	184	71		5		D
War over Angola	186	72		18		M
Second Ogaden War, Phase 2	187	73		6		D
Vietnamese-Cambodian	189	74		3		M
Ugandian-Tanzanian	190	75		2		M
Sino-Vietnamese Punitive	193	76		1		M
Iran-Iraq	199	77		27		D
Falkland Islands	202	78		7		
War over Lebanon	205	79		5	1	M
China-Vietnam		92	Added	4		M
War over the Aouzou Strip	207	80		6		D
Sino-Vietnamese Border War	208	81		5		
Gulf War	211	82	Initiator changed	8		D
Bosnian Independence	215		Removed	9		
Azeri-Armenian	216	83		5		D
Cenepa Valley	217		Removed	8		
Badme Border	219	84		5		D
War for Kosovo	221	85		1		M
Kargil War	223	86		1		
Invasion of Afghanistan	225	87		6		M
Invasion of Iraq	227	88		6		M

Appendix B: Defining and Coding Battles

Definitions of battles tend to be broad and attempt to capture units of combat in a manner that minimizes ex post assessments. Three examples attest to this.

- "At the simplest level, a battle is any clash between organised forces of combatants. While this allows no distinction in scope, scale or significance, considerations such as significance are often applied only in retrospect and may have very little to do with scope or scale." (Jaques 2007)
- "A battle is usually defined as a general fight or encounter between hostile military forces. Some of the elements of the definition include length of time of the encounter, scale (intensity) of fighting, size of the forces involved, influence of a particular campaign, and decisiveness of the action. A battle may be further defined by distinguishing it from a skirmish, a raid, or a siege. This book, however, uses the term battle in the broadest sense—that is, as a confrontation between opposing armed forces that resulted in casualties or in a change in the military position." (Eggenberger 1985)
- "A *battle* is combat between major forces, each having opposing assigned or perceived operational missions, in which each side seeks to impose its will on the opponent by accomplishing its own mission, while preventing the opponent from achieving his. A battle starts when one side initiates mission-directed combat and ends when one side accomplishes its mission or when one or both sides fail to accomplish the mission(s). Battles are often parts of campaigns. Battles between large forces usually are made up of several engagements, and can last from a few days to several weeks." (Dupuy 1987)

Note that campaigns are a fundamentally different unit of combat. Campaigns are aimed are achieving strategic goals (those that relate to national policy and the entire conflict), while battles focus on realizing operational goals (those concerning the actual employment of military forces to gain an advantage over the enemy to advance the strategic objective).[30] This distinction is strong; campaigns are not individual battles, but composed of many constituent battles. For example, the Gallipoli Campaign of World War I consists of 19 battles.

Despite the apparent abstract nature of the definition of a "battle," most battles are not controversial and are recorded across multiple sources. Table 3 shows how different resources vary in their coverage of the Seven Weeks' War between Austria and Prussia in 1866. While I do not include dates here, all sources agree on battles that they discuss.

This table is a good representation of how thoroughly each resource catalogs battles, and why I use Jaques's dictionary as the backbone of my battle data. Jaques almost always provides the most comprehensive list of battles. Eggenberger simply covers fewer battles for all wars, focusing on events that were often retrospectively seen to have strategic importance to the overall war. Clodfelter and Showalter write about individual wars in extended narratives. As a consequence, their review of battles tends to be driven by a chronological and continuous flow that focuses on strategically key battles and smaller battles that happen to be part of the larger narrative. Also note that the CDB90—the current quantitative database of record—only contains a single battle for this entire conflict.[31]

[30] Rogers, Clifford J. 2006. "Strategy, Operational Design, and Tactics." In *International Encyclopedia or Military History*, ed. James C. Bradford. New York: Routledge.

[31] Both Showalter and the CDB90 include the Battle of Custoza, which is not on this table. However, the Battle of Custozza takes place between Italy and Austria and is typically counted as part of a separate Italian War of Independence (not recorded in COW).

Battles (Jaques)	Clodfelter	Eggenberger	Showalter	CDB90
Aschaffenburg				
Blumenau				
Gerchsheim				
Gitschin	✓		✓	
Hammelburg				
Helmstadt				
Huhnerwasser				
Kissingen				
Koniggratz	✓	✓	✓	✓
Langensalza	✓	✓	✓	
Laufach				
Liebenau				
Munchengratz		✓	✓	
Nachod	✓		✓	
Podol				
Schweinschadel				
Skalitz	✓			
Soor	✓			
Tauberbischofsheim				
Tobitschau				
Trautenau	✓		✓	
Werbach				
Wiesenthal				
Wurzburg				
Zella				

Table 3: Battle coverage for the Seven Weeks' War (1866).

Looking at the coverage of battles across these five sources, seveal battles in Table 3 are only included in Jaques's dictionary. However, each of these battles is documented in more detailed historical texts that focus solely on the Seven Weeks' War. Wright and Hozier (1872) provide a very comprehensive example.[32]

It is worth emphasizing that all of these resources agree upon what constitutes a battle. Differences in the number of recorded events is based on the depth of coverage, and not fundamental conflicts about what the unit of analysis captures.[33]

B.1: Example Codings

I present four example entries from Jaques's dictionary and discuss how each one's outcome is coded. These examples underscore how codings are relatively straightforward. The names in bold refer to other battles included in the dictionary and are in bold in the original dictionary text.

[32] Wright, Charles H. and Henry M. Hozier. 1924. *The Campaign of 1866 in Germany.* London: Harrison and Sons.

[33] In contrast, we could imagine a scenario where one collection records ten battles to represent what another collection considers to be a single battle.

Minsk | 1941 | World War II (Eastern Front)

When Germany invaded Russia, Panzer Generals Heinz Guderian and Herman Hoth circled behind Minsk, where they trapped 15 Soviet divisions. The double encirclement of Minsk and **Bialystok** yielded 320,000 prisoners, 2,500 tanks and 1,400 guns, and Russian Commander Dmitri Pavlov was arrested and shot. The Germans continued east towards **Smolensk** (22 June-9 July 1941).

The narrative makes clear that German forces attacked the Soviets. Moreover, the Germans handily won this battle on multiple dimensions, including the seizure of Minsk. Since German/Axis forces are the initiator of the overall war and also the attacker in this battle, this battle gets a score of +1. The positive sign reflects the fact that the war initiator won the battle, and the magnitude of 1 reflects the fact that the attacker won the battle.

Cañada Tarija | 1934 | Chaco War

When Bolivian forces in the disputed Chaco Boreal concentrated near Picuiba under Colonel Francisco Peña, Paraguayan Colonel Frederico Smith advanced northwest from Camacho and encircled Colonel Angel Bavía at Cañada Tarija. Almost 1,200 Bolivians were forced to surrender, after which Bavía committed suicide and Peña was dismissed from command (26-27 March 1934).

The paragraph indicates that Paraguayan forces took the offensive against the Bolivians and realized a relatively decisive victory that involved a surrender of military forces. Paraguay was the target of the overall war, and Bolivia was the initiator. Therefore, the victor at Cañada Tarija was the war target, leading to a score of −1.

Ouadi Doum | 1987 | Libyan-Chad War

When Libya sent two columns 50 miles south from Ouadi Doum to retake Fada, both were routed with terrible losses and Chad's army advanced after brutal fighting to take Ouadi Doum and huge booty. The disaster cost Libya perhaps 3,000 killed and her occupation of northern Chad was effectively over. Further Libyan defeat at Maaten-as-Sarra in September ended the war (19-22 March 1987).

The description indicates that Libya started the battle by sending forces against Chadians at Fada. However, Libya suffered a resounding loss and was driven out. Chadian forces thus managed to maintain their position in Ouadi Doum. Chad was the war initiator, so the battle score is +1.

Plevna (2nd) | 1877 | Russo-Turkish Wars

With the Danube fortresses of **Svistov** and **Nicopolis** secured, Grand Duke Nicholas marched south against Plevna, defended by 30,000 Turks under Osman Pasha. Following costly Russian assaults in July General Mikhail Skobelev led a fresh attack, which captured two redoubts. However, he was driven out with a claimed 20,000 casualties and the siege continued (10-12 September 1877).

Russian forces took the offensive against a Turkish stronghold and suffered a humiliating loss. The Turks successfully repulsed an assault and maintained their position in Plevna. Turkey was the target of this war, so the assault on Plevna gets a score of −1.

B.2: Comparisons of Battle Narratives

For illustrative purposes, I show how four sources—Jaques, Clodfelter, Eggenberger, and Showalter—record several identical battles. These comparisons demonstrate how most records agree upon the key features of each battle, and how I reconcile any differences that may arise.

Battle of Plevna

As previously mentioned, Turkey was the target of the Russo-Turkish War and was the defender in this particular battle. Given that Turkey defended its position against the Russians, the assault on Plevna gets a score of -1, where the negative sign reflects a victory by a war target.

Showalter only describes Plevna in terms of a single siege. The other sources also acknowledge that Plevna was besieged for months but specifically identify several distinct battles where Russian forces make concentrated assaults to break through. I adopt the predominant approach here and record the constituent battles.

Jaques:

> With the Danube fortresses of **Svistov** and **Nicopolis** secured, Grand Duke Nicholas marched south against Plevna, defended by 30,000 Turks under Osman Pasha. Following costly Russian assaults in July General Mikhail Skobelev led a fresh attack, which captured two redoubts. However, he was driven out with a claimed 20,000 casualties and the siege continued (10-12 September 1877).

Clodfelter:

> The third attack on Plevna, the "Great Assault," fell on September 11 after a 4-day, 30,000-round shelling that killed or wounded 500 Turks.... All along the perimeter of Plevna the attackers lost on those two days 18,600 killed or wounded and 2,000 taken prisoner. Osman's stalwarts lost about 5,000 dead or disabled. After this disastrous failure, Frants Todleben, the hero of Sevastopol, was put in charge of siege operations.

Eggenberger:

> The Russian army of investment, now 90,000 strong, launched a new assault on September 11 under the command of Grand Duke Michael, younger brother of Nicholas and Czar Alexander II. A force led by Gen. Mikhail Skobelev captured two redoubts on the southwest, but a Turkish counterattack regained the positions the second day. In all, the Russians lost 20,000 men in the futile two-day battle. Turkish casualties were about 5,000. The firm Ottoman resistance aroused the admiration of most of the civilized world.

Showalter:

> A force of 110,000 Russian, Romanian and Bulgarian troops under the Grand Duke Nicholas and Prince Carol I of Romania defeated Osman Nuri Pasha's 40,000-strong Turkish garrison, but sustained an estimated 40,000 casualties.

Battle of Sinope

The four entries all agree on the basic information about the Battle of Sinope during the Crimean War: the battle attacker (Russia), battle defender (Turkey), date (November 30, 1853), and outcome (victory for Russia). Since Turkey was the initiator of the overall war, any of these four accounts produces a score of +1.

Jaques:

> Near the start of the war, Russian Admiral Paul Nakhimov attacked Sinope Harbour on the Black Sea, where Osman Pasha commanded nine frigates and three corvettes. With Russia using newly invented naval shells against wooden hulls, the Turkish fleet was utterly destroyed. Over 4,000 died, including Osam fatally wounded. Only one steamer escaped in the smoke (30 November 1853).

Clodfelter:

> This Russian defeat [at the Danube] was more than balanced when at the end of the month Admiral Paul S. Nakhimov led a squadron of 6 ships-of-the-line, 3 frigates, and several smaller ships against Turkish Admiral Hussein Pasha's flotilla of 7 frigates, 3 corvettes, and 2 small steamers anchored in Sinope Harbor on the Black Sea coast of Anatolia. The Russian ships, firing new explosive shells instead of the traditional round shot, massacred the smaller Turkish vessels.... November 30, 1853.

Eggenberger:

> Although Turkey (Abdul Medjid I) opened the war with a victory over Turris along the Danube on November 4, the contest at sea took a different turn. Czar Nicholas I sent a Russian fleet across the Black Sea. On November 30 the Russian vessels trapped nine Turkish ships in the harbor at Sinope. A heavy, no-quarter bombardment totally destroyed the Ottoman squadron and harbor installations. More than 4,000 Turks were killed. The battle aroused the indignation of Great Britain and France, who promptly ordered their fleets into the Black Sea to protect Turkish shipping. The war would soon widen.

Showalter:

> 30 November 1853: A Russian flotilla of 12 ships under Nakhimov attacked an Ottoman flotilla of 14 ships under Osman Pasha at Sinope, on the northern coast of modern-day Turkey. The Ottoman force also head support from shore batteries. Superior Russian gunnery and ammunition won a decisive victory. While Nakhimov suffered damage to three ships, the Russians destroyed the entire Ottoman flotilla and knocked out two shore batteries.

Se La and Bomdi La

The battles at Se La and Bomdi La took place during the 1962 Sino-Indian (Assam) War. The narratives below are relatively short and/or devoid of precise statistics. (The fact that two sources discuss them simultaneously attests to the lack of specific information they contain.) They are examples of battles that lack reliable measures of force deployments or casualties, which prevents a dataset from including such variables.

Nonetheless, these records indicate that the Chinese initiated and won both battles. China is the overall war initiator, so both battles receive a score of +1. I defer to the dates Jaques provides, as they are more precise than those in the other sources. The relatively higher detail of Jaques's narratives also lend greater credibility.

Jaques (two separate entries):

> [Se La] In the wake of Chinese victory at the Namka Chu in northeast India (20 October), the border war eased for diplomatic manoeuvring and India reinforced the forward position at Se La. When the Chinese attacked again in force, Brigadier Hoshiar Singh initially held them off and inflicted costly losses. He was finally overwhelmed and the invaders drove south on Bomdila (16 November 1962).
>
> [Bomdi La] Renewing their offensive in the border war in northeast India, Chinese forces took Se La, then drove south through Dirang Dzong towards the last major Indian position at Bomdila, where troops under General Anant Singh Pathania were badly beaten in a major defeat. China declared a unilateral ceasefire and partly withdrew, but retained some key strategic conquests (18-19 November 1962).

Clodfelter:

> Se La and Bombdi were the locations of two heavily fortified Indian positions in the North-east Frontier Agency during the 1962 Sino-Indian War. Se La was cut off and Bombdi fell to Chinese attacks between 17 and 20 November 1962.

Eggenberger: No entries.

Showalter:

> ...November 17-21, practically wiped out the Indian 4th Infantry Division at Se La and Bomdi La on the western flank of the NEFA front and captured Walong on the eastern flank.

Appendix C: Descriptive Statistics

Table 4 summarizes several characteristics of individual wars. Tables 5 and 6 are descriptive statistics of all variables used in the analysis.

	Min.	1Q	Med.	Mean	3Q	Max.
War length (days)	5.000	61.000	166.000	409.800	445.500	3735.000
Battles	1.000	3.000	6.000	18.610	13.000	453.000
Battle length (days)	1.000	1.000	4.000	25.700	14.000	2075.000

Table 4: Summary statistics at the war level.

	Min.	1Q	Med.	Mean	3Q	Max.
Observed	0.000	0.350	0.529	0.557	0.853	1.000
Completed battles (logged)	0.000	1.386	2.303	2.370	3.135	6.107
Inconsistency	0.000	0.106	0.230	0.294	0.407	0.991
Stagnation	0.000	2.398	3.664	3.457	4.644	6.737
Issue salience	0.000	2.000	2.000	2.489	3.000	4.000
Active battles	0.000	0.000	0.000	1.094	1.000	22.000
Active belligerents (logged)	1.099	1.099	1.099	1.474	1.792	2.944
Recent battles	0.000	0.000	0.000	0.611	1.000	22.000

Table 5: Summary statistics for continuous variables.

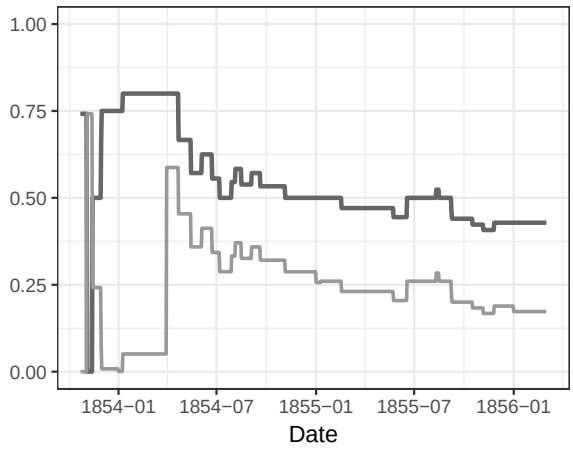
	0 (No)	1 (Yes)
Contiguity	7,589 (0.223)	26,426 (0.777)
Major/Nuclear	13,572 (0.399)	20.443 (0.601)
Democracy	24,413 (0.630)	12,602 (0.370)
Post-1945	21,243 (0.625)	12,772 (0.3755)
Post-Cold War	32,420 (0.953)	1,595 (0.047)

Table 6: Summary statistics for binary variables. Proportions in parentheses.

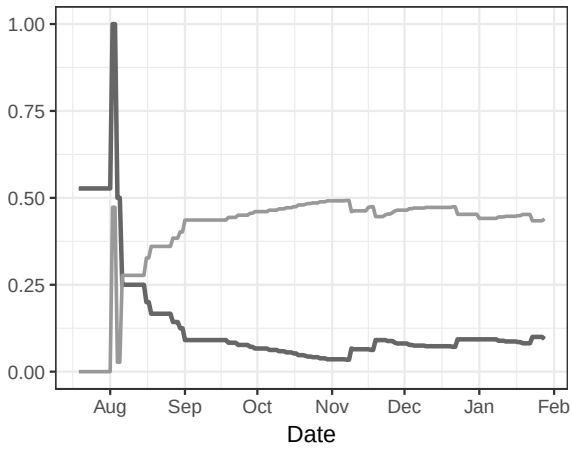
Appendix D: More War Plots

Figures 1 and 2 provide plots of *Observed* and *Inconsistency* over time for several additional wars covering a wide range of time and space.

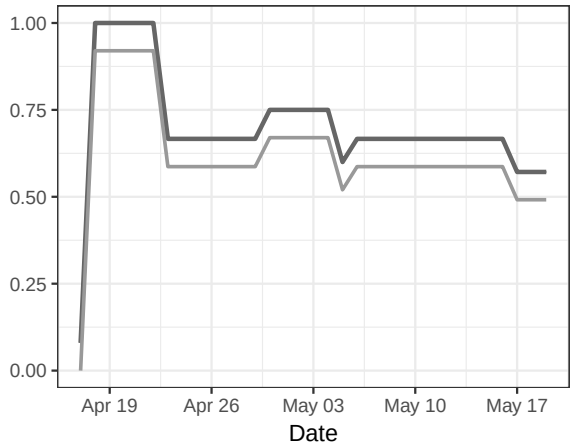
Figure 1: *Observed* (dark gray line) and *Inconsistency* (light gray line) for four pre-1945 wars.



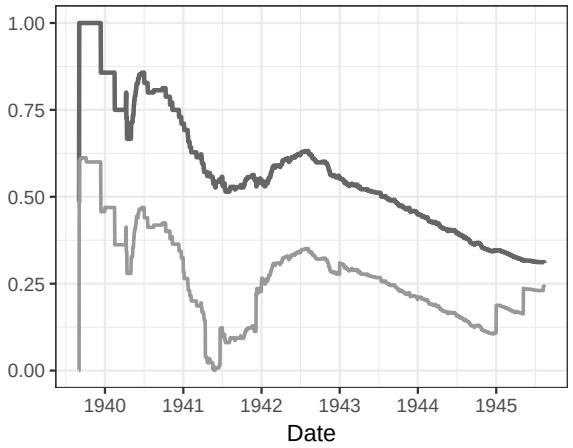
(a) Crimean War (1853 – 1856)



(b) Franco-Prussian War (1870 – 1871)

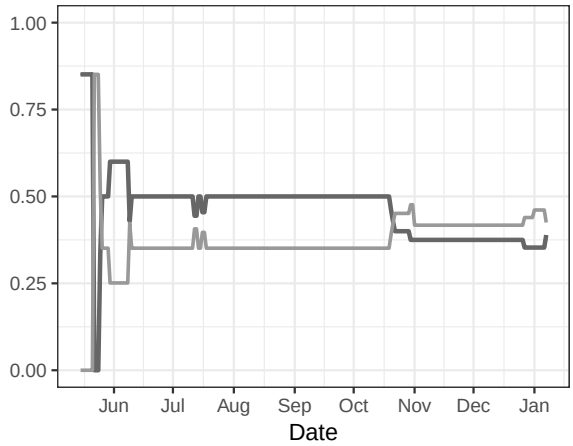


(c) Greco-Turkish War (1897)

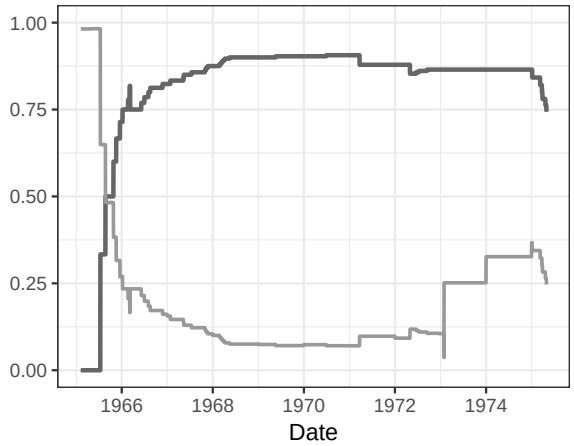


(d) World War II (1939 – 1945)

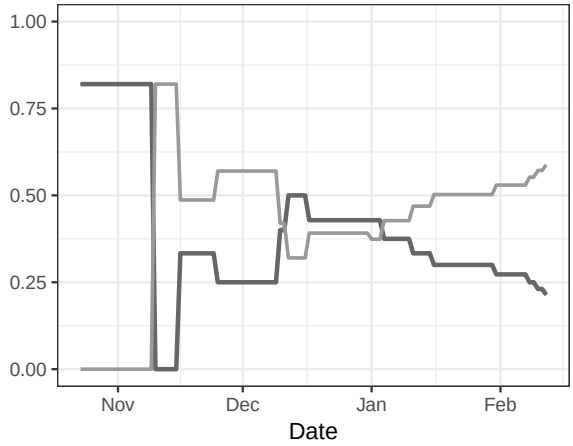
Figure 2: *Observed* (dark gray line) and *Inconsistency* (light gray line) for four post-1945 wars.



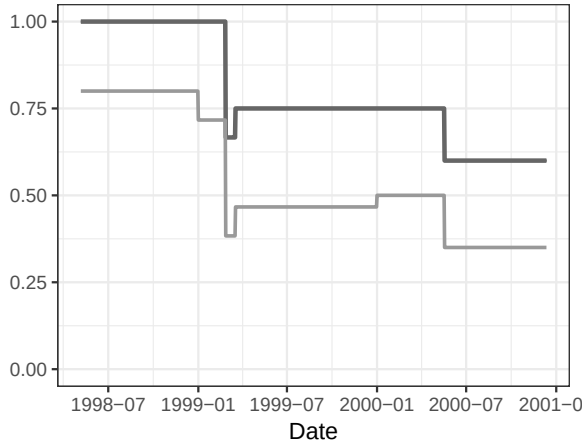
(a) Arab-Israeli War (1948 – 1949)



(b) Vietnam War (1965 – 1975)



(c) War over Angola (1975 – 1976)



(d) Badme Border (1998 – 2000)

Appendix E: Surprise

The analysis in the main text relies on a definition of inconsistency that tracks divergence between observed outcomes and expected outcomes, which are based on initial relative capabilities. Large differences between what p the belligerents may have expected at the outset of conflict and what they see from fighting are considered unexpected outcomes that are likely to promote updating.

Some may question the validity of treating an initial capability ratio as the "prior" for the entirety of the war, as this precludes any updating during the conflict itself. As such, in this appendix, I create an alternate measure of inconsistent outcomes which captures a more dynamic sense of updating. I call this measure *surprise*, and I use it to replicate the analysis in the main text.

Creating a Measure of Surprise

In order to create this variable, I first need a fluid measure of prior beliefs regarding the battlefield—that is, what outcomes belligerents expect to occur in the near future. This could then be compared with observed battlefield outcomes to create a measure of surprise.

Expected outcomes

The manner I use to determine this daily value depends on whether or not any battles have taken place. On days before any battles are completed, I use the *Prior* measure described in the main text. On all days after at least one battle has taken place, $Expected_{w,t} = Observed_{w,t}$. The rationale for this will become clearer when I formally define my variable for surprising battlefield activity. Regardless of how the measure is created, it is bounded between 0 and 1. Higher values indicate the expectation that the war initiator is likely to do well in fighting; lower values do so for the war target.

Surprising battlefield activity

I can use my measures of expected and observed fighting to gauge surprising activity on the battlefield. To do so, I compare fighting outcomes on a given war-day to expectations from 14 days prior. Stated more formally:

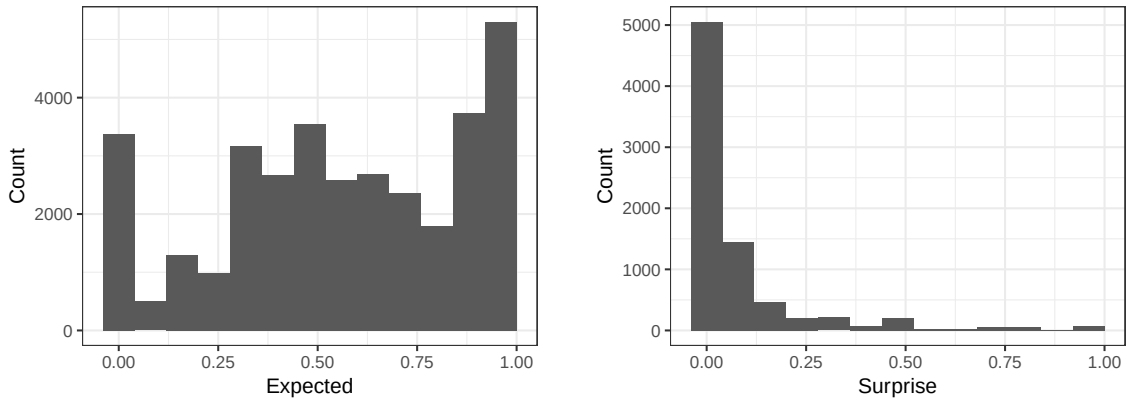
$$Surprise_{w,t} = |Observed_{w,t} - Expected_{w,t-14}|$$

Note that this measure is only defined starting on day 15 of hostilities. For all days 1 through 14, *Surprise* takes a value of zero.

The measure is designed so that if a battle concludes on some day t, the "surprise" associated with it lasts for 14 additional days. The shift in battlefield outcomes then becomes normalized and, barring any interceding battles, the measure returns to zero on day $t + 15$. Values near 1 indicate massive surprises on the battlefield that shatter recent expectations, regardless of which belligerent benefits or suffers. A value of zero reflects no changes or surprises from fighting. See Figure 3 for histograms of the *Expected* and *Surprise* variables.

Analysis

If we focus on short-term surprises instead of longer-term trends, informational and ripeness theories have contradictory expectations. The former suggests that surprising activities, which indicate a divergence between expected and observed fighting, are likely to make belligerents come closer to



(a) Expected outcomes. Higher values indicate expected success for war initiator.

(b) Surprising battlefield activity. To enhance visibility, zeroes are removed.

Figure 3: Histograms of variables related to surprise.

settlement. Meanwhile, the latter suggests that surprises, which present the opposite of stagnation, would motivate belligerents to keep fighting.

Table 7 displays the results. Model 1 (the first two columns) explore the role of surprising outcomes without controls. We see a positive and highly statistical significant coefficient for surprising battlefield activity with respect to negotiated war terminations. This is consistent with informational theories of war, which predict that unexpected outcomes are most effective in reshaping beliefs and getting belligerents closer to opening a viable bargaining range. On the other hand, this same term has no significance in explaining non-diplomatic war termination, suggesting that wars ending through military means are not driven by the same logic.

Model 2 (the last two columns) include a series of relevant controls. The main result still holds in support of informational theories of war, but its significance falls just short of the 95% level. Surprising battlefield activities increase the likelihood of war termination using diplomatic methods, but do not have any meaningful impact on non-diplomatic war termination. Note that most of the control variables behave similarly as they do in Table 2 of the main text.

As such, even when we use more dynamic notions of prior beliefs and inconsistent information, we obtain results that are more consistent with informational theories of war than with ripeness theory.

Table 7: Results of competing risks models on the relationship between surprising outcomes in the last 14 days and conflict termination. Standard errors in parentheses, hazard ratios in brackets.

	Termination			
	(1)		(2)	
	Negotiated	Military	Negotiated	Military
Surprise	2.149***	0.044	1.602*	−0.065
	(0.781)	(2.059)	(0.826)	(1.904)
	[8.573]	[1.045]	[4.962]	[0.937]
Issue salience			−0.913***	0.374
			(0.176)	(0.290)
			[0.401]	[1.454]
Contiguity			0.736**	−1.839***
			(0.375)	(0.633)
			[2.088]	[0.159]
Democracy			0.785**	0.252
			(0.332)	(0.484)
			[2.193]	[1.286]
Major/Nuclear			0.261	−0.329
			(0.350)	(0.588)
			[1.299]	[0.72]
Active battles			−0.264*	0.050
			(0.137)	(0.151)
			[0.768]	[1.051]
Active belligerents			−0.087	−0.931
			(0.430)	(0.782)
			[0.917]	[0.394]
Post-1945			0.114	0.656
			(0.343)	(0.470)
			[1.120]	[1.927]
Post-Cold War			−0.390	0.393
			(0.766)	(0.718)
			[0.677]	[1.481]
Events	53	30	53	30
Observations	34,015		34,015	
Log-likelihood	−634.040		−605.133	

$^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$

Appendix F: Recent Battles

In this appendix, I redo my analyses after replacing the measure of total completed battles (as seen in the main text) with a measure of recent battlefield intensity.

For each war-day, I count the number of battles that have ended in the previous 14 days. Unsurprisingly, I call this measure *recent battles*. Figure 4 shows the distribution of this variable.

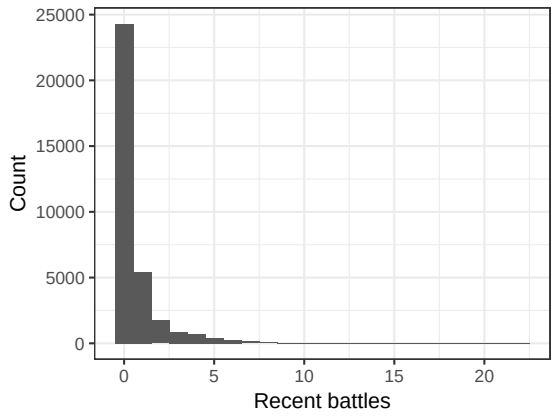


Figure 4: Histogram of the recent intensity variable.

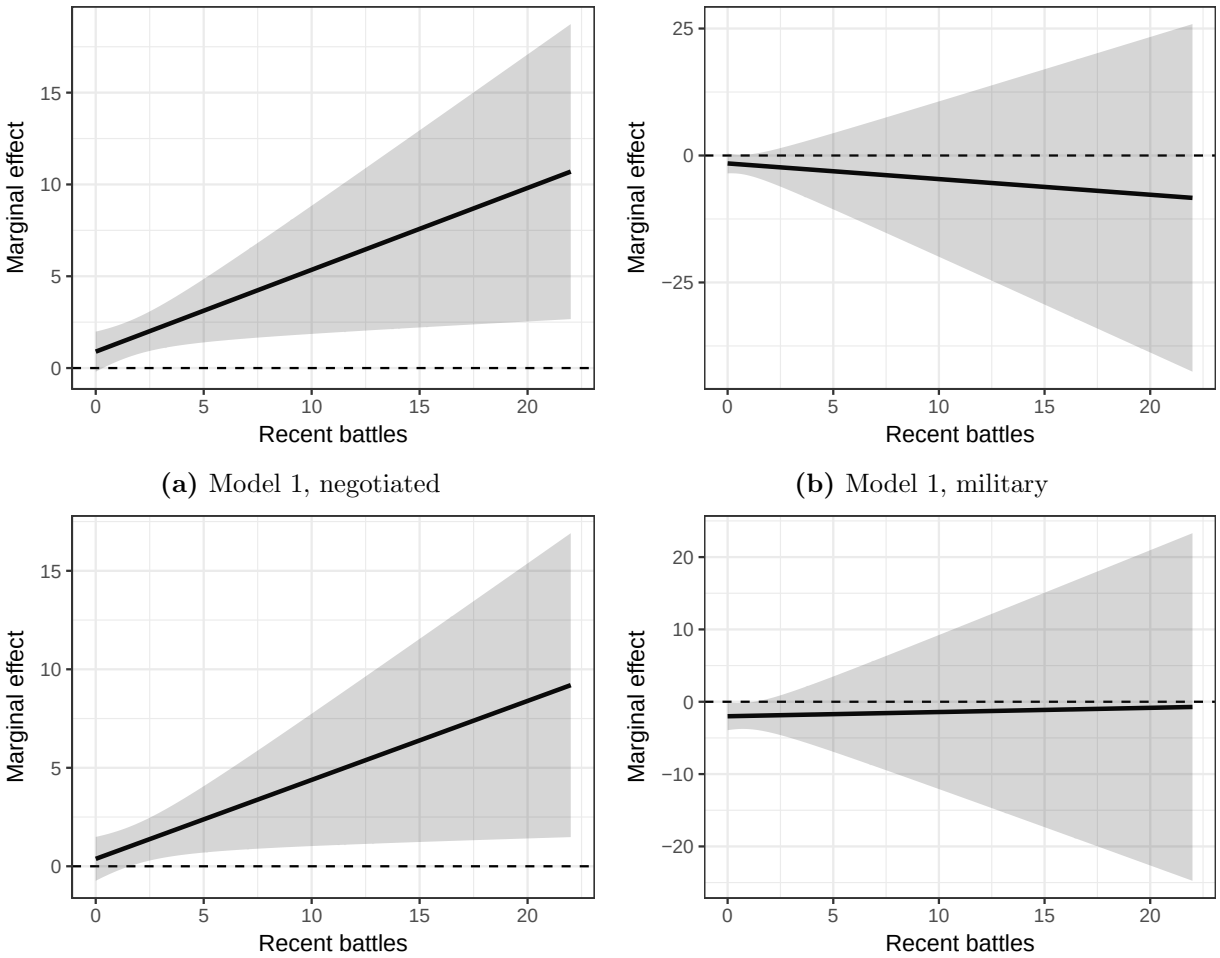
Table 8 and Figure 5 reproduce the main results concerning inconsistency. We see that even when we use a measure of recent battles, support for informational theories is quite strong. Observed fighting that is inconsistent with baseline beliefs increase the likelihood of a war ending through a negotiated settlement. This positive effect increases as the number of recent battles fought—and thus, the amount of recent information—rises.

Table 9 and Figure 6 analyze the interaction of stagnation and recent intensity on the battlefield. Once again, evidence for ripeness theory is very weak. There appears to be no meaningful relationship between stagnation and the likelihood of war termination by either negotiated or military means. This lack of relationship does not change as the amount of recent fighting increases.

Table 8: Results of competing risks models on the relationship between inconsistent outcomes and conflict termination, conditional on recent battlefield intensity in the last 14 days. Standard errors in parentheses, hazard ratios in brackets.

	Termination			
	(1)		(2)	
	Negotiated	Military	Negotiated	Military
Inconsistency × Recent battles	0.446**	−0.308	0.401**	0.058
	(0.197)	(0.808)	(0.189)	(0.572)
	[1.562]	[0.735]	[1.493]	[1.060]
Inconsistency	0.894	−1.561	0.377	−2.005**
	(0.557)	(1.000)	(0.568)	(0.985)
	[2.444]	[0.210]	[1.458]	[0.135]
Recent battles	0.124	0.116	0.220***	0.291**
	(0.079)	(0.142)	(0.075)	(0.114)
	[1.132]	[1.123]	[1.246]	[1.337]
Issue salience			−0.842***	0.382
			(0.183)	(0.282)
			[0.431]	[1.465]
Contiguity			0.560	−1.767***
			(0.388)	(0.613)
			[1.750]	[0.171]
Democracy			0.780**	0.207
			(0.331)	(0.496)
			[2.181]	[1.231]
Major/Nuclear			0.157	−0.385
			(0.357)	(0.585)
			[1.170]	[0.681]
Active battles			−0.373**	−0.066
			(0.147)	(0.176)
			[0.688]	[0.936]
Active belligerents			−0.380	−1.271
			(0.481)	(0.817)
			[0.684]	[0.281]
Post-1945			0.226	0.679
			(0.353)	(0.455)
			[1.253]	[1.972]
Post-Cold War			−0.468	0.577
			(0.774)	(0.726)
			[0.626]	[1.780]
Events	53	30	53	30
Observations	34,015		34,015	
Log-likelihood	−621.678		−585.780	

$^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$



(a) Model 1, negotiated

(b) Model 1, military

(c) Model 2, negotiated

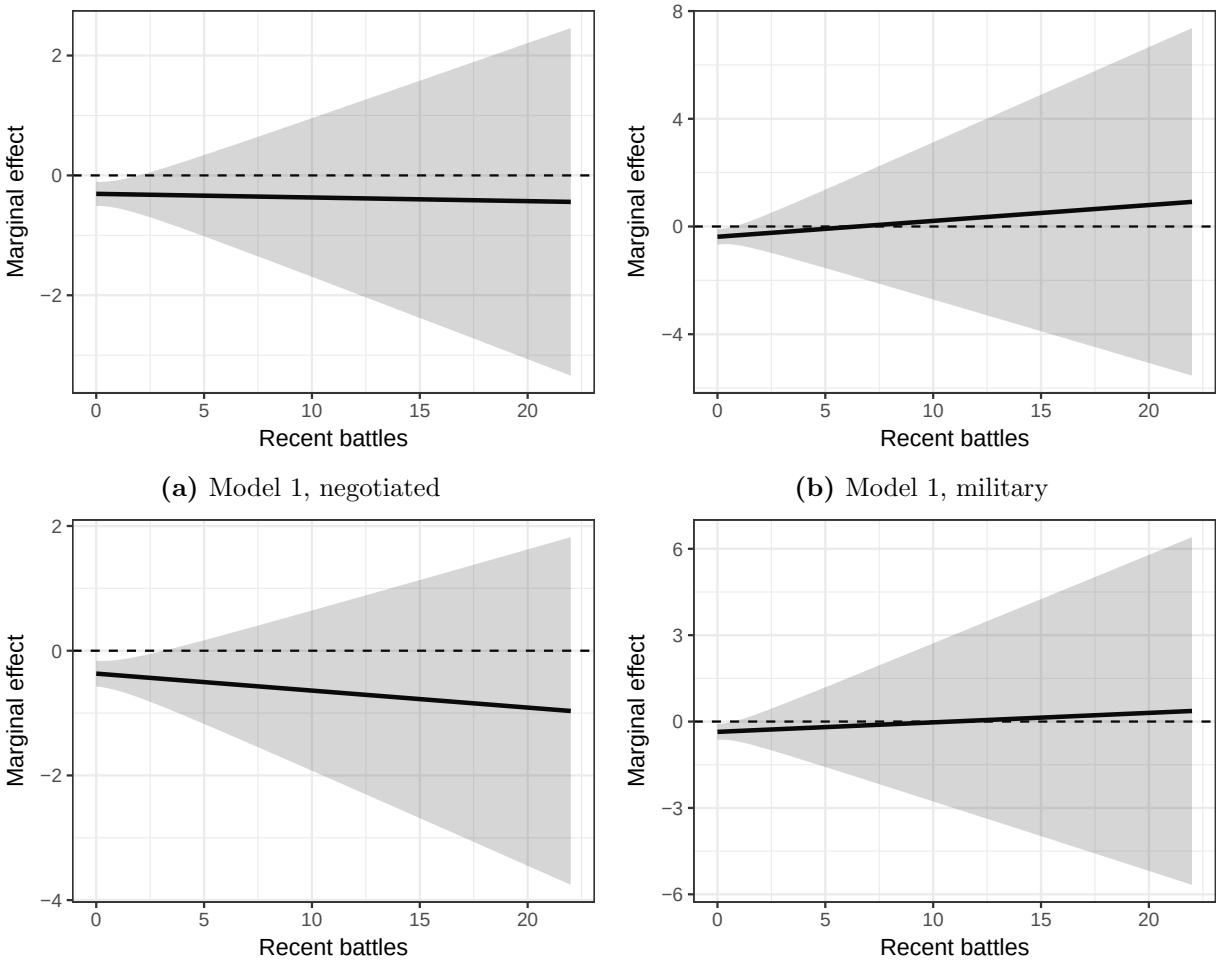
(d) Model 2, military

Figure 5: Marginal effect of inconsistency on war termination, but replacing completed battles with recent battles. Based on results from Table 8. Bands represent 95% confidence intervals.

Table 9: Results of competing risks models on the relationship between stagnation and conflict termination, conditional on recent battlefield intensity in the last 14 days. Standard errors in parentheses, hazard ratios in brackets.

	Termination			
	(1)		(2)	
	Negotiated	Military	Negotiated	Military
Stagnation × Recent battles	−0.006	0.059	−0.027	0.033
	(0.067)	(0.151)	(0.064)	(0.140)
	[0.994]	[1.061]	[0.973]	[1.034]
Stagnation	−0.308***	−0.382**	−0.367***	−0.358***
	(0.103)	(0.150)	(0.106)	(0.139)
	[0.735]	[0.683]	[0.693]	[0.699]
Recent battles	0.105	−0.204	0.262***	0.156
	(0.077)	(0.233)	(0.062)	(0.198)
	[1.110]	[0.816]	[1.299]	[1.169]
Issue salience			−0.722***	0.413
			(0.177)	(0.279)
			[0.486]	[1.511]
Contiguity			0.459	−1.693***
			(0.375)	(0.577)
			[1.582]	[0.184]
Democracy			0.705**	0.109
			(0.323)	(0.478)
			[2.024]	[1.115]
Major/Nuclear			0.045	−0.439
			(0.348)	(0.550)
			[1.046]	[0.645]
Active battles			−0.525***	−0.122
			(0.166)	(0.188)
			[0.591]	[0.886]
Active belligerents			−0.328	−1.054
			(0.450)	(0.764)
			[0.721]	[0.349]
Post-1945			0.267	0.732
			(0.344)	(0.454)
			[1.306]	[2.080]
Post-Cold War			−0.25	0.406
			(0.766)	(0.711)
			[0.779]	[1.501]
Events	53	30	53	30
Observations	34,015		34,015	
Log-likelihood	−621.385		−582.545	

$^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$



(a) Model 1, negotiated

(b) Model 1, military

(c) Model 2, negotiated

(d) Model 2, military

Figure 6: Marginal effect of stagnation on war termination, but replacing completed battles with recent battles. Based on results from Table 9. Bands represent 95% confidence intervals.

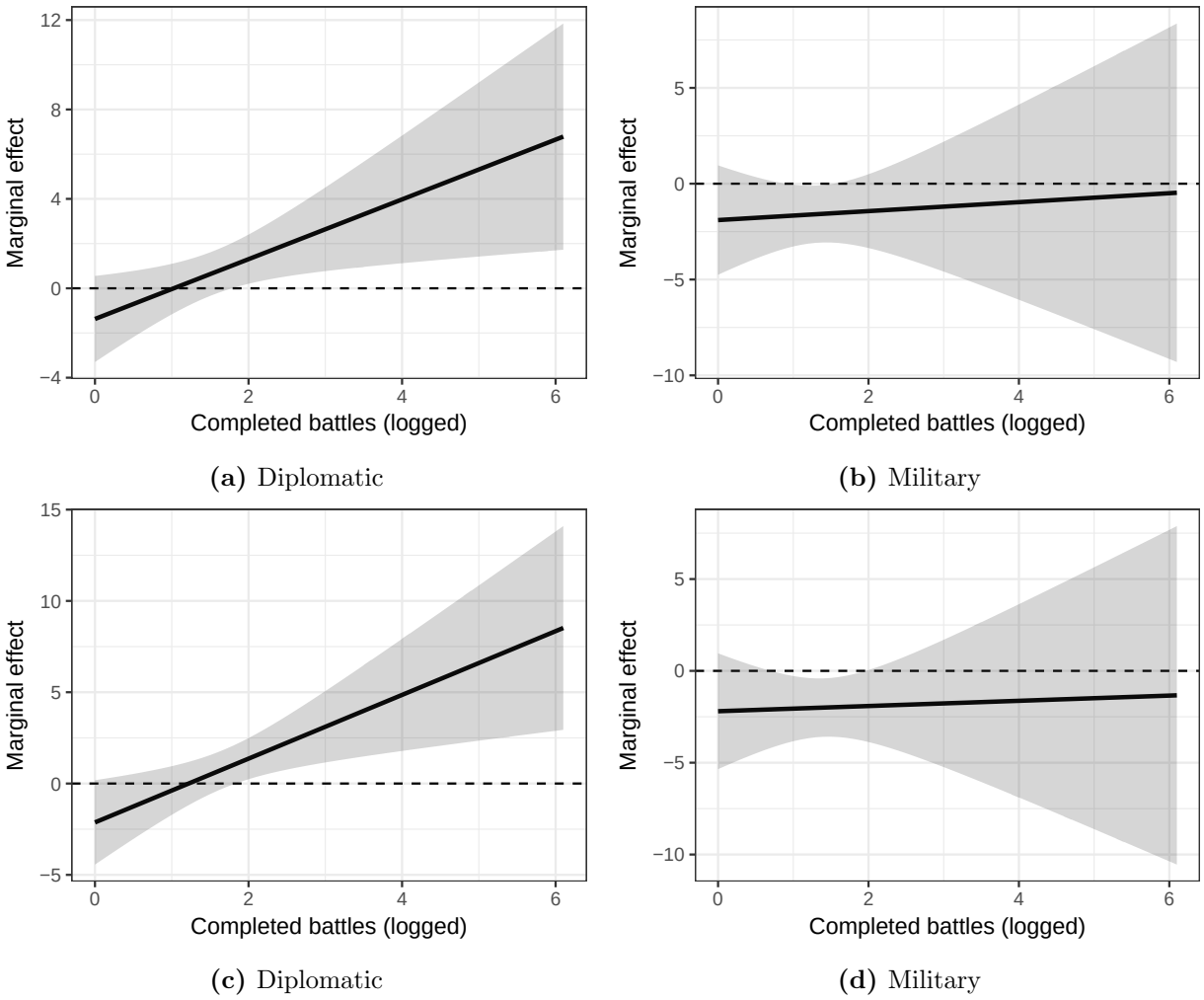
Appendix G: COW Data

Below, I present the results of the same competing risk models using COW data. Table 10 and Figure 7 show the impact of inconsistency conditional on past fighting; Table 11 and 8 illustrate the interaction of stagnation and past fighting. These results are similar to those obtained using the IWD in the main analysis.

Table 10: Results of competing risks models on the relationship between inconsistent outcomes and conflict termination, conditional on completed battles and using COW data. Standard errors in parentheses, hazard ratios in brackets.

	Termination			
	(1)		(2)	
	Negotiated	Military	Negotiated	Military
Inconsistency × Completed battles	1.337**	0.234	1.745***	0.142
	(0.554)	(0.932)	(0.630)	(0.987)
	[3.809]	[1.263]	[5.728]	[1.152]
Inconsistency	−1.373	−1.898	−2.128*	−2.197
	(0.982)	(1.456)	(1.178)	(1.609)
	[0.253]	[0.150]	[0.119]	[0.111]
Completed battles	−0.377**	−0.392**	−0.032	−0.168
	(0.158)	(0.188)	(0.200)	(0.229)
	[0.686]	[0.676]	[0.968]	[0.846]
Issue salience			−1.153***	0.023
			(0.186)	(0.236)
			[0.316]	[1.024]
Contiguity			0.730**	0.158
			(0.324)	(0.433)
			[2.076]	[1.171]
Democracy			0.772***	0.515
			(0.301)	(0.409)
			[2.164]	[1.674]
Major/Nuclear			−0.048	0.773*
			(0.311)	(0.438)
			[0.954]	[2.166]
Active battles			−0.431***	0.009
			(0.151)	(0.142)
			[0.650]	[1.009]
Active belligerents			0.603	−0.737
			(0.406)	(0.550)
			[1.828]	[0.478]
Post-1945			0.229	0.125
			(0.314)	(0.439)
			[1.258]	[1.134]
Post-Cold War			−0.161	1.135*
			(0.641)	(0.612)
			[0.851]	[3.110]
Events	53	30	53	30
Observations	36,998		36,998	
Log-likelihood	−693.277		−661.249	

$^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$



(a) Diplomatic **(b)** Military

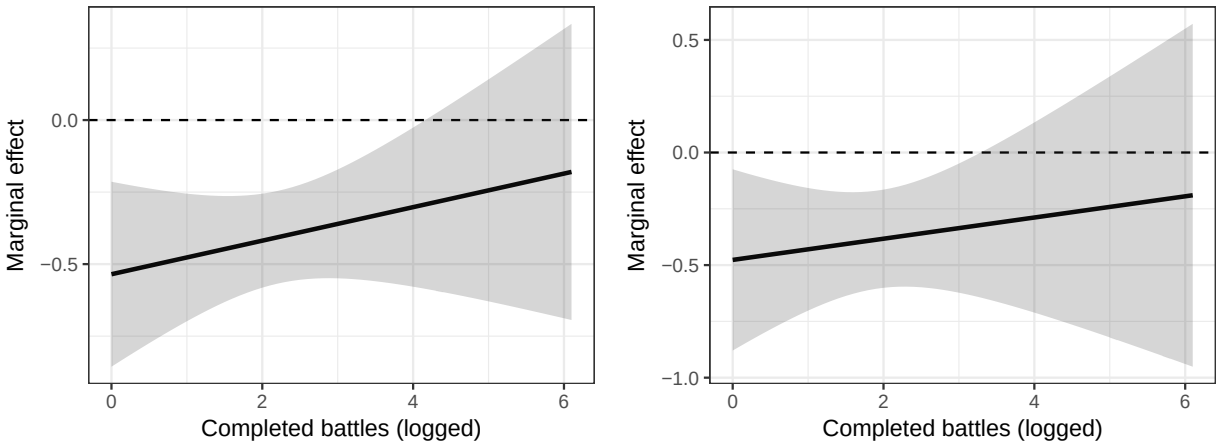
(c) Diplomatic **(d)** Military

Figure 7: Marginal effect of inconsistency on war termination, using COW data. Based on results from Table 10. Bands represent 95% confidence intervals.

Table 11: Results of competing risks models on the relationship between stagnation and conflict termination, conditional on completed battles and using COW data. Standard errors in parentheses, hazard ratios in brackets.

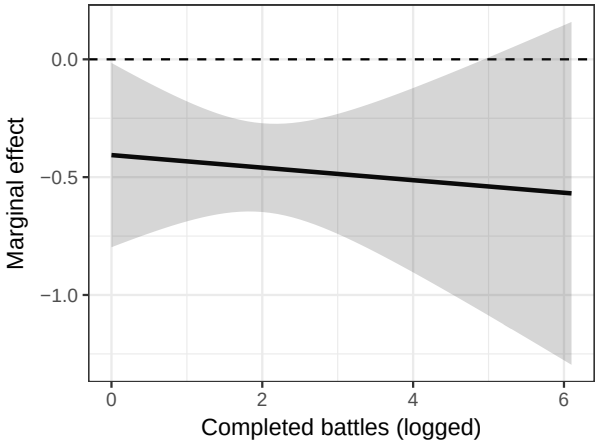
	Termination			
	(1)		(2)	
	Negotiated	Military	Negotiated	Military
Stagnation × Completed battles	0.058	0.047	−0.027	0.006
	(0.064)	(0.089)	(0.087)	(0.107)
	[1.060]	[1.048]	[0.974]	[1.006]
Stagnation	−0.535***	−0.477**	−0.406**	−0.446**
	(0.164)	(0.205)	(0.200)	(0.223)
	[0.586]	[0.621]	[0.666]	[0.640]
Completed battles	−0.31**	−0.469**	0.432*	−0.149
	(0.156)	(0.237)	(0.259)	(0.323)
	[0.733]	[0.626]	[1.541]	[0.861]
Issue salience			−0.925***	0.056
			(0.178)	(0.232)
			[0.397]	[1.057]
Contiguity			0.397	0.122
			(0.312)	(0.437)
			[1.488]	[1.129]
Democracy			0.654**	0.198
			(0.288)	(0.408)
			[1.924]	[1.219]
Major/Nuclear			−0.034	0.629
			(0.303)	(0.437)
			[0.967]	[1.876]
Active battles			−0.570***	−0.119
			(0.171)	(0.169)
			[0.565]	[0.888]
Active belligerents			0.118	−0.573
			(0.420)	(0.562)
			[1.126]	[0.564]
Post-1945			0.294	0.195
			(0.311)	(0.444)
			[1.342]	[1.216]
Post-Cold War			0.144	1.135*
			(0.648)	(0.598)
			[1.155]	[3.113]
Events	53	30	53	30
Observations	36,998		36,998	
Log-likelihood	−681.437		−652.054	

$^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$

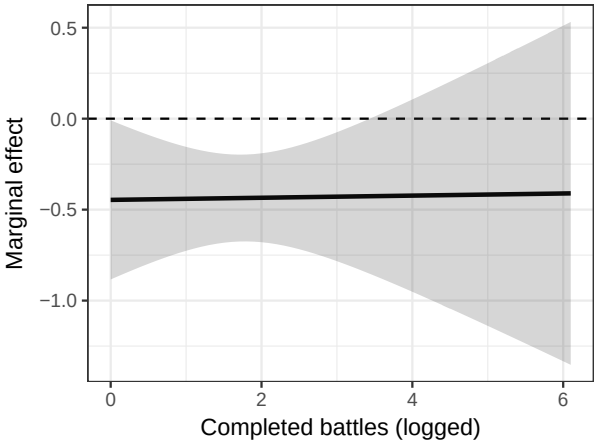


(a) Diplomatic

(b) Military



(c) Diplomatic



(d) Military

Figure 8: Marginal effect of stagnation on war termination, using COW data. Based on results from Table 11. Bands represent 95% confidence intervals.

Appendix H: Truncated Data

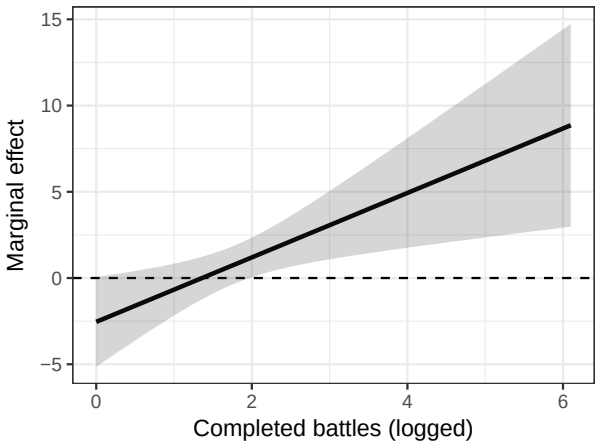
In the main analysis, war-days where no battles have yet been completed are given a *Observed* measure based on CINC ratios. 3,265 days fall into this category. All days featuring these CINC ratios will, by definition, have an *Inconsistency* measure of 0. There may be some concerns that these somewhat arbitrarily defined observations unduly affect the results.

Tables 12 and 13 perform the same analyses as Table 2 and 3 in the main text after removing these observations. Figures 9 and 10 present respective marginal effects plots. Two wars—the Ecuadorian-Colombian War and the Soviet Invasion of Hungary—are removed because they only have a single day of data. All estimates remain substantively similar to those in the main text.

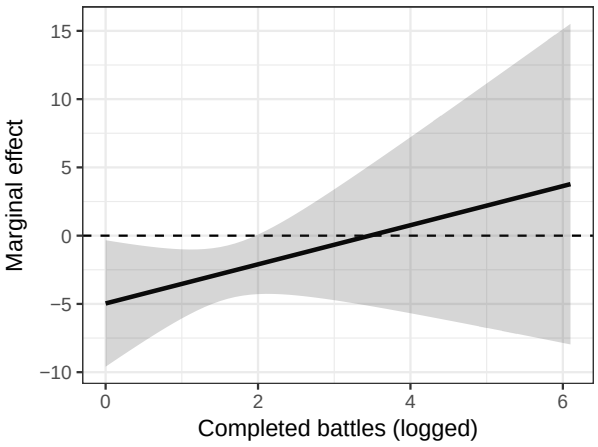
Table 12: Results of competing risks models on the relationship between inconsistent outcomes and conflict termination, conditional on completed battles and using truncated data. Standard errors in parentheses, hazard ratios in brackets.

	Termination			
	(1)		(2)	
	Negotiated	Military	Negotiated	Military
Inconsistency × Completed battles	1.869***	1.433	1.764**	1.064
	(0.680)	(1.320)	(0.765)	(1.322)
	[6.481]	[4.190]	[5.836]	[2.897]
Inconsistency	−2.542*	−4.966**	−2.445	−4.179*
	(1.326)	(2.363)	(1.550)	(2.290)
	[0.079]	[0.007]	[0.087]	[0.015]
Completed battles	−0.672***	−0.959***	−0.163	−0.709*
	(0.236)	(0.327)	(0.288)	(0.382)
	[0.510]	[0.383]	[0.849]	[0.492]
Issue salience			−1.019***	0.341
			(0.192)	(0.307)
			[0.361]	[1.407]
Contiguity			0.887**	−1.969***
			(0.402)	(0.672)
			[2.428]	[0.140]
Democracy			0.922***	0.476
			(0.353)	(0.491)
			[2.514]	[1.610]
Major/Nuclear			0.276	−0.821
			(0.385)	(0.623)
			[1.318]	[0.440]
Active battles			−0.328**	0.124
			(0.152)	(0.157)
			[0.721]	[1.132]
Active belligerents			−0.181	−0.479
			(0.462)	(0.815)
			[0.834]	[0.619]
Post-1945			0.079	0.666
			(0.364)	(0.482)
			[1.082]	[1.946]
Post-Cold War			−0.105	0.487
			(0.793)	(0.767)
			[0.900]	[1.627]
Events	53	28	53	28
Observations	32,247		32,247	
Log-likelihood	−601.573		−574.694	

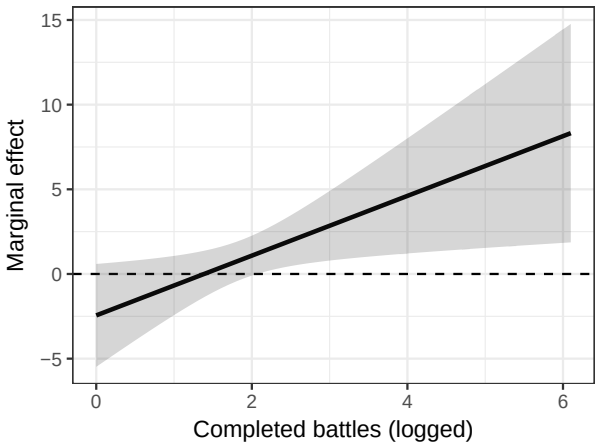
$^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$



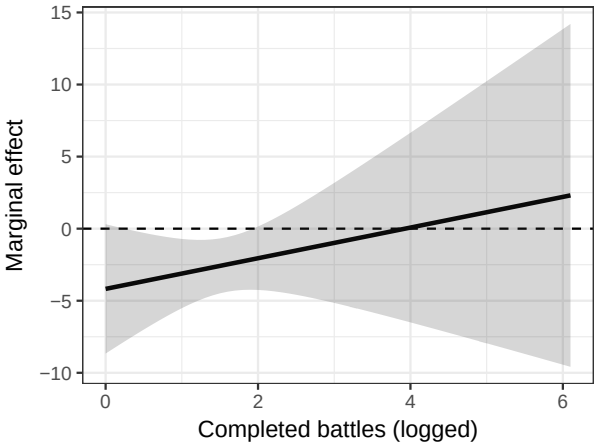
(a) Model 1, negotiated



(b) Model 1, military



(c) Model 2, negotiated



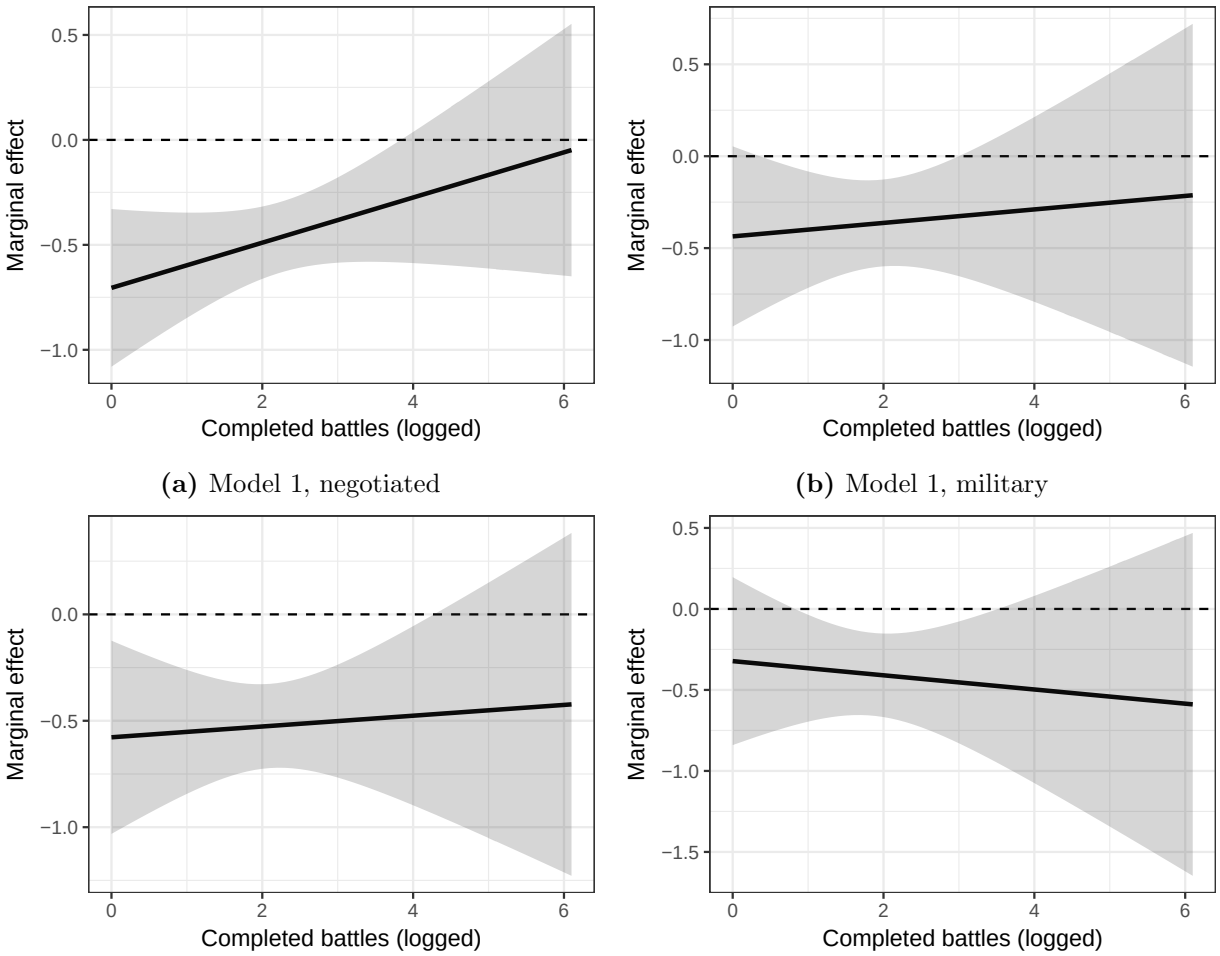
(d) Model 2, military

Figure 9: Marginal effect of inconsistency on war termination, using truncated data. Based on results from Table 12. Bands represent 95% confidence intervals.

Table 13: Results of competing risks models on the relationship between stagnation and conflict termination, conditional on completed battles and using truncated data. Standard errors in parentheses, hazard ratios in brackets.

	Termination			
	(1)		(2)	
	Negotiated	Military	Negotiated	Military
Stagnation × Completed battles	0.108	0.037	0.025	−0.044
	(0.076)	(0.111)	(0.099)	(0.124)
	[1.114]	[1.037]	[1.026]	[0.957]
Stagnation	−0.705***	−0.436*	−0.578**	−0.322
	(0.192)	(0.25)	(0.232)	(0.264)
	[0.494]	[0.646]	[0.561]	[0.725]
Completed battles	−0.538***	−0.619*	0.222	−0.134
	(0.191)	(0.319)	(0.294)	(0.410)
	[0.584]	[0.538]	[1.249]	[0.875]
Issue salience			−0.825***	0.450
			(0.180)	(0.308)
			[0.438]	[1.568]
Contiguity			0.549	−2.050***
			(0.385)	(0.625)
			[1.732]	[0.129]
Democracy			0.776**	0.200
			(0.336)	(0.481)
			[2.172]	[1.222]
Major/Nuclear			0.144	−0.657
			(0.366)	(0.578)
			[1.155]	[0.519]
Active battles			−0.503***	−0.061
			(0.174)	(0.194)
			[0.604]	[0.941]
Active belligerents			−0.407	−0.612
			(0.481)	(0.794)
			[0.665]	[0.542]
Post-1945			0.200	0.776
			(0.354)	(0.486)
			[1.222]	[2.172]
Post-Cold War			0.161	0.355
			(0.793)	(0.737)
			[1.175]	[1.427]
Events	53	28	53	28
Observations	32,247		32,247	
Log-likelihood	−592.693		−565.176	

$^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$



(a) Model 1, negotiated

(b) Model 1, military

(c) Model 2, negotiated

(d) Model 2, military

Figure 10: Marginal effect of stagnation on war termination, using truncated data. Based on results from Table 13. Bands represent 95% confidence intervals.

Appendix I: Weighted Battles

The main study treats all battles as equal units. This is obviously a simplification. Based on a variety of factors, different battles provide different degrees of information. Due to inconsistent, missing, or contested data on casualties and troop commitments, there are clear limitations to our ability to assign highly specific weights to individual battles.

Nevertheless, this appendix tries several strategies to assign different weights to individual battles based on their "impact" on shaping belligerents' beliefs. These include "surprising" victories and battle duration. After re-weighting battles using one of these methods, I recalculate the *Inconsistency* variable. I then redo the same analysis using the same competing risk models. My main findings remain robust across all methods.

I.1: "Surprising" Victories

Parties that take the offensive select into battles where they have tactical and strategic advantages and believe they will likely win.[34] Losing a battle one initiates is surprising, falls short of the attacker's expectations, and thus may bear greater informational weight.

Defining Attacker and Defender

Two tightly related criteria help to identify the attacker and defender of each battle: occupation and movement. (Note the distinction in terminology, where "initiator" and "target" refer to the overall war, and "attacker" and "defender" refer to individual battles.) In most battles, a specific military objective such as a fort or other territory is being contested. The defender is the party that already occupies the objective and and is not actively moving. The attacker is the party that is seeking to destroy/seize the objective and is moving toward it. Approximately 90% of battles are straightforward to code in this regard. In the remaining 10%, no information on occupation is provided. This may involve new objectives, "incidental" encounters on the battlefield, or simple omissions that arise from writing narratives that do not systematically list this information. For those situations, the side that makes the initial move toward the other is coded as the attacker.

	Battle Attacker	**Inconclusive**	**Battle Defender**	*Total*
War Initiator	540 (0.326) 1		242 (0.146) v	782 (0.472)
Inconclusive		70 (0.042) 0		70 (0.042)
War Target	571 (0.345) -1		233 (0.141) $-v$	804 (0.486)
Total	1,101 (0.665)	70 (0.042)	475 (0.287)	1,656 (1.000)

Table 14: Distribution of all battle victories according to which party started the overall war and which party started the battle in question. First line lists raw counts and proportions. Second line has battle scores used to create fighting data. In this paper, $v = 2$.

Table 14 displays the distribution of battle outcomes according to (1) whether the victor was the overall war initiator or war target and (2) whether the victor was the battle attacker or the battle defender. We see that even though war initiators and targets win a roughly equal number of battles across time, battle attackers win about two-thirds of all battles. This points to a manifestation of

[34] Luttwak, Edward N. 1987. *Strategy: The Logic of War and Peace.* Cambridge, MA: Belknap Press.

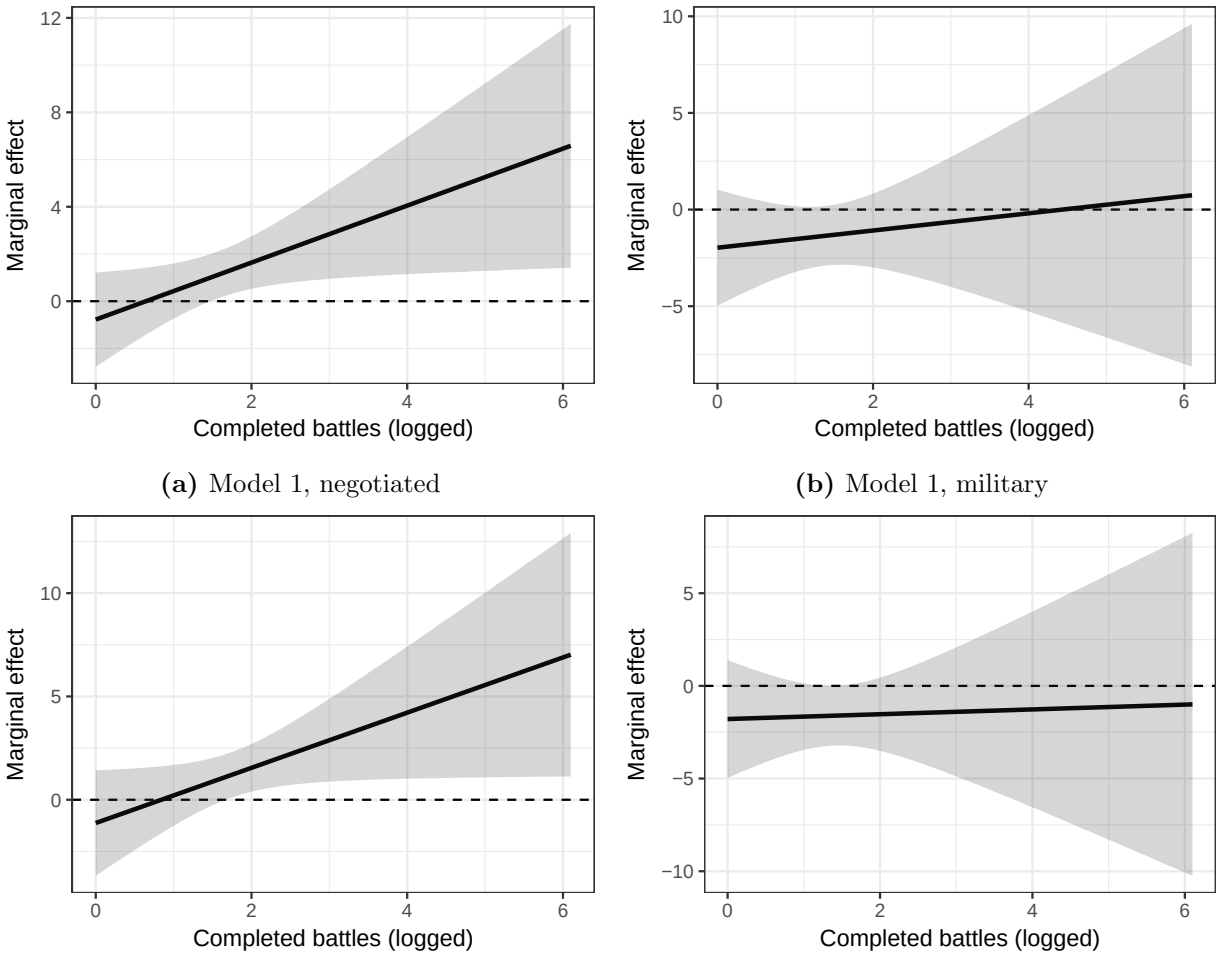
the first-mover advantage. I give battles won by defenders a weight of $v = 2$ to roughly reflect this ratio.

Using these re-weighted battle outcomes, I redo the analysis involving inconsistent battlefield outcomes. Table 15 shows the coefficient estimates, and Figure 11 displays marginal effects plots. All results are effectively the same as those in the main text.

Table 15: Results of competing risks models on the relationship between inconsistent outcomes and conflict termination, conditional on completed battles and using battle data re-weighted by attacker/defender. Standard errors in parentheses, hazard ratios in brackets.

	Termination			
	(1)		(2)	
	Negotiated	Military	Negotiated	Military
Inconsistency × Completed battles	1.207**	0.445	1.336**	0.130
	(0.569)	(0.946)	(0.677)	(0.991)
	[3.344]	[1.560]	[3.802]	[1.138]
Inconsistency	−0.779	−1.974	−1.126	−1.788
	(1.018)	(1.532)	(1.303)	(1.621)
	[0.459]	[0.139]	[0.324]	[0.167]
Completed battles	−0.322*	−0.463**	0.124	−0.247
	(0.170)	(0.198)	(0.236)	(0.253)
	[0.725]	[0.629]	[1.133]	[0.781]
Issue salience			−1.073***	0.415
			(0.195)	(0.289)
			[0.342]	[1.515]
Contiguity			0.964**	−1.690***
			(0.400)	(0.587)
			[2.623]	[0.185]
Democracy			0.920***	0.294
			(0.357)	(0.501)
			[2.508]	[1.342]
Major/Nuclear			0.260	−0.380
			(0.384)	(0.548)
			[1.296]	[0.684]
Active battles			−0.411***	0.083
			(0.160)	(0.155)
			[0.663]	[1.086]
Active belligerents			−0.264	−0.912
			(0.476)	(0.825)
			[0.768]	[0.402]
Post-1945			0.174	0.511
			(0.368)	(0.446)
			[1.190]	[1.667]
Post-Cold War			−0.366	0.349
			(0.788)	(0.769)
			[0.693]	[1.417]
Events	53	30	53	30
Observations	34,015		34,015	
Log-likelihood	−626.068		−596.695	

$^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$



(a) Model 1, negotiated

(b) Model 1, military

(c) Model 2, negotiated

(d) Model 2, military

Figure 11: Marginal effect of inconsistency on war termination, using battle data re-weighted by attacker/defender. Based on results from Table 15. Bands represent 95% confidence intervals.

I.2: Battle Duration

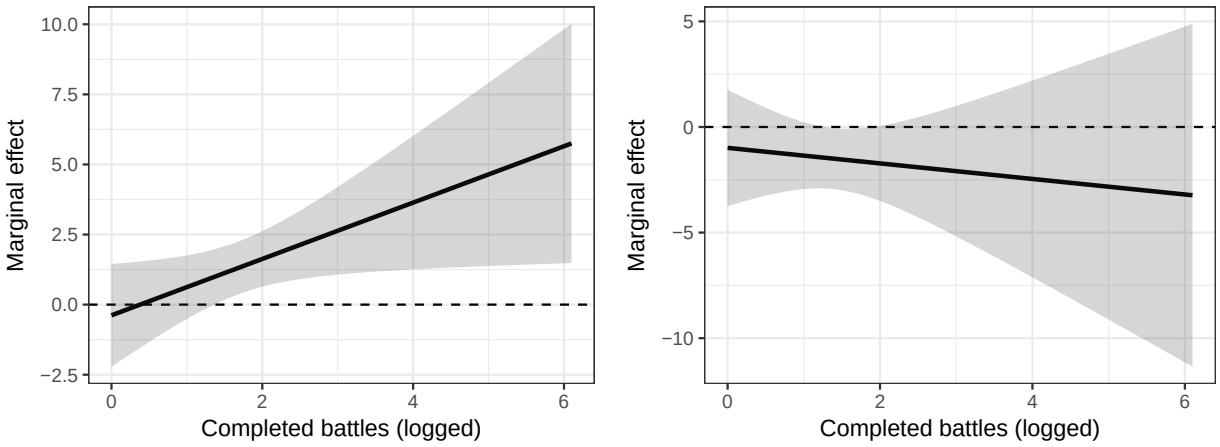
In the main text, I re-weight battles by their raw length in d days. Battles won by a war initiator get a score of $+d$, and those won by the war target get a score of $-d$. The results are robust to this re-weighting. Here, we try logged values: I assign a score of $+[\log d + 1]$ when the war initiator wins and $-[\log d + 1]$ when the war target wins.

Table 16 and Figure 12 show the results of competing risk models with battles re-weighted by their raw length. Tables 17 and Figure 13 show the results using logged battle lengths. Both continue to support the main finding with respect to informational theories of war.

Table 16: Results of competing risks models on the relationship between inconsistent outcomes and conflict termination, conditional on completed battles and using battle data re-weighted by raw battle length. Standard errors in parentheses, hazard ratios in brackets.

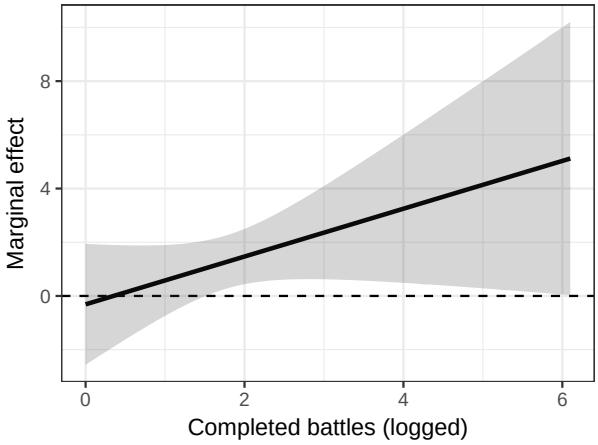
	Termination			
	(1)		(2)	
	Negotiated	Military	Negotiated	Military
Inconsistency × Completed battles	1.005**	−0.368	0.890	−0.436
	(0.480)	(0.865)	(0.586)	(0.914)
	[2.732]	[0.692]	[2.436]	[0.646]
Inconsistency	−0.381	−0.988	−0.313	−1.088
	(0.935)	(1.406)	(1.149)	(1.463)
	[0.683]	[0.372]	[0.731]	[0.337]
Completed battles	−0.282*	−0.356**	0.180	−0.163
	(0.170)	(0.177)	(0.241)	(0.240)
	[0.754]	[0.700]	[1.197]	[0.850]
Issue salience			−1.003***	0.397
			(0.194)	(0.302)
			[0.367]	[1.488]
Contiguity			0.776**	−1.580***
			(0.395)	(0.601)
			[2.172]	[0.206]
Democracy			0.906**	0.288
			(0.361)	(0.486)
			[2.474]	[1.334]
Major/Nuclear			0.519	−0.527
			(0.389)	(0.548)
			[1.681]	[0.590]
Active battles			−0.449***	0.114
			(0.167)	(0.147)
			[0.638]	[1.121]
Active belligerents			−0.104	−1.169
			(0.495)	(0.890)
			[0.902]	[0.311]
Post-1945			−0.044	0.655
			(0.364)	(0.462)
			[0.957]	[1.926]
Post-Cold War			−0.034	0.291
			(0.788)	(0.739)
			[0.967]	[1.338]
Events	53	30	53	30
Observations	34,015		34,015	
Log-likelihood	−624.138		−596.496	

$^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$

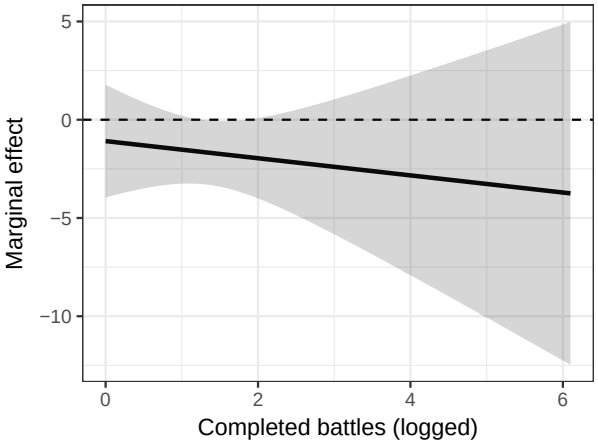


(a) Model 1, negotiated

(b) Model 1, military



(c) Model 2, negotiated



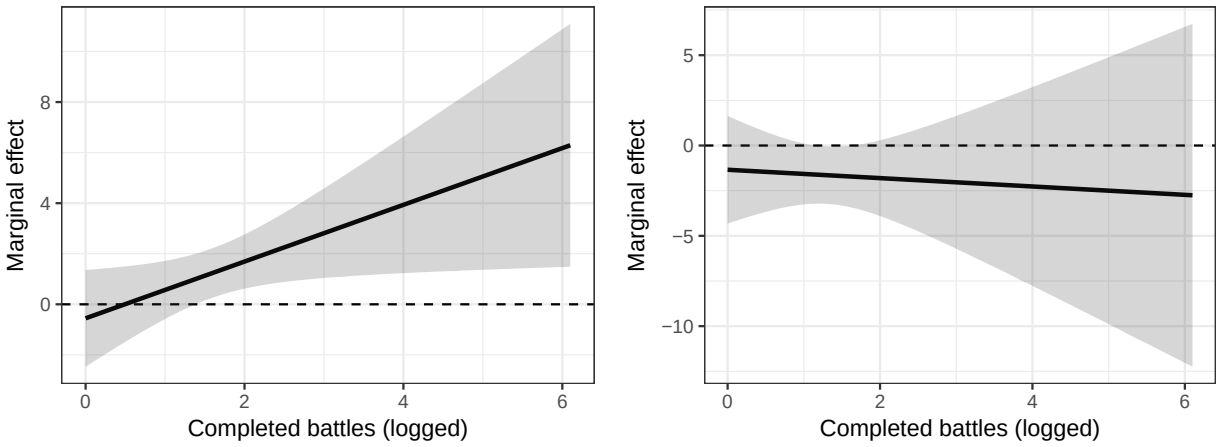
(d) Model 2, military

Figure 12: Marginal effect of inconsistency on war termination, using battle data re-weighted by raw battle lengths. Based on results from Table 16. Bands represent 95% confidence intervals.

Table 17: Results of competing risks models on the relationship between inconsistent outcomes and conflict termination, conditional on completed battles and using battle data re-weighted by logged battle length. Standard errors in parentheses, hazard ratios in brackets.

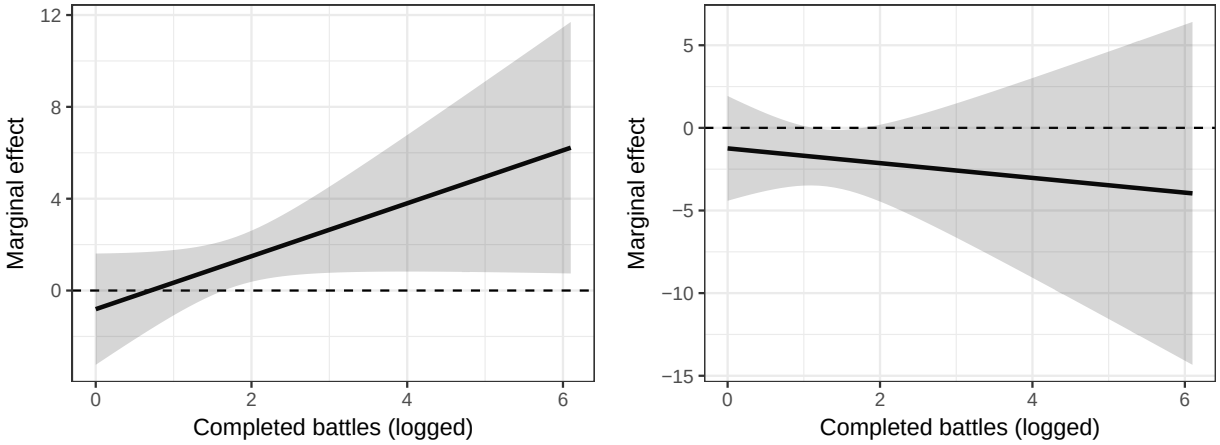
	Termination			
	(1)		(2)	
	Negotiated	Military	Negotiated	Military
Inconsistency × Completed battles	1.122**	−0.231	1.153*	−0.446
	(0.531)	(0.994)	(0.631)	(1.079)
	[3.071]	[0.793]	[3.167]	[0.64]
Inconsistency	−0.554	−1.342	−0.812	−1.241
	(0.977)	(1.521)	(1.237)	(1.618)
	[0.575]	[0.261]	[0.444]	[0.289]
Completed battles	−0.312*	−0.364*	0.148	−0.149
	(0.173)	(0.196)	(0.233)	(0.262)
	[0.732]	[0.695]	[1.160]	[0.862]
Issue salience			−1.037***	0.413
			(0.193)	(0.294)
			[0.355]	[1.511]
Contiguity			0.878**	−1.656***
			(0.397)	(0.593)
			[2.406]	[0.191]
Democracy			0.865**	0.273
			(0.364)	(0.494)
			[2.376]	[1.314]
Major/Nuclear			0.405	−0.441
			(0.386)	(0.545)
			[1.500]	[0.643]
Active battles			−0.421***	0.111
			(0.159)	(0.152)
			[0.656]	[1.118]
Active belligerents			−0.186	−1.073
			(0.484)	(0.871)
			[0.830]	[0.342]
Post-1945			0.091	0.561
			(0.365)	(0.446)
			[1.095]	[1.752]
Post-Cold War			−0.165	0.364
			(0.787)	(0.750)
			[0.848]	[1.439]
Events	53	30	53	30
Observations	34,015		34,015	
Log-likelihood	−625.063		−596.489	

$^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$



(a) Model 1, negotiated

(b) Model 1, military



(c) Model 2, negotiated

(d) Model 2, military

Figure 13: Marginal effect of inconsistency on war termination, using battle data re-weighted by logged battle lengths. Based on results from Table 17. Bands represent 95% confidence intervals.

Appendix J: Multilateral Wars

The IWD disaggregates multilateral wars into smaller sub-conflicts involving individual dyads. My battle data are not designed to be disaggregated in a similar manner, as many battles in multilateral wars involve multiple states on each side.

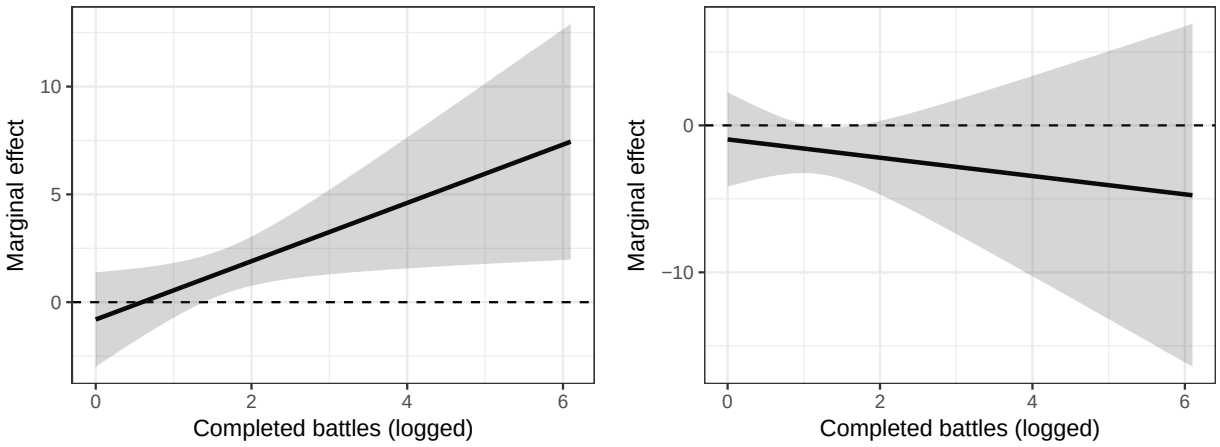
We can assess whether multilateral wars affect my results by removing wars with the highest number of sub-conflicts. I therefore redo the analysis after omitting the four conflicts with the highest number of dyads in conflict, according to the IWD: World War I (15), World War II (54), Korean War (16), and the Gulf War (17).

Table 18 and Figure 14 display results involving inconsistency. Table 19 and Figure 15 display results regarding battlefield stagnation. The results remain broadly unchanged. The marginal effects on negotiated settlements in Model 2 are weaker, but remain largely statistically significant at the 95% level. We therefore continue to see support for the informational theory of war. We see stronger evidence against ripeness theory: the negative relationship between stagnation and war termination is statistically significant at most values of completed battles. Moreover, as the number of completed battles increases, this negative effect becomes stronger. This differs from most other results, both in the main text and these appendices, involving stagnation.

Table 18: Results of competing risks models on the relationship between inconsistent outcomes and conflict termination, conditional on completed battles and removing highly multilateral wars. Standard errors in parentheses, hazard ratios in brackets.

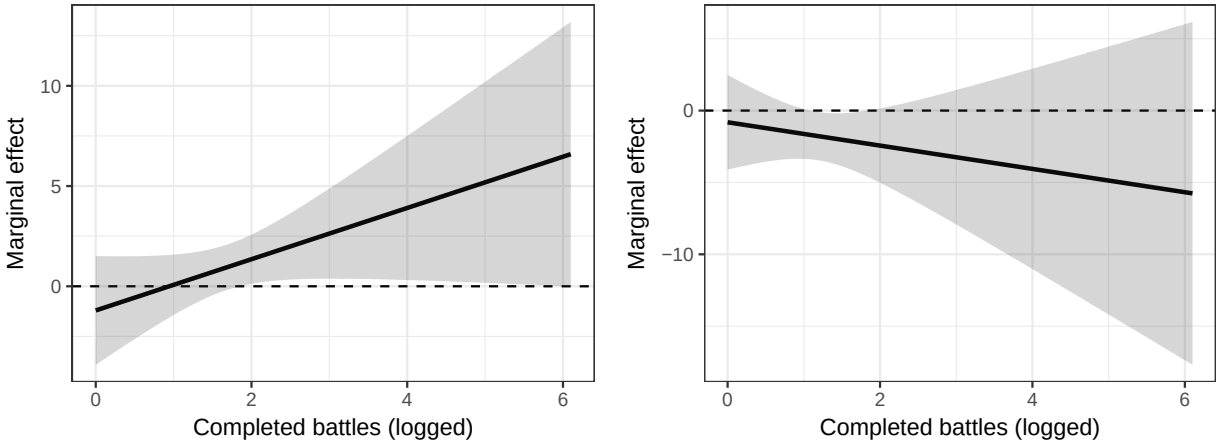
	Termination			
	(1)		(2)	
	Negotiated	Military	Negotiated	Military
Inconsistency × Completed battles	1.352**	−0.623	1.278*	−0.811
	(0.610)	(1.199)	(0.750)	(1.225)
	[3.865]	[0.536]	[3.591]	[0.444]
Inconsistency	−0.803	−0.954	−1.207	−0.813
	(1.117)	(1.638)	(1.384)	(1.682)
	[0.448]	[0.385]	[0.299]	[0.443]
Completed battles	−0.169	−0.315	0.221	−0.175
	(0.218)	(0.223)	(0.280)	(0.277)
	[0.845]	[0.730]	[1.248]	[0.839]
Issue salience			−1.056***	0.361
			(0.215)	(0.308)
			[0.348]	[1.435]
Contiguity			0.843**	−1.436**
			(0.418)	(0.580)
			[2.323]	[0.238]
Democracy			0.912***	0.233
			(0.348)	(0.501)
			[2.489]	[1.262]
Major/Nuclear			0.317	−0.303
			(0.383)	(0.546)
			[1.373]	[0.739]
Active battles			−0.075	0.168
			(0.183)	(0.257)
			[0.928]	[1.182]
Active belligerents			0.213	−0.839
			(0.721)	(1.021)
			[1.238]	[0.432]
Post-1945			0.041	0.512
			(0.390)	(0.449)
			[1.042]	[1.668]
Post-Cold War			0.030	0.326
			(0.800)	(0.752)
			[1.031]	[1.386]
Events	53	30	53	30
Observations	29,058		29,058	
Log-likelihood	−586.949		−564.037	

$^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$



(a) Model 1, negotiated

(b) Model 1, military



(c) Model 2, negotiated

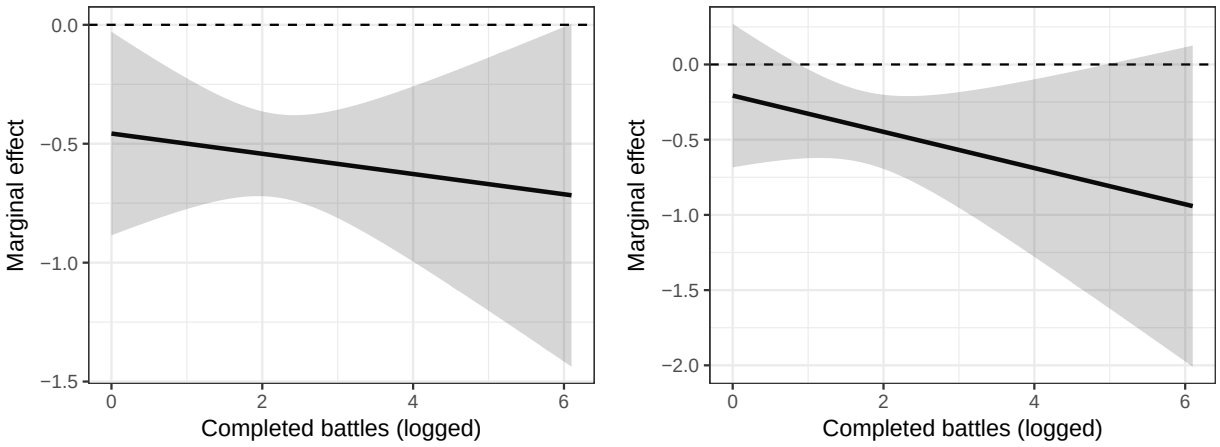
(d) Model 2, military

Figure 14: Marginal effect of inconsistency on war termination, removing highly multilateral wars. Based on results from Table 18. Bands represent 95% confidence intervals.

Table 19: Results of competing risks models on the relationship between stagnation and conflict termination, conditional on completed battles and removing highly multilateral wars. Standard errors in parentheses, hazard ratios in brackets.

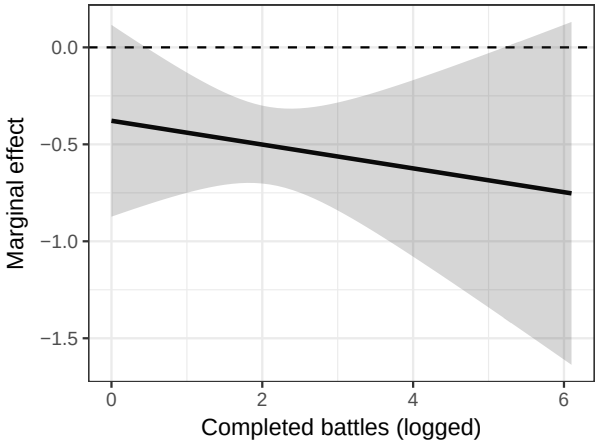
	Termination			
	(1)		(2)	
	Negotiated	Military	Negotiated	Military
Stagnation × Completed battles	−0.043	−0.120	−0.061	−0.152
	(0.091)	(0.122)	(0.110)	(0.123)
	[0.958]	[0.887]	[0.940]	[0.859]
Stagnation	−0.457**	−0.207	−0.379	−0.178
	(0.218)	(0.243)	(0.252)	(0.249)
	[0.633]	[0.813]	[0.685]	[0.837]
Completed battles	0.279	0.012	0.672**	0.159
	(0.265)	(0.370)	(0.329)	(0.377)
	[1.322]	[1.013]	[1.958]	[1.172]
Issue salience			−0.862***	0.435
			(0.201)	(0.301)
			[0.423]	[1.545]
Contiguity			0.548	−1.416***
			(0.396)	(0.553)
			[1.730]	[0.243]
Democracy			0.882***	0.090
			(0.334)	(0.485)
			[2.417]	[1.094]
Major/Nuclear			0.100	−0.356
			(0.364)	(0.528)
			[1.105]	[0.700]
Active battles			−0.234	−0.119
			(0.195)	(0.272)
			[0.791]	[0.888]
Active belligerents			−0.193	−0.633
			(0.677)	(0.988)
			[0.824]	[0.531]
Post-1945			0.111	0.707
			(0.370)	(0.447)
			[1.117]	[2.028]
Post-Cold War			0.256	0.146
			(0.800)	(0.726)
			[1.291]	[1.157]
Events	53	30	53	30
Observations	29,058		29,058	
Log-likelihood	−570.338		−550.620	

$^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$

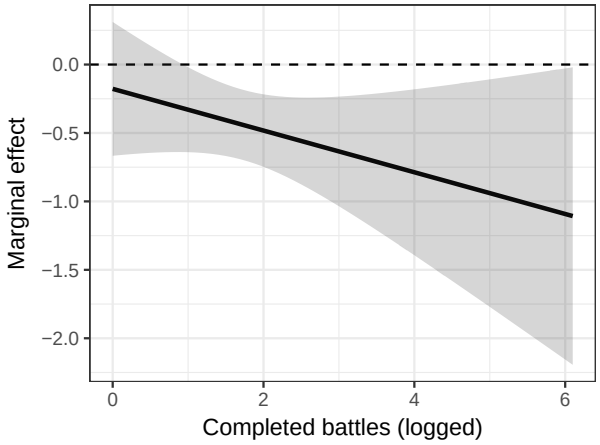


(a) Model 1, negotiated

(b) Model 1, military



(c) Model 2, negotiated



(d) Model 2, military

Figure 15: Marginal effect of stagnation on war termination, removing highly multilateral wars. Based on results from Table 19. Bands represent 95% confidence intervals.