ESSAYS ON POWER SHIFTS, INFORMATION UNCERTAINTY AND INTERNATIONAL CONFLICT

By

Haonan Dong

Dissertation

Submitted to the Faculty of the

Graduate School of Vanderbilt University

in partial fulfillment of the requirements

for the degree of

DOCTOR OF PHILOSOPHY

in

Political Science

August 9, 2024

Nashville, Tennessee

Approved:

Brett Benson, Ph.D.

Brenton Kenkel, Ph.D.

Bradley Smith, Ph.D.

Adam Meirowitz, Ph.D.

Copyright © 2024 Full Legal Name
All Rights Reserved

ACKNOWLEDGMENTS

I greatly thank my committee members: Prof. Brett Benson, Prof. Brenton Kenkel, Prof. Bradley Smith and Prof. Adam Meirowitz for offering invaluable help and guidance on my dissertation. I thank my parents and my wife for their support and care during my graduate education. I also want to thank Prof. James Bisbee, Prof. Peter Schram, Prof. Andrew Coe for the advise and training they gave me.

TABLE OF CONTENTS

Page

LIST OF TABLES . . . . . **vi**

LIST OF FIGURES . . . . . **vii**

1 The Politics of Delay in Crisis Negotiations **1**

1.1 Introduction 1
1.2 Model 4
1.2.1 Key Features of the Model 6
1.3 Analysis 8
1.3.1 Distinguishable Sources of Delay 8
1.3.2 Indistinguishable Sources of Delay 9
1.4 Historical Evidence 13
1.4.1 The Negotiation of Twenty-One Demands (1915) 13
1.4.2 The Russo-Japanese War (1904) 16
1.5 Conclusion 17
1.6 Proofs 19
1.6.1 Proofs of Proposition 1 19
1.6.2 Proofs of Proposition 2 20
1.6.3 Proofs of Proposition 3 21
1.6.4 Extension: Positive Shifts without Delay at Probability $\beta > 0$ 24
1.6.5 Extension: Reverse the Proposal Power 27
1.6.6 Extension: Figures of Probability of War & Probability of Delay 33

2 Uncertainty about Power Shifts and Preventive War: Empirical Measurement and Hypothesis Test **37**

2.1 Introduction 37
2.2 Research Design 40
2.2.1 Measuring Uncertainty about Power Shifts 41
2.2.2 Predicting Military Power 43
2.2.3 Estimating Error Variance 44
2.3 Testing Preventive War Hypothesis 46
2.3.1 Data 46
2.4 Results 47
2.4.1 Extension: A Non-Parametric Estimation 52
2.5 Conclusion 55
2.6 Appendix 58
2.6.1 Replication of Bell & Johnson (2015) Main Results 58
2.6.2 A2: Logistic Regression of War Initiation Excluding World War II Observations . 59
2.6.3 A3: The Plot of MEM of the size of expected power shift across uncertainty percentile 60
2.6.4 A4: Marginal Effect of Power Shifts on Probability of War excluding WWII Observations 61
2.6.5 A5: The plot of AME of the size of expected power shift across uncertainty percentile excluding World War II years 62
2.6.6 A6: The Plot of MEM of the size of expected power shift across uncertainty percentile excluding World War II years 62

3 Co-exist with Rivals: The Politics of Cooperation and Competition 63

3.1 Introduction 63
3.2 Model 66
3.3 Analysis 67
3.4 Discussion 71
3.5 Conclusion 72

References 75

LIST OF TABLES

Table		Page
2.1	Regression of Military Power with Heteroskedasticity	48
2.2	Regression Coefficients of Error Variance Equation	49
2.3	Logistic Regression on Power Shifts and Uncertainty	51
2.4	Marginal Effect of the Size of Expected Power Shift across Uncertainty Percentile	52
2.5	Logistic Regression with Non-Parametric Uncertainty	55
2.6	Replication of Bell and Johnson's Results	58
2.7	Logistic Regression on Non-WWII Dyads	59
2.8	Marginal Effect of Power Shift across Uncertainty Percentile Excluding WWII Observations	61

LIST OF FIGURES

Figure		Page
1.1	Game tree for the interaction, assuming State 1 is a rising type.	6
1.2	Probability of War in Equilibrium	12
1.3	Probability of Power Shifts in Equilibrium	12
1.4	Comparison of the probability of war and power shifts between models with and without uncertainty about reasons for delay. $w_1 = 0.35, w_2 = 0.5, q = 0.3, \delta = 0.8, \alpha = 0.45, w_1' = 0.65$. The labels on the lines represent State 2's strategy after each type of delay in the baseline model (red line), and after unknown types of delay in the main model (blue line). "Exo" refers to Exogenous, "Int" refers to Intentional.	12
1.5	Probability of War in Pareto Dominant Equilibrium. The labels on the lines represent player's equilibrium strategy in each part of r parameter space. "R(S)S1" refers to the "rising (static)" type State 1, "S2" refers to State 2. "S1" refers to both types of State 1.	33
1.6	Probability of Tolerated Delay. The labels on the lines represent player's equilibrium strategy in each part of r parameter space. "R(S)S1" refers to the "rising (static)" type State 1, "S2" refers to State 2. "S1" refers to both types of State 1.	34
1.7	Probability of Delay in Pareto Dominant Equilibrium. The labels on the lines represent player's equilibrium strategy in each part of r parameter space. "R(S)S1" refers to the "rising (static)" type State 1, "S2" refers to State 2. "S1" refers to both types of State 1.	35
1.8	Probability of Delay. The labels on the lines represent player's equilibrium strategy in each part of r parameter space. "R(S)S1" refers to the "rising (static)" type State 1, "S2" refers to State 2. "S1" refers to both types of State 1.	36
2.1	AME of Expected Power Shift across Uncertainty Percentile	53
2.2	MEM of Expected Power Shift across Uncertainty Percentile	60
2.3	AME of Expected Power Shift across Uncertainty Percentile on Non-WWII Dyads	62
2.4	MEM of Expected Power Shift across Uncertainty Percentile on Non-WWII Dyads	62
3.1	Game tree for the interaction, only one type of Challenger is shown	66

CHAPTER 1

The Politics of Delay in Crisis Negotiations

States often intentionally stall crisis negotiations, hoping to build arms or attract allies to achieve a more favorable bargaining position. Why do their adversaries tolerate delay in some cases, but attack upon delay in others? I argue that this is because states cannot perfectly distinguish between intentional and unavoidable delays. This presents a strategic tension: a state prefers to attack preventively if the delay is intentional, but prefers to avoid costly war otherwise. To study this tension, I build a formal model of crisis bargaining with delay tactics, showing that rising states may mask bargaining delays behind natural exogenous delays to complete a peaceful power shift. I find that uncertainty over the source of delay may decrease the risk of war. However, this effect only holds in the short term. As the length of delay increases, opponents infer that it is likely intentional, and preventive war occurs.

1.1 Introduction

In August 1903, Japan and Russia entered negotiations over control of Manchuria. Displeased with Russia's refusal to remove troops from southern Manchuria, Japanese diplomats sought to locate a compromise. However, negotiations stalled. Blaming bureaucratic procedure, illness among the royal family, and the Emperor's holiday plans, Russian diplomats were slow to produce responses and counter-proposals. The Japanese initially tolerated these delays, but as the months dragged on, they became convinced that the excuses were a mere pretense for Russia to increase its military power in the region, allowing Russia to bargain from a strengthened position. Fed up with the delays and convinced their opponents were no longer negotiating in good faith, Japan terminated negotiations and formally declared war on Russia in 1904.

Just over a decade later, in January 1915, Japan again found itself locked in delayed negotiations. This time, Japan sought to consolidate and expand its position and solidify dominance over China by delivering a list of twenty-one demands in an attempt to establish effective control over vital functions of the Chinese government. Chinese foreign minister Lu Tseng-Tsiang drew out the negotiations, citing his own ailing health and need to consult with President Yuan Shih-Kai. Instructing his staff to serve tea and cigarettes to placate Japanese diplomats during the weeks of three-hour meetings, Lu secretly worked with other Chinese diplomats outside the meetings to rally international support for China. Unlike in the previous decade's negotiations with Russia, Japanese diplomats did not believe that the delay tactics were intended to buy time for China to improve its position. Consequently, Japan took a conciliatory stance, continuing to negotiate instead of using military force. However, by May 1915 it became clear that China had secretly rallied the

West to its aid, having disclosed the most onerous demands to Britain. In the face of widespread international support for China, Japan was left with no choice but to scale back its demands, eventually agreeing to a settlement that left it worse off than at the outset.

These historical negotiations highlight variation in how states respond to bargaining delays. In some cases, delay is met with aggression, as in the Russo-Japanese War. In others, delay is tolerated and negotiations continue, as in the Twenty-One Demands Negotiation. What accounts for this difference? I argue that the answer arises from an important and previously unacknowledged type of uncertainty: a negotiator's *uncertainty over the reason for delay*. Diplomats cannot always distinguish whether these delays are genuine, or simply a pretense for stalling negotiations so that an opponent can improve its position. How does the strategic tension created by this uncertainty impact decisions to negotiate or fight?

To answer this question, I develop a game-theoretic model of crisis bargaining with delay tactics. My model formalizes the idea that delay may be either an unintentional circumstance out of a state's control, or an intentional ploy to bring about a favorable shift in bargaining power. Uncertainty about the reason for delay allows opportunistic states to mask intentional delay behind a commonplace reality. In the Marshall Mission (1946), the Chinese Communist Party intentionally delayed peace talks but blamed delays on the lack of communication and transportation tools; in the Twenty-One Demands (1915), the Chinese government delayed the negotiation to buy time to garner international support but framed delays as an innocuous result of shared cultural routines and plausibly exogenous factors.

Meanwhile, there are many exogenous reasons why real-world bargaining might be drawn-out. Domestic turmoil and external intervention delayed the Sino-Belgium Treaty negotiation (1927) and the Northeast Flag Replacement in China (1928) respectively; bureaucratic obstruction delayed U.S.' trade agreements with Panama, Colombia and South Korea; limited communication and transportation delayed the Treaty of Nerchinsk (1689) and Franco-Russian alliance (1894). Thus, my model assumes that states cannot distinguish the sources of delay that are genuine and unavoidable from the sources of delay that are purposeful and intentional. This paper contributes to a long-standing literature on crisis bargaining by modeling such delay and studying its effects on the conflict process.

The equilibrium analysis yields three main findings. First, when there is uncertainty about the sources of delay, states may tolerate delays that allow large power shifts. When a state knows that delays are intentional, it infers that delays are specious and in turn employs a "bluff calling" strategy, attacking with some positive probability at least after observing intentional delays. When the reasons for delays are unknown, a state's responses to delays critically depends on ascertaining whether the delay is intentional. When states can not distinguish the real source of delays and believe their opponents have no incentive to cause any delay *per se*, they may erroneously perceive that delays are unexpected circumstances that bear no impact on relative

power. Consequently, an opponent whose power will increase in the future and who would thus benefit from a delay, maintains plausible deniability about intentional stalling and obtains more power through employing delaying tactics.

Second, I find that beliefs about the reason for delay are key to understanding why delay is met with aggression in some cases but not others. If the delay is an uncontrollable circumstance that will not lead to an underlying shift in bargaining power, costly military action is undesirable and states prefer to engage peacefully. Conversely, if the delay is likely a pretense for secret arming or solicitation of external support and designed to bring about a shift in power, then the other side prefers to attack to forestall those adverse events. Under some conditions, states' inability of identifying real sources of delay has the unexpected effect of facilitating peaceful power shifts while weakly dampening the motivation of preventive attacks.

Third, the effectiveness of delay tactics is limited by the time needed to bring about the power shift. In the infinite-horizon model, I find that a state becomes more and more suspicious after repeated periods of delay. Long-term delay undermines plausible deniability, as multiple sequential delays are relatively unlikely to be the product of exogenous circumstances. So while delay tactics do not cause preventive strikes in the short-term, they generate risks of war as time goes on. In particular, delay tactics create a tradeoff for who employs them: delay may allow for a peaceful and favorable power shift, but as time passes, each additional attempt to delay raises the risk of preventive war. The negotiating process of Russo-Japanese War follows the pattern here: the Japanese initially tolerated delays but eventually attacked as they became more suspicious about Russia's motive after observing recurring delays.

My theory of crisis negotiations with delay tactics advances several literatures in international relations. By examining strategic responses to bargaining delay, I bring a new perspective to the literature on dynamic, shifting-power commitment problems as a cause of war. Prior theoretical models have shown that large power shifts are either forestalled by preventive attacks (Powell 2004, 2006; Fearon 1995), or bargained away peacefully (Chadefaux 2011; Coe 2018; Spaniel 2019). Meanwhile, empirical studies have found mixed results about the relationship between power shifts and war (Lemke, 2003; Bell and Johnson, 2015). I contribute to the theoretical literature by highlighting delay tactics as an important tool for states to accomplish a power rise without being the target of preventive conflicts, as long as their adversaries cannot completely distinguish these tactical delays from unavoidable exogenous ones. On the empirical side, my model shows that given one of the many ambiguities in the real-world negotiations, it may make sense that the relationship between power shifts and war is more intricate and complex than existing empirical studies suggest.

My theory also enriches our understanding of endogenous power shifts, arming, and alliance formation. As in the present study, earlier work on these topics focuses on costly or risky attempts to alter the balance of power. In particular, scholars have highlighted delay as an important factor in the politics of arming and

alliance formation. Bas and Coe (2016) and Coe (2018) assume that the military investment of weak states may not yield immediate success, which causes delay in possessing unconventional arms. Benson and Smith (2022) assume that an alliance may fail to be implemented immediately, which causes delay in altering the balance of relative power. In their work, the delay is assumed to be caused by some exogenous difficulties in the progress of power shifts, such as technological trial and error, imperfect intelligence gathering, unexpected contract disruption, and slow coordination of joint military effectiveness. Unlike these studies, which take delay as an exogenous impediment to arming, I focus on *delay as a bargaining tactic*. In my setting, delay may arise endogenously as a means to bring about a power shift. This new perspective on delay thus serves to complement existing work on shifting-power commitment problems.

Finally, my theory contributes to the literature on uncertainty and war by identifying a novel source of asymmetric information that drives bargaining and conflict outcomes. The existing literature has focused on asymmetric information concerning the distribution of power, the cost of fighting, or both as a cause of war (Fearon 1995; Fey and Ramsay 2011; Powell 2012; Wolford, Reiter and Carrubba 2011; Debs and Monteiro 2014). I focus on a novel source of uncertainty: asymmetric information about whether an opponent is negotiating "in good faith". I find that when there is uncertainty about the source of bargaining delay, significant power shifts may occur peacefully and the risk of war (weakly) decreases. As such, the results are related to those of Debs and Monteiro (2014), who show that unobserved investment in military capabilities can sometimes succeed. Like their work, I consider a setting in which there is initial uncertainty over whether a power shift will occur. However, I introduce a novel mechanism—uncertainty over the sources of bargaining delays, demonstrating that this additional source of uncertainty makes peace more likely under some conditions, but makes war more likely under others. Therefore, my work also complements existing work that shows increasing the amount of uncertainty in a crisis bargaining can reduce the likelihood of conflict (Tarar 2023; Debs and Weiss 2016; Joseph 2021).

1.2 Model

I model bargaining across two stages between State 1 and State 2. At the outset of the game, Nature determines whether State 1 is a *Rising* or *Static* type, $T_1 \in \{R, S\}$. The prior probability of a rising type is $r \equiv Pr(T_1 = R)$. This prior distribution is common knowledge, but State 2 does not learn State 1's type realization until the second stage. The rising type of State 1 can potentially achieve a power rise in the second stage, whereas the static type of State 1 can not. In each stage of the game, the two states bargain over a prize whose value is normalized to 1.

In the first stage, State 1 makes the first move, choosing the action *Delay* or *Not Delay*. If State 1 chooses *Not Delay*, then Nature causes a delay with probability $\alpha > 0$. I label the delay caused by State 1

as *Intentional Delay*, and the delay caused by Nature as *Exogenous Delay*. If either type of delay occurs, State 2 chooses to *Fight* or *Wait*. If State 2 fights, then the game ends, and the players receive present and future values (w_1, w_2) that represent their war payoffs. If State 2 waits, then players receive the present value $(q, 1-q)$ as status quo payoffs that represent the existing condition of affairs before any settlement is reached between states, and the game proceeds to the second stage. If instead there is no delay in the first stage, then State 2 offers $x_1 \in [0,1]$ to State 1. If State 1 accepts, they receive the present value $(x_1, 1-x_1)$, and the game moves to the second stage. If State 1 rejects, then players receive present and future values (w_1, w_2).[1]

In the second stage, State 2 first learns State 1's type, then offers $x_2 \in [0,1]$ to State 1 who accepts or rejects. Either way, the game ends at this point. If State 1 accepts, then players receive $(x_2, 1-x_2)$. If State 1 rejects, they receive war payoffs that now depend on State 1's type. If State 1 is the static type, then war payoffs are still (w_1, w_2). Otherwise, then war payoffs are (w_1', w_2') because State 1 will become stronger in the second stage.

States have common discount factor, $\delta \in (0,1)$. In each state's final utility, its first–stage payoff is multiplied by $1-\delta$ and its second–stage payoff is multiplied by δ, so that δ captures the weight states place on long–run outcomes. To model the inefficiency of war, I assume $w_1 + w_2 < 1$ and $w_1' + w_2' < 1$. To capture how power shifts in favor of a rising type of State 1, I assume that $w_1 < w_1'$ and $w_2 > w_2'$. Finally, I assume the static type of State 1 is dissatisfied with the status quo—$q < w_1$, implying that delay involves costs such that it is desirable only to the rising type State 1 who anticipates a favorable power shift. To illustrate the sequence of play, Figure 3.1 shows the extensive form game when State 2 faces a rising type of State 1.

[1] There can be a power shift even no delay occurs: the rising type State 1 can use the interim between stages to obtain power anyway. My model assumes that delay allows it more time to grow, making the power shift more likely. In the Supplementary Appendix, I study the extension with a positive probability of power shifts $\beta > 0$ after no-delay, and show that all substantive results still holds as long as $\beta < \bar{\beta} < 1$.

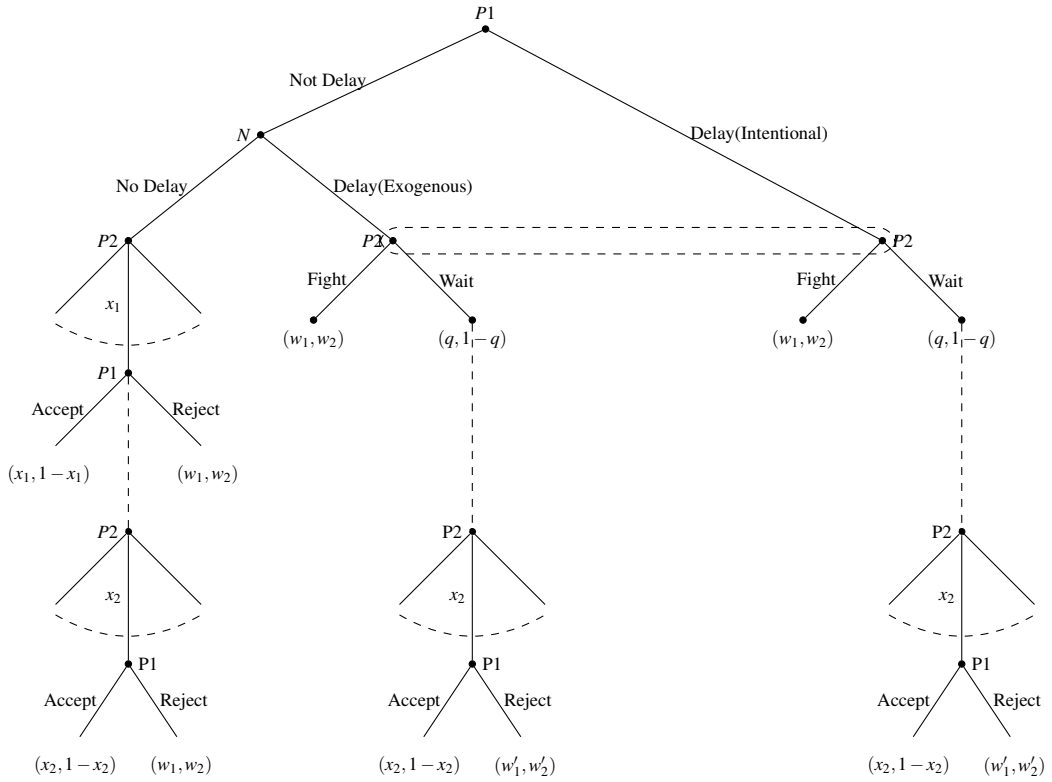

Figure 1.1: Game tree for the interaction, assuming State 1 is a rising type.

1.2.1 Key Features of the Model

The model incorporates the essential feature of existing theoretical work on the commitment problem—that the expectation of a large power shift could induce the declining state to fight before it is completed (Fearon 1995; Powell 2004,2006). I innovate by modeling two important features of bargaining that are overlooked by previous shifting-power models: bargaining may be delayed for various reasons, and states may be uncertain about the sources of the delay. In fact, the limiting case of my model with no uncertainty about State 1's type and the source of delay is a standard shifting-power model.

Delay can be a tactical choice by a state to gain bargaining power in the interim. For example, in 1996, the Peruvian government intentionally stalled negotiations with the Tupac Amaru Revolutionary Movement in a hostage event, to gain time and collect information for a raid (Schemo 1997). In the fifth and sixth rounds of the Six-Party Talks, North Korea used many delaying tactics to exhaust South Korea and the United States until they were ready to concede (Zhou and van Wyk 2021). In the Marshall Mission of 1946, the Chinese Communist Party intentionally delayed peace talks with the Chinese Nationalist Party in order to consolidate its power and foothold in Northeast China.[2]

[2] *Foreign Relations of the United States* 1945–1952, Volume IX, China, ed. Ralph R. Goodwin, (Washington: Government Printing Office, 2013), Document 377.

Factors outside of a state's control may also prolong negotiations. Two primary categories of exogenous factors are (1) obstacles that arise to bargaining itself and (2) unexpected interruptions from home and abroad. As an example of the first category, obstacles to communication and transportation were key to delays in reaching the 1689 Treaty of Nerchinsk between Russia and China. Likewise, disagreements on the terms of negotiation and long-distance travel were responsible for delays in the negotiations of the 1894 Franco-Russian alliance and the 1955 U.S.-Republic of China defense pact (Benson and Smith 2022).

External factors such as domestic turmoil, bureaucratic obstruction and external intervention may also result in bargaining delays. In the Sino-Belgium Treaty negotiations of 1927, the success of the Northern Expedition led by the Chinese Nationalist government intensified the uncertainty in China's domestic politics, and China's domestic turmoil delayed the negotiation between China and Belgium (Martin 1980, 133). The U.S. negotiated and signed free trade agreements with Panama, Colombia, and South Korea, but all three agreements were delayed in Congress due to the opposition from labor, environmental groups and import-competing industries (Haftel and Thompson 2013). In July 1928, Japan disrupted negotiations over the unity of China between Zhang Xueliang and the Chinese Nationalist government for three months. Neither the warlord nor the central government anticipated the explosive reaction of Japan (Taylor 2009, 84).

I extend earlier work by recognizing that it is difficult for states to distinguish whether any given delay is caused by exogenous circumstances or tactical decisions. There are many sources of exogenous delay, and states that seek a tactical delay could fabricate plausibly exogenous factors to mislead its adversary about the underlying causes, making attribution difficult. For instance, in the negotiations over the Twenty-One Demands, China framed its delays as an innocuous result of shared cultural routines. In the Marshall Mission, the Communist representatives stalled peace talks but attributed delays to their widely dispersed personnel, poor communication equipment, and the lack of transportation tools.[3]

If the delay is initiated by states whose power will improve over time, it may serve the purpose of secretly arming, seeking external support or forming alliances to improve bargaining power. However, exogenous causes of delay offer a natural cover for states to stall bargaining in many circumstances. A state that is unable to discern the real source of delay will therefore also be uncertain whether a power shift is afoot. To formalize the ambiguity in the sources of delay, I model the occurrence of delay as a move that is unobservable to State 2. To capture the resulting uncertainty over shifts in relative power, I assume that only the rising type of State 1 could achieve a power rise after bargaining delay.

[3] *Foreign Relations of the United States* 1945-1952, Volume IX, China, ed. Ralph R. Goodwin, (Washington: Government Printing Office, 2013), Document 132.

1.3 Analysis

I solve the model for Perfect Bayesian Equilibrium (PBE). Perfect Bayesian Equilibrium requires that players act optimally at each information set in the game and that players update their beliefs using Bayes Rule whenever possible, given their knowledge about the strategies of other players. I demonstrate that uncertainty about the reasons for delay facilitates states to complete their power rise. As a baseline, I first show that State 1 can not leverage the intentional delay to achieve its power rise peacefully when State 2 can distinguish whether delays are exogenous or intentional. I then show that State 1 can exploit State 2's uncertainty about the source of delay to initiate the intentional delay, increasing its chance of ascent.

Throughout the analysis of the two-stage game, I focus on conditions under which the rising type of State 1 would gain enough power to provoke war in a standard commitment problem model, as this is where my model yields the most starkly novel results. Assumption 1 formalizes this condition.

Assumption 1. $w_1' > \bar{w_1} = \frac{1-w_2-(1-\delta)q}{\delta}$.

If Assumption 1 fails to hold, then the magnitude of power shifts is inconsequential to State 2's decision-making: State 2 would tolerate a slight power rise of State 1 rather than prevent it with fighting. Assumption 1 is closely related to the war condition in existing literature (Fearon 1995) and is a straightforward simplification of the general condition for wars in infinite horizon models (Powell 2004, 2006).

1.3.1 Distinguishable Sources of Delay

To illustrate that State 2's inability to discern the source of delay is important for the possibility of a peaceful power shift, supposing instead that at this moment State 2 can discern between the two possible sources of delay. Two properties emerge from all equilibria of the game.

First, the rising type State 1 can not peacefully achieve its power rise anyway when State 2 strongly believes that State 1's strength will benefit from bargaining delays. This is because State 2 fears the loss of bargaining power that follows both exogenous delays and intentional delays, and will choose to fight regardless of their reasons. Thus, the model with a high prior chance of power shifts is analogous to the existing shifting-power commitment problem models in which the opponent will rise significantly and war ensues (Fearon 1995; Powell 2004, 2006; Krainin 2017).

Second, the rising type State 1 can not cause bargaining delays to peacefully improve its power even if State 2 believes that State 1 is unlikely to benefit from them. State 2 always fights upon the intentional delay with a positive probability, knowing that the rising type State 1 wants to craft delays to obtain power. This "bluff calling" strategy drives the rising type State 1 to imitate the static counterpart who lacks the incentive for delaying. In equilibrium, the rising type State 1 either attempts the intentional delay that accompanies

the risk of preventive war, or gambles on the window of opportunity when the bargaining is disrupted by exogenous factors, sacrificing control over its rising process. I term such equilibrium outcomes as *partial* power shifts.

1.3.2 Indistinguishable Sources of Delay

I now analyze the main model, in which State 2 cannot distinguish delays initiated by State 1 from delays caused by exogenous factors (Nature). In contrast to the baseline model, it is now possible for State 1 to peacefully complete its power rise through the intentional delay, which is summarized in the following proposition regarding the properties of all equilibria.

Proposition 1. *Define* $r_* = \frac{\alpha[1-w_2-q-\delta(w_1-q)]}{\delta(w_1'-w_1)-(1-w_2-q)+\alpha[1-w_2-q-\delta(w_1-q)]}$. *In all equilibria:*

- *If* $r > r_*$*, State 2 fights after delay with probability one.*
- *If* $r < r_*$*, State 2 waits after delay with probability one.*

Denote State 2's prior belief about State 1 being the rising type as r. If State 2 cannot independently verify the source of delay, it will be uncertain about the impacts of delay on future negotiations and not able to employ targeted responses to delays. Then State 2 relies on its prior belief to assess the real source of delay and infer the consequence of its responses. When State 2's prior belief that State 1 will obtain power from bargaining delays is high enough—$r > r_*$, it will fight after delay due to a high risk of the adverse shift in future bargaining power, much like when the source of delay is public in the previous section.

When State 2 strongly believes that State 1 does not have inherent incentives to cause delays—$r < r_*$, it will lean towards interpreting the delay as exogenous circumstances rather than intentional plots. Thus, low r along with the uncertainty about the reasons for delay give State 2 more confidence that waiting upon delays will not bring about significant shifts in bargaining power. This updating process dampens State 2's incentive to fight upon observing delays. In contrast, when State 2 could clearly discern the source of delay, it always needs to deter the rising type State 1 from stalling, therefore never wait upon the intentional delay with confidence. To sum up, when the sources of delay are indistinguishable, the rising type State 1 can intentionally stall negotiations and obtain more power. The following proposition contains the result.

Proposition 2. *When* $r < r_*$*, there is a unique Perfect Bayesian Equilibrium in which:*

- *The static type State 1 chooses Not Delay; the rising type State 1 chooses Delay.*
- *Facing delays, State 2 chooses to Wait.*
- *There is a peaceful power shift between State 1 and State 2*

When State 2 believes that State 1 is unlikely to obtain power after delays, there is a unique Perfect Bayesian Equilibrium in which State 1 adopts a separating strategy profile and each type of State 1 takes its

preferred action. The intuition is that the rising type State 1 can stall for time to complete its power rise, meanwhile fabricating excuses and blaming the delay on those fake reasons. Still, State 2 chooses to wait because it is not concerned about the artificial delay that brings about adverse shifts in bargaining power. As a consequence, both types of State 1 obtain its ideal outcome: the static type State 1 has the best chance of obtaining a fair revision of the status quo; the rising type State 1 peacefully improves its bargaining power via the most efficient means and avoids the preventive attack, establishing the power shift as a *fait accompli*. Thus, the equilibrium outcome is a *peaceful power shift* when $r < r_*$.

Previous work tends to highlight the provocative implications when there is uncertainty about shifts in relative power, suggesting that power shifts usually involve a positive probability of war (Debs and Monteiro 2014), or power shifts will be disrupted or limited by containment measures such as preventive fighting or sanctioning (Yoder 2019a; McCormack and Pascoe 2017; Bas and Coe 2016). My model investigates the impact of unobservable causes of delay, and identifies the specific condition under which heightened uncertainty about power shifts arising from delaying sources does not necessarily cause preventive wars and may facilitate peaceful shifts in power.

Now, I summarize how uncertainty about the reasons for delay influences the outcomes of crisis bargaining. The comparison between the baseline and the main models illustrates the add-on effect of the uncertainty about the reasons for delay on the likelihood of preventive war as well as peaceful power shifts. The finding is concluded in the proposition below.

Proposition 3. *Uncertainty about the reasons for delay has the following effects on the equilibrium outcomes:*

• *When $r < r_*$, weakly decreases the probability of preventive war, increases the probability of peaceful power shifts.*

• *When $r_* < r < r^*$, increases the probability of preventive war, decreases the probability of peaceful power shifts.*

• *When $r > r^*$, does not affect the probability of preventive war and peaceful power shifts.*

When $r < r_*$, the baseline and the main models feature different equilibrium outcomes. In the baseline model when State 2 can discern the real source of delay, it always fights after the intentional delay at some positive probability, but waits after the exogenous delay. The rising type State 1 mimics the strategy of the static type State 1, otherwise its action reveals its type to State 2. The static type State 1 faces the same prospect of obtaining a revision of the status quo, thus is indifferent between delaying or not. Therefore, the probability of war depends on the type of delay that realizes. When State 1 sometimes opts to not delay and sometimes causes the delay intentionally, the solid line in Figure 1.2 depicts the equilibrium probability of

war as r increases.[4] The rising type State 1 can achieve its power rise through either exogenous delay or intentional delay, both of which are probabilistic events. The solid line in Figure 1.3 shows the corresponding probability of power shifts.

In contrast, in the main model when State 2 cannot discern the real source of delay, the rising type State 1 attempts the intentional delay since delaying is not informative about its type. State 2 still waits upon delay with unknown sources since its prior belief is sufficiently low. Consequently, the probability of war drops to zero, as the dashed line of Figure 1.2 shows. In fact, State 2 mistakes the intentional delay caused by the rising type State 1 as the exogenous delay triggered by the static type State 1 and Nature. Consequently, the rising type State 1 peacefully accomplishes its power rise *with certainty* through the intentional delay when State 2 holds a sufficiently low prior belief. The dashed line of Figure 1.3 corroborates that the probability of peaceful power shifts becomes higher after introducing uncertainty about reasons for delay.

However, when $r_* < r < r^*$, uncertainty about the real source of delay loosens the conditions for preventive war. The intuition is that State 2's inability to identify the real reason for delays induces the rising type State 1 to delay intentionally, therefore aggravating State 2's concern about the adverse power shift following delays in this intermediate range of beliefs. Anticipating that the rising opponent would exploit its uncertainty, State 2 becomes more cautious about waiting and fights more often than it would otherwise in order to avert the unfavorable shift in bargaining power. Thus, uncertainty about reasons for delay makes the probability of war higher and the probability of power shifts lower when r falls into this middle range, as can be seen in Figure 1.2 and Figure 1.3. Finally, when $r > r^*$, uncertainty about the reasons for delay has no impact on the chance of war and power shifts, simply because the *ex ante* risk of adverse power shifts is sufficiently high such that State 2 will fight regardless of the real source of delay.

Proposition 3 implies that asymmetric information over whether the opponent is obtaining power can cause peace where war would otherwise have occurred, which is opposite to conclusions in prior work (Debs and Monteiro 2014). My distinct modeling assumption is that there are two dimensions of uncertainty faced by State 2: 1) whether State 1 will be more powerful intrinsically, and 2) whether the observed delay is intentional or exogenous. With uncertainty over only the first dimension, the information about the cause of delay facilitates State 2's responses to delays that it never wait with full assurance as long as State 1 can possibly benefit from intentional delays. Introducing uncertainty over the second dimension leads to peace, because it can make State 2 mis-attribute the real source of bargaining delay and forgo the timing of preventive attacks. This effect complements previous findings that increasing the amount of uncertainty in a crisis bargaining can reduce the likelihood of conflict (Tarar 2023; Debs and Weiss 2016; Joseph 2021).

[4]There exists a pooling equilibrium in which both types State 1 choose pure strategy Not Delay, and the probability of war is zero. Section A.6 of Supplementary Appendix presents the figure of the probability of war in the pooling equilibrium.

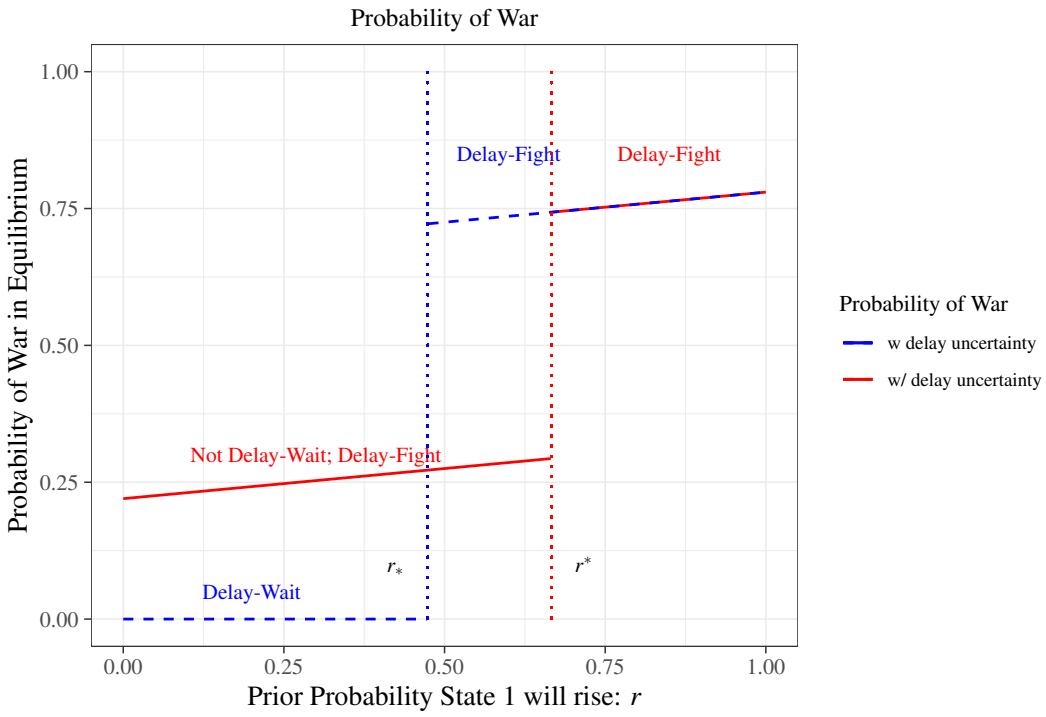

Figure 1.2: Probability of War in Equilibrium

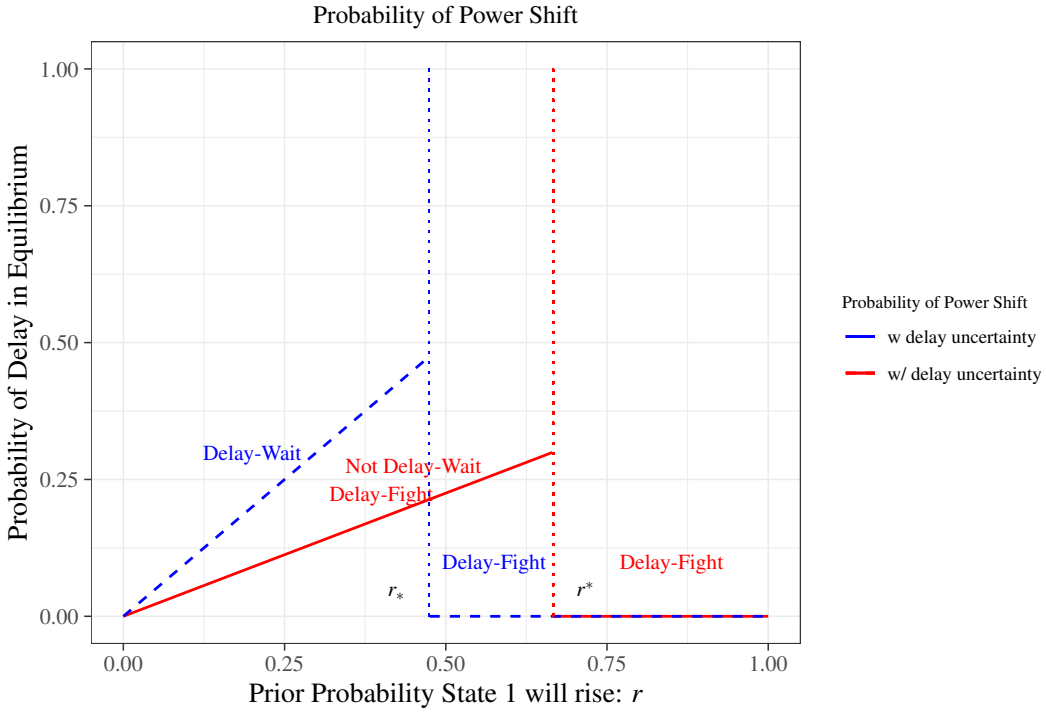

Figure 1.3: Probability of Power Shifts in Equilibrium

Figure 1.4: Comparison of the probability of war and power shifts between models with and without uncertainty about reasons for delay. $w_1 = 0.35, w_2 = 0.5, q = 0.3, \delta = 0.8, \alpha = 0.45, w_1' = 0.65$. The labels on the lines represent State 2's strategy after each type of delay in the baseline model (red line), and after unknown types of delay in the main model (blue line). "Exo" refers to Exogenous, "Int" refers to Intentional.

1.4 Historical Evidence

My theoretical results allow us to better understand historical examples of war that take place during power shifts. In this section, I demonstrate how uncertainty over the sources of bargaining delay resulted in a peaceful power shift in the Twenty-One Demands (1915) negotiation between China and Japan but produced the preventive war between Russia and Japan in 1904. In the former case, Japan did not think it was likely that China's power was rising and did not recognize that the delay was intentional. In the latter, Japan realized that Russia was intentionally delaying the negotiation to buy more time, and believed Russia's power would rise if delays continued. In analyzing these historical cases, my theory helps account for the reasons why power shifts might occur in some circumstances whereas they might instead result in preventive wars under different circumstances. I refer to evidence from both primary and secondary sources to track the strategic thinking of key decision-makers when possible (Goemans and Spaniel 2016; Lorentzen, Fravel and Paine 2017).

1.4.1 The Negotiation of Twenty-One Demands (1915)

The negotiation over the Twenty-One Demands illustrates how uncertainty over the sources of delay can result in peaceful power shifts. In January 1915, China was aware that Japanese demands could create frictions between Japan and Western countries. Thus, China's strategy was to intentionally delay the negotiation while seeking international support, namely by leaking the details of the demands to the U.S. and Britain. Japan consistently believed it was unlikely China's power would rise and did not recognize that China was intentionally stalling the talks. The resulting uncertainty drove Japan to tolerate bargaining delay and provided a window of opportunity for China to garner external support. By the time Britain and the U.S expressed strong opposition, Japan had to accept the *fait accompli* that world opinion had shifted in China's favor. Consequently, Japan dropped the most objectionable demands. Consistent with my theoretical analysis, Japan's uncertainty over the rise of China and the cause of delay led to a rapid and significant power shift in China's favor.

The core features of my model are present in the negotiations over the Twenty-One Demands. China was certain that disclosing those demands would invite international opposition to Japan, leading to an increase in China's bargaining power. Japan could have easily used military means to coerce China into accepting the demands, but eventually failed because China managed to endanger the Anglo-Japanese Alliance and the U.S-Japan relationship. Thus, China and Japan respectively played the roles of a rising State 1 and a declining State 2.

This case is closely related to Proposition 2, which shows the conditions under which a state can delay bargaining to obtain power without triggering preventive war. Two crucial conditions are (1) the declining

State 2 cannot distinguish whether the delay is intentional or exogenous, and (2) the declining State 2 must believe its adversary is unlikely to benefit from delays. When these hold, a state can intentionally delay bargaining, but fabricate exogenous reasons to cover the use of delaying tactics. Evidence from primary and secondary sources substantiate the mechanism of my model—Japan failed to ascertain that China's power would grow over time and China employed delaying tactics.

In the eyes of Japanese elites, 1915 was a unique opportunity to realize complete mastery over China. First, European countries were completely absorbed in World War I, and Japan believed that no Western country could spare any effort for affairs in the Far East (Gowen 1971). Second, other Western governments' initial reactions seemed weaker than Japan had expected. In the early stages of the negotiation, British politicians still held a relatively favorable view of Japan and suggested that none of the demands were particularly problematic,[5] giving Japan the impression that the Western countries had retreated from Far East affairs (Best 2016; Nish 2002, 99). It is plausible that these initial attitudes by Western powers led Japan to disregard the possibility of external intervention in favor of China.

Upon seeing the initial Twenty-One Demands in January 1915, the Chinese government was aware that practically every item in Group V conflicted with treaty engagements between China and Western nations. Lu Tseng-Tsiang, the Chinese foreign minister, tried every means to delay the bargaining process, which gave the Chinese government time to stoke international objections and solicit outside support. To this end, Lu fabricated exogenous reasons to relax Japan's suspicion about the cause of delay. Consequently, Japan was not certain that the delay was due to stalling tactics by the Chinese government.

For instance, Lu persuaded the Japanese minister in Peking to meet three times a week rather than on a daily basis, claiming that he needed sufficient time to study the demands in their entirety, that his personal health could not withstand intense meetings, and that his work schedule had been fully filled. At each three-hour meeting, Lu instructed the Chinese staff to serve tea and cigarettes in excessively polite and careful manners that usually took an hour, leaving only two hours for formal discussions. The Japanese diplomats did not complain about these gestures, which appeared to be rooted in the cultural routines of Asian countries (Koo 1976, 33). During the formal discussions, Lu sought to appear either vaguely agreeable or evasive about any agreement by demanding that he had to first consult President Yuan Shih-kai. The Japanese diplomats could not push too hard because it seemed reasonable that any substantive agreement had to be permitted by President Yuan in the first place (Shi 1999, 163–164).

Had Japan realized that China was deliberately stalling, would Japan have resorted to military coercion instead of peaceful negotiation? Predictions from formal models are well-suited for considering such counterfactual outcomes (Fearon 1991; De Mesquita 1996; Levy 2008). Section 1.3.1 makes a prediction in the

[5] NGM Inoue to Kato, 8 Mar. 1915, pp. 606–607

hypothetical counterfactual: the declining state never wait for the intentional delay with full assurance. This suggests that those Japanese politicians who believed that China was stalling should have advocated for the use of force. There was indeed a different voice within the Japanese government: a section of the Japanese military authority was exasperated by the delay and demanded the use of military force instead (Blumenthal and Chi 1970, 42). However, the Japanese government resisted the use of force and insisted to push through all 21 demands via negotiations (Dull 1950; Takeuchi 2010). Given this, it is plausible that Japan would have used military force had the key decision-makers been able to identify the root cause of delay.

Consistent with the prediction of Proposition 2, the rising State 1 will peacefully improve its bargaining power through the intentional delay, by then the declining State 2 has to accept the power shift as the *fait accompli* and correspondingly make concessions in the negotiation. Below I provide direct evidence that China obtained international support and sympathy through delaying the talks, and that Japan was compelled to scale back its demands because world opinion had shifted in China's favor.

While negotiations were stalled, President Yuan Shih-kai instructed Chinese diplomats to secretly leak the demands that threatened Western interests, especially those regarding China's independence and equal opportunity of trade. As Japan's ambitions gradually came to light, Western countries changed their tune and grew increasingly distrustful of Japan. The Chinese government managed to shift world opinion as more critical and sensational press about Japan began to appear (Lowe 1969, 244). Britain decided to support China in late April, indicating that "perseverance in the Group V demands could destroy the Anglo-Japanese alliance."[6] In early May, Britain and the United States explicitly requested that Japan remove Group V.[7] Diplomatic pressure and the threat of intervention by Britain and the U.S. effectively persuaded Japan to moderate its demands. The final demands were much lighter than the initial ones since Japan modified them to mollify many objections raised by the Chinese government (Dull 1950).

My theory shows that China achieved a peaceful power rise through employing delay tactics, allowing it to reduce the scope of Japan's demands, and this was possible because Japan did not recognize the underlying cause of delay and did not expect Chinese power to grow over the course of negotiations. It complements the existing studies on this case: some historical accounts credit the effectiveness of China's delaying strategy (Blumenthal and Chi 1970, 41–42; Craft 2014, 36–37); others point to the ineptitude of Japanese diplomacy and Japan's inability to recognize the intentional delay (Best 2016).

[6]FO371/2324 minute by Alston, May 5, 1915 No. 550751; Grey to Greene, May 5, 1915, No. 549873
[7]TNA FO371/2324 Grey to Greene 3 May 1915, tel. 119.

1.4.2 The Russo-Japanese War (1904)

My theory predicts that a declining State 2 will wage a preventive war if it believes that its adversary is becoming more powerful with time and deliberately delaying negotiations. The Russo-Japanese War illustrates this strategic dynamic. Russia was confident in its gradually growing power in Manchuria and was not interested in reaching a hasty agreement with Japan. Thus, Russia's strategy was to delay negotiations as much as possible until its improving power naturally solved the issue in its favor. Japan lost its patience after realizing that Russia would grow stronger over time and intentionally delayed the talk to tilt the balance of power. Therefore, Japan became determined to fight as fast as possible to prevent Russia from taking a dominant position in the negotiation.

Negotiations between Russia and Japan reflect the essential components of my theoretical model. Russia was confident that the advancement and completion of Trans-Siberian railroads would help Russia gradually annex Manchuria (Kowner 1998, 215). By the same token, Japan stood to lose its existing advantages in Manchuria and Korea if Russia was given more time to grow without check (White 2015, 95). Russia and Japan respectively played the roles of a rising type State 1 and a declining State 2.

Consistent with my theoretical analysis, Japan decided to launch a preventive war when it believed that Russia would become more powerful in the foreseeable future and the negotiation was intentionally delayed to buy time (Nish 2014, 211). Below, I provide direct evidence that Russia purposely stalled negotiations to enhance its military establishment in Manchuria, and Japan resorted to military force to settle the question when concluding that the stalemate would significantly curtail its bargaining power.

The Russian Emperor was convinced that Russia's power in the Far East stood to increase enormously with every year of peace (Kowner 1998, 217). In an internal meeting of late December 1903, the Russian Emperor explicitly said that time was on the side of Russia and that its position would be strengthened each year (White 2015, 114). After formal exchanges began, Russia delegated some bargaining power from the highest level of authority in St. Petersburg to Port Arthur (White 2015, 72–73). The dual management of negotiations considerably delayed Russia's diplomatic replies to Japan, as each reply had to go through a cumbersome and dispersed administrative process before it could be formulated and transmitted (Gurko 1939, 281–284; White 2015, 110). The bureaucratic procedure is obviously a crafted reason for delay, as the Russia viceroy at Port Arthur, Yevgeni Alekseiev, suggested: "the negotiation should be prolonged to allow Russia time to reinforce its military strength in Manchuria, and Russia's geographical position and military strength will gradually solve the question in Russia's favor as the insufficiency of its land forces is remedied in the course of time" (White 2015, 111, 126).

Japanese decision-makers, however, suspected that Russia's military power would increase with time. By

mid-1903, there appeared to be ample reasons to suspect Russia's true motives: Russia refused to proceed with a promised evacuation of troops from Manchuria, allowed the ongoing construction of railways to two strategic ports in the Far East, and continued the permanent establishment of civilian and military bases in northern Korea under the disguise of protecting its economic interests (White 2015, 95-99; Malozemoff 2020). Shortly after the begin of formal talks, Russia pressured China and Korea to revise existing treaties and lease new territories in Manchuria and the north of Korea (White 2015, 104). These aggressive acts made it difficult for Japan to reconcile the bargaining delay with the claimed exogenous reasons.[8]

Japan decided to fight when it found that the delay was caused by Russia's desire to significantly improve its bargaining position. In January 1904, Japanese politicians unanimously agreed that Russia refused to enter into negotiations over Manchuria, while simultaneously trying to build up its military strength there, and if Japan had to go to war, it should do so immediately.[9] The Japanese sentiments are explained by Itō Hirobumi's memorandum in February: "There is no question but that Russia's aim was from the start to increase her military and naval forces and then reject Japan's demands. In this way she could fulfill her ambitions in Manchuria and Korea without interference. This being so, if Japan does not now go to war and defend her threatened interests, she will eventually have to kowtow to the Russian governor of one of her frontier provinces" (Nish 2014, 207). While some time would be required to finish the power shift, it was obvious that further delay would only play into Russia's hands (Romanov 1947, 241). In February 1904, Japan ended diplomatic talks and formally declared war on Russia.

With a close examination of Russia's delay tactics in negotiations, I show that war followed a preventive logic on the part of Japan. My conclusion concurs with previous historical studies pointing out Japan's concern about the growing economic and military power of Russia prior to the Russo-Japanese War (Langer 1960, 172), and my model highlights the consequences of intentional delay tactics as a key mechanism underpinning the causes of the war.

1.5 Conclusion

This paper identifies a puzzle in international bargaining: why would states tolerate extensive delay in some crisis negotiations, but not others? My answer is that the sources of delay are ambiguous to states. This information asymmetry causes declining states to misperceive the real causes of delay and end up tolerating stalling tactics. Thus, opponent states often try to delay bargaining to buy time to complete a power shift, but claim that exogenous forces are in fact responsible for the delay. Especially, rising states can obtain power peacefully via delaying tactics when declining states can not ascertain the real reason for delay and hold lower

[8] When explaining for delays, Russia claimed that "the emperor is taking a holiday; the Empress is ill; the Viceroy (at Port Arthur) must be consulted. See Spring-Rice to Mrs Roosevelt, 9 Dec, 1903, in S. Gwynn (ed.), The Letters and Friendships of Sir Cecil Spring-Rice, vol. 1, p. 373.

[9] Japan, Navy Ministry, Yamamoto Gombei to Kaigun, pp. 189–201

prior beliefs about their opponents being the beneficiaries of delays.

The model extends our theoretical understanding of why states accomplish power rise without being the targets of preventive wars. I identify conditions under which a state can achieve a power rise peacefully and completely (Proposition 2). Previous work suggests that rapid and significant power shifts would not be peaceful or complete, either because other states take preventive measures like war and sanctions (Fearon 1995; Powell 2004, 2006; McCormack and Pascoe 2017; Yoder 2019a), or because power shifts are bargained away peacefully with compensation (Chadefaux 2011; Coe 2018; Spaniel 2019). My model yields a clean equilibrium outcome of peaceful power shifts which does not depend on sophisticated assumptions about power dynamics (Bas and Schub 2017), nor involves noisy signals (Debs and Monteiro 2014; Bas and Coe 2016).

On the empirical side, my findings suggest avenues for future research on how uncertainty about power shifts influences the risk of interstate conflicts. One of my theoretical results implies that aggravated uncertainty about potential power shifts, arising from asymmetric information about the reasons for delay, can weakly decrease the risk of war and increase the prospect for peaceful power shifts. This is distinct from conventional results regarding the provocative effect of asymmetric information on international conflicts. My theoretical model is intended to capture and formalize certain aspects of international bargaining, and the results emerging from it only hold under specific conditions and do not carry over into other contexts. Despite the scope conditions, my theoretical results highlight the importance of accounting for the uncertainty about power shifts in evaluating states' incentive of preventive fighting, calling for more empirical efforts to examine the relationship between power shifts and war.

Although there are extensive theoretical studies on shifting-power commitment problems, empirical investigations on the relationship between power shifts and war remains insufficient. Existing studies focus on measuring the size of potential power shifts and corroborate its positive correlation with war initiation, but overlook quantifying the uncertainty about power shifts (Bell and Johnson 2015). Since my study suggests a more intricate and complex relationship between power shifts and war, future empirical research should 1) spend efforts on measuring the uncertainty about power shifts using existing or novel data sources, and 2) investigate whether uncertainty about power shifts is associated with a higher risk of war, and unpack the specific conditions under which increasing this kind of uncertainty may or may not induce more conflicts.

1.6 Proofs

I prove the propositions in the main text through showing a set of preliminary lemmas. I first prove properties regarding the equilibrium in the main model, and then compare the probability of war and power shifts between the baseline model and the main model.

1.6.1 Proofs of Proposition 1

All lemmas in this section are geared towards proving Proposition 1. When State 2 can not tell if the delay is intentional or exogenous, denote State 2's strategy profile as $\sigma_2(\mu_R, \sigma_D)$, where μ_R is State 2's posterior belief about State 1 being a rising type facing a delay, and σ_D is State 2's probability of fighting after delay. Consider a general strategy of State 1, $\sigma_1(\sigma_R, \sigma_S)$, where σ_R is the rising type State 1's probability of Delay, σ_S is the static type State 1's probability of Delay.

Lemma 1.6.1 pins down State 2's best responses given State 1's strategy and its posterior belief that is updated via Bayes rule.

Lemma 1.6.1. *Facing a delay, State 2 prefers to fight if* $\mu_R > \frac{1-w_2-q-\delta(w_1-q)}{\delta(w_1'-w_1)}$*; State 2 prefers to wait if* $\mu_R < \frac{1-w_2-q-\delta(w_1-q)}{\delta(w_1'-w_1)}$*; State 2 is indifferent between fighting and waiting if* $\mu_R = \frac{1-w_2-q-\delta(w_1-q)}{\delta(w_1'-w_1)}$.

Proof. Facing delay, if State 2 chooses to fight, then it receives the war payoff

$$W_2 = (1-\delta)w_2 + \delta w_2 = w_2$$

if State 2 chooses to wait, then it receives the continuation value payoff

$$V_2 = (1-\delta)(1-q) + \delta[\mu_R(1-w_1') + (1-\mu_R)(1-w_1)]$$

State 2 prefers to fight when $W_2 > V_2$

$$\begin{aligned} w_2 &> (1-\delta)(1-q) + \delta[\mu_R(1-w_1') + (1-\mu_R)(1-w_1)] \\ \mu_R &> \frac{1-w_2-q-\delta(w_1-q)}{\delta(w_1'-w_1)} \end{aligned}$$

State 2 prefers to wait when $W_2 < V_2$, implying $\mu_R < \frac{1-w_2-q-\delta(w_1-q)}{\delta(w_1'-w_1)}$; State 2 is indifferent and mixes between fighting and waiting when $W_2 = V_2$, implying $\mu_R = \frac{1-w_2-q-\delta(w_1-q)}{\delta(w_1'-w_1)}$. This completes the proof. □

Lemma 1.6.2. $\forall\ \sigma_D \in [0,1)$*, State 1 adopts a separating strategy profile:* $\sigma_R = 1$ *and* $\sigma_S = 0$.

Proof. Lemma 1.6.2 shows that if State 2 waits after delay at a positive probability, then the rising type State 1 strictly prefers the action Delay, and the static type State 1 strictly prefers the action Not Delay.

Suppose $\sigma_D \in [0,1)$, the rising type State 1 would receive

$$V_{R1}^D = \sigma_D w_1 + (1-\sigma_D)[(1-\delta)q + \delta w_1']$$

from the action Delay, and would receive

$$V_{R1}^{ND} = (1-\alpha)w_1 + \alpha[\sigma_D w_1 + (1-\sigma_D)((1-\delta)q + \delta w_1')]$$

from the action Not Delay. Under Assumption 1, it is easy to verify that $V_{R1}^D > V_{R1}^{ND}\ \forall \sigma_D \in [0,1)$, so the rising type State 1 prefers the action Delay, $\sigma_R = 1$. The static type State 1 would receive

$$V_{S1}^D = \sigma_D w_1 + (1-\sigma_D)[(1-\delta)q + \delta w_1]$$

from the action Delay, and would receive

$$V_{S1}^{ND} = (1-\alpha)w_1 + \alpha[\sigma_D w_1 + (1-\sigma_D)((1-\delta)q + \delta w_1)]$$

from the action Not Delay. Under the assumption $w_1 > q$, it is easy to verify that $V_{S1}^{ND} > V_{S1}^{D}\ \forall \sigma_D \in [0,1)$, so the static type State 1 prefers the action Not Delay, $\sigma_S = 0$. This completes the proof. □

Proposition 1. *Define* $r_* = \frac{\alpha[1-w_2-q-\delta(w_1-q)]}{\delta(w_1'-w_1)-(1-w_2-q)+\alpha[1-w_2-q-\delta(w_1-q)]}$. *In all equilibria:*

- *If* $r > r_*$, *State 2 fights after delay with probability one.*
- *If* $r < r_*$, *State 2 waits after delay with probability one.*

Proof. According to Bayes rule, State 2's posterior belief is

$$\mu_R = \frac{r[\sigma_R + (1-\sigma_R)\alpha]}{r[\sigma_R + (1-\sigma_R)\alpha] + (1-r)[\sigma_S + (1-\sigma_S)\alpha]}$$

Lemma 1.6.1 shows that when $\mu_R > \frac{1-w_2-q-\delta(w_1-q)}{\delta(w_1'-w_1)}$, State 2 fights after delay at probability one. Both types of State 1 receive w_1 from the action Delay and Not Delay, thus they are indifferent and have no incentive to deviate from any prescribed strategy profile $\sigma_1(\sigma_R, \sigma_S)$. There exists equilibrium in which State 2 fights after delay, $\sigma_D = 1$. $\mu_R > r^*$ implies

$$r > \frac{[1-w_2-q-\delta(w_1-q)][(1-\alpha)\sigma_S+\alpha]}{(1-\alpha)\sigma_R[\delta(w_1'-q)-(1-w_2-q)]+\alpha\delta(w_1'-w_1)+(1-\alpha)\sigma_S[1-w_2-q-\delta(w_1-q)]} \equiv r(\sigma_R, \sigma_S)$$

it is easy to verify that $r(\sigma_R, \sigma_S)$ decreases in σ_R and increases in σ_S.

$$\min r(\sigma_R, \sigma_S) = \frac{\alpha[1-w_2-q-\delta(w_1-q)]}{\delta(w_1'-w_1)-(1-w_2-q)+\alpha[1-w_2-q-\delta(w_1-q)]} \equiv r_*$$

when $\sigma_R = 1$ and $\sigma_S = 0$. Thus, when $r > r_*$, State 2 fights after delay in all equilibria.

Lemma 1.6.1 shows that when $\mu_R < \frac{1-w_2-q-\delta(w_1-q)}{\delta(w_1'-w_1)}$, State 2 waits after delay at probability one. Lemma 1.6.2 shows that $\sigma_1(\sigma_R = 1, \sigma_S = 0)$. This implies a unique separating equilibrium of the game in which the rising type State 1 chooses Delay and the static type State 1 chooses Not Delay. $\mu_R < r(\sigma_R = 1, \sigma_S = 0)$ implies

$$r < \frac{\alpha[1-w_2-q-\delta(w_1-q)]}{\delta(w_1'-w_1)-(1-w_2-q)+\alpha[1-w_2-q-\delta(w_1-q)]} \equiv r_*$$

Thus, when $r < r_*$, State 2 waits after delay in the unique equilibrium.

It is easy to verify that r_* increases in α, $\max r_* = \frac{1-w_2-q-\delta(w_1-q)}{\delta(w_1'-w_1)}$ as $\alpha \to 1$. Thus, $r_* < r^*$ always. This completes the proof. □

1.6.2 Proofs of Proposition 2

Proposition 2. *When* $r < r_*$, *there is a unique Perfect Bayesian Equilibrium in which:*

- *The static type State 1 chooses Not Delay; the rising type State 1 chooses Delay.*
- *Facing delays, State 2 chooses to Wait.*
- *There is a peaceful power shift between State 1 and State 2*

Proof. Suppose there is an equilibrium in which State 1 adopts a separating strategy profile in which the rising type State 1 chooses *Delay* and the static type State 1 chooses *Not Delay*. According to Bayes rule, State 2's posterior belief about State 1 being the rising type is

$$\mu_R = \frac{r[\sigma_R + (1-\sigma_R)\alpha]}{r[\sigma_R + (1-\sigma_R)\alpha] + (1-r)[\sigma_S + (1-\sigma_S)\alpha]}$$

$r < r_*$ implies that $\mu_R < \frac{1-w_2-q-\delta(w_1-q)}{\delta(w_1'-w_1)}$, so State 2 will wait after delay according to lemma 1.6.1.

Then, I show that either type of State 1 has no incentive to deviate from the prescribed strategy profile. The rising type State 1 receives payoff.

$$V_{R1}^{D} = (1-\delta)q + \delta w_1'$$

it would receive payoff

$$V_{R1}^{ND} = (1-\alpha)w_1 + \alpha[(1-\delta)q + \delta w_1']$$

if deviates to the action *Not Delay*. Under Assumption 1, it is easy to verify that $V_{R1}^{D} > V_{R1}^{ND}$. Thus, the rising type State 1 has no incentive to deviate. The static type State 1 receives payoff

$$V_{S1}^{ND} = (1-\alpha)w_1 + \alpha[(1-\delta)q + \delta w_1]$$

it would receive payoff

$$V_{S1}^{D} = (1-\delta)q + \delta w_1$$

if deviates to the action *Delay*. Under the assumption $w_1 > q$, it is easy to verify that $V_{S1}^{ND} > V_{S1}^{D}$. Thus, the static type State 1 has no incentive to deviate. The separating profile constitutes an equilibrium. The rising type State 1 can completes its power rise after the intentional delay. This completes the proof. □

1.6.3 Proofs of Proposition 3

All lemmas in this section are geared towards proving Proposition 3. I first calculates the probability of war and the probability of power shifts in the baseline model where sources of delay are distinguishable, then I return to the main model where sources of delay are indistinguishable. Finally, I compare the statistics between the two models.

For now, assuming the baseline model where State 2 can tell if the delay is intentional or exogenous. Consider State 2's general strategy $\sigma_2(\sigma_{ID}, \sigma_{ED})$. Let σ_{ID} be State 2's probability of fighting after the intentional delay, and σ_{ED} be State 2's probability of fighting after the exogenous delay.

Lemma 1.6.3. *In all equilibria of the game,* $1-\sigma_{ID} = \alpha(1-\sigma_{ED})$*, where* $\sigma_{ID} > 0$*.*

Proof. If the rising type State 1 chooses the action Delay, it receives payoff

$$V_{R1}^{D} = \sigma_{ID} w_1 + (1-\sigma_{ID})[(1-\delta)q + \delta w_1']$$

if the rising type State 1 chooses the action Not Delay, it receives payoff

$$V_{R1}^{ND} = (1-\alpha)w_1 + \alpha[\sigma_{ED} w_1 + (1-\sigma_{ED})((1-\delta)q + \delta w_1')]$$

The rising type State 1 prefers Delay when $V_{R1}^{D} > V_{R1}^{ND}$

$$[1-\sigma_{ID} - \alpha(1-\sigma_{ED})][(1-\delta)q + \delta w_1'] > [1-\sigma_{ID} - \alpha(1-\sigma_{ED})]w_1$$

under Assumption 1, the inequality holds as long as $1-\sigma_{ID} > \alpha(1-\sigma_{ED})$. The rising type State 1 prefers Not Delay when $1-\sigma_{ID} < \alpha(1-\sigma_{ED})$, and it is indifferent and mixes Delay and Not Delay when $1-\sigma_{ID} = \alpha(1-\sigma_{ED})$.

If the static type State 1 chooses the action Delay, it receives payoff

$$V_{S1}^{D} = \sigma_{ID} w_1 + (1-\sigma_{ID})[(1-\delta)q + \delta w_1]$$

if the static type State 1 chooses the action Not Delay, it receives payoff

$$V_{S1}^{ND} = (1-\alpha)w_1 + \alpha[\sigma_{ED} w_1 + (1-\sigma_{ED})((1-\delta)q + \delta w_1)]$$

The static type State 1 prefers Delay when $V_{S1}^{D} > V_{S1}^{ND}$

$$[1-\sigma_{ID} - \alpha(1-\sigma_{ED})][(1-\delta)q + \delta w_1] > [1-\sigma_{ID} - \alpha(1-\sigma_{ED})]w_1$$

under the assumption $w_1 > q$, the inequality holds if and only if $1-\sigma_{ID} < \alpha(1-\sigma_{ED})$. The static type State 1 prefers Not Delay when $1-\sigma_{ID} > \alpha(1-\sigma_{ED})$, and it is indifferent and mixes Delay and Not Delay when $1-\sigma_{ID} = \alpha(1-\sigma_{ED})$. The results show that when $1-\sigma_{ID} \neq \alpha(1-\sigma_{ED})$, State 1 adopts a separating strategy. It is easy to verify that such a strategy can not constitute an equilibrium.

Suppose in equilibrium, State 2 fights after the intentional delay with probability σ_{ID} and the exogenous delay with probability σ_{ED} such that $1-\sigma_{ID} = \alpha(1-\sigma_{ED})$. Previous analysis demonstrates that both types State 1 receive the same payoff from the action Delay and the action Not Delay, therefore are indifferent and have no incentive to deviate from any prescribed strategy. Since $\alpha(1-\sigma_{ED}) < 1$, which implies $\sigma_{ID} > 0$. This completes the proof. □

Proposition 1.6.1. *In all equilibria of the game when sources of delay are distinguishable:*

- *If* $r > \frac{1-w_2-q-\delta(w_1-q)}{\delta(w_1'-w_1)} \equiv r^*$*, State 2 fights after both types of delay with probability one.*
- *If* $r \leq \frac{1-w_2-q-\delta(w_1-q)}{\delta(w_1'-w_1)} \equiv r^*$*, State 2 fights after the intentional delay with probability* σ_{ID} *and the exogenous delay with probability* σ_{ED} *such that* $1-\sigma_{ID} = \alpha(1-\sigma_{ED})$*, where* $\sigma_{ID} \in (0,1]$ *and* $\sigma_{ED} \in [0,1]$*.*

Proof. Consider a general strategy of State 1, $\sigma_1(\sigma_R, \sigma_S)$ where σ_R is the rising type State 1's probability of Delay, σ_S is the static type State 1's probability of Delay. According to Bayes rule, $\mu_{R|ID} = \frac{r\sigma_R}{r\sigma_R+(1-r)\sigma_S}$ and is not defined when $\sigma_R = \sigma_S = 0$, $\mu_{R|ED} = \frac{r(1-\sigma_R)}{r(1-\sigma_R)+(1-r)(1-\sigma_S)}$ and is not defined when $\sigma_R = \sigma_S = 1$. Lemma 1.6.3 shows that $1-\sigma_{ID} = \alpha(1-\sigma_{ED})$ in all equilibria.

First, Suppose State 2 fights after the intentional delay at probability one, $\sigma_{ID} = 1$, the equality implies that $\sigma_{ED} = 1$, so State 2 fights after both types of delay with probability one. This equilibrium requires $\mu_{R|ID} > r^*$ and $\mu_{R|ED} > r^*$. It is easy to verify that $\mu_{R|ID} > r^*$ implies

$$r > \frac{\sigma_S[1-w_2-q-\delta(w_1-q)]}{\sigma_R[\delta(w_1'-q)-(1-w_2-q)]+\sigma_S[1-w_2-q-\delta(w_1-q)]} \equiv \hat{r}$$

and $\mu_{R|ED} > r^*$ implies

$$r > \frac{(1-\sigma_S)[1-w_2-q-\delta(w_1-q)]}{(1-\sigma_R)[\delta(w_1'-q)-(1-w_2-q)]+(1-\sigma_S)[1-w_2-q-\delta(w_1-q)]} \equiv \widetilde{r}$$

The equilibrium requires that $r > \max\{\hat{r}, \widetilde{r}\}$. It is easy to verify that $\hat{r} > \widetilde{r}$ when $\sigma_S > \sigma_R$, and $\hat{r} < \widetilde{r}$ when $\sigma_S < \sigma_R$. Also, $\hat{r}$ decreases in σ_R and increases in σ_S, $\widetilde{r}$ increases in σ_R and decreases in σ_S. When $\sigma_R = \sigma_S$

$$\min\max\{\hat{r}, \widetilde{r}\} = \frac{1-w_2-q-\delta(w_1-q)}{\delta(w_1'-w_1)} \equiv r^*$$

Thus, when $r > r^*$, there exists equilibrium in which State 2 fights after both types of delay.

Second, suppose State 2 fights after the intentional delay at probability $\sigma_{ID} = 1-\alpha$, the equality implies that $\sigma_{ED} = 0$, so State 2 waits after the exogenous delay at probability one. This equilibrium requires $\mu_{R|ID} = r^*$ and $\mu_{R|ED} < r^*$. Solving for the prior belief, $\mu_{R|ID} = r^*$ implies $r = \hat{r}$, $\mu_{R|ED} < r^*$ implies $r < \widetilde{r}$.

If both $\mu_{R|ID}$ and $\mu_{R|ED}$ are well defined, it implies $\hat{r} < \widetilde{r}$ which holds when $\sigma_S < \sigma_R$. Then it is easy to verify that $\hat{r} < r^* < \widetilde{r}$. If one of them is not defined, then it implies either $\mu_{R|ID} = r = r^*$ and there is no restriction on the off–path belief $\mu_{R|ED}$, or $\mu_{R|ED} = r < r^*$ and there is no restriction on the off–path belief $\mu_{R|ID}$. All off–path beliefs survive Dominance Refinement and Equilibrium Refinement. Thus, when $r \leq r^*$, there exists equilibrium in which State 2 waits after the exogenous delay and fights after the intentional delay at probability $1-\alpha$.

Third, suppose State 2 adopts $\sigma_2(\sigma_{ID}, \sigma_{ED}) \in (0,1)\times(0,1)$ such that $1-\sigma_{ID} = \alpha(1-\sigma_{ED})$, so State 2 fights after each type of delay at a positive probability. This mixing-strategy implies $\mu_{R|ID} = \mu_{R|ED} = r^*$. In all cases, the equilibria require $\mu_{R|ID} = \mu_{R|ED} = r$. This completes the proof. □

Lemma 1.6.4. *Suppose State 2 can distinguish the sources of delay. In the Pareto Dominant equilibrium:*

- *When* $r < r^*$*,* $Pr(War) = 0$*,* $Pr(Power\ Shift) = r\alpha$
- *When* $r > r^*$*,* $Pr(War) = \alpha$*,* $Pr(Power\ Shift) = 0$

Proof. Previous analysis shows that when $r < r^*$, in equilibrium, State 2 fights after the intentional delay with probability $1-\alpha$ and waits after the exogenous delay. Given State 2's strategy, both types State 1 are

indifferent between the action Delay and Not Delay. Given State 1's strategy profile $\sigma_1(\sigma_R, \sigma_S)$, the rising type State 1 can achieve a power rise at probability

$$Pr(Power\ Shift)_{r<r^*} = r[\sigma_R\alpha + (1-\sigma_R)\alpha] = r\alpha$$

and the ex ante probability of war is

$$Pr(War)_{r<r^*} = (1-\alpha)[r\sigma_R + (1-r)\sigma_S] \in [0, 1-\alpha)$$

Although there exists multiple equilibrium when $r < r^*$, it is easy to verify that the Pareto Dominant equilibrium is the one in which both types State 1 pool on the action Not Delay ($\sigma_R = 0, \sigma_S = 0$), and the probability of war on the path of play is zero.

Previous analysis shows that when $r > r^*$, in equilibrium, State 2 fights after both types of delay with probability one, and both types State 1 are indifferent between the action Delay and Not Delay. Given State 1's strategy profile $\sigma_1(\sigma_R, \sigma_S)$, the rising type State 1 can achieve a power rise at probability

$$Pr(Power\ Shift)_{r>r^*} = 0$$

and the ex ante probability of war is

$$Pr(War)_{r>r^*} = 1-(1-\alpha)[(1-r)(1-\sigma_S) + r(1-\sigma_R)] \in [\alpha, 1]$$

although there exists multiple equilibrium when $r > r^*$, it is easy to verify that the Pareto Dominant equilibrium is the one in which both types State 1 pool on the action Not Delay ($\sigma_R = 0, \sigma_S = 0$), so the probability of war on the path of play is $Pr(War)_{r>r^*} = \alpha$. This completes the proof. □

Lemma 1.6.5. *Suppose State 2 can not distinguish the sources of delay. In the Pareto Dominant equilibrium:*

- *When $r < r_*$, $Pr(War) = 0$, $Pr(Power\ Shift) = r$*
- *When $r > r_*$, $Pr(War) \geq \alpha$, $Pr(Power\ Shift) = 0$*

Proof. Proposition 2 shows that when $r < r_*$, there is a unique separating equilibrium in which the rising type State 1 chooses Delay, the static type State 1 chooses Not Delay, and State 2 waits after delay at probability one. Thus, the probability of war is 0 and the probability of power shift is r.

Proposition 1 shows that when $r > r_*$, State 2 fights after delay in all equilibria. Both types State 1 are indifferent between the action Delay and Not Delay. There exists multiple equilibria when $r > r_*$. Given State 1's strategy profile $\sigma_1(\sigma_R, \sigma_S)$, the ex ante probability of war is

$$Pr(War)_{r_*<r<r^*} = 1-(1-\alpha)[(1-r)(1-\sigma_S) + r(1-\sigma_R)] > (1-\alpha)[r\sigma_R + (1-r)\sigma_S]$$

It is easy to verify that when $r_* < r < r^*$, the Pareto Dominant equilibrium features the rising type State 1 employs a mixing strategy and the static type State 1 chooses the action Not Delay. Given State 1's strategy profile $\sigma_1(\sigma_R, 0)$, the probability of war on the path of play is

$$Pr(War)_{r_*<r<r^*} = 1-(1-\alpha)[1-r+r(1-\sigma_R)] \geq \alpha$$

whose minimum value approaches α as $\sigma_R \to 0$.

It is easy to verify that when $r > r^*$, the Pareto Dominant equilibrium features both types State 1 pool on the action Not Delay. Given State 1's strategy profile $\sigma_1(0,0)$, the probability of war on the path of play is

$$Pr(War)_{r>r^*} = \alpha$$

The probability of power shift is 0 obviously. This completes the proof. □

Proposition 3. *Uncertainty about the reasons for delay has the following effects on the equilibrium outcomes:*

- *When $r < r_*$, weakly decreases the probability of preventive war, increases the probability of peaceful power shifts.*
- *When $r_* < r < r^*$, increases the probability of preventive war, decreases the probability of peaceful power shifts.*

• *When $r > r^*$, does not affect the probability of preventive war and peaceful power shifts.*

Proof. The proof follows directly from Lemma 1.6.4 and Lemma 1.6.5.

When $r < r_*$, if the sources of delay are distinguishable to State 2, Lemma 1.6.4 shows that the probability of war is zero, and the probability of peaceful power shift is $r\alpha$, where $\alpha < 1$. If the sources of delay are indistinguishable to State 2, Lemma 1.6.5 shows that the probability of war is zero, and the probability of peaceful power shift is r. Since, $r\alpha < r$. To sum up, imposing uncertainty about the reasons for delay weakly decreases the probability of war, and increases the probability of peaceful power shifts.

When $r_* < r < r^*$, if the sources of delay are distinguishable to State 2, Lemma 1.6.4 shows that the probability of war is zero, and the probability of peaceful power shift is $r\alpha$, where $\alpha < 1$. If the sources of delay are indistinguishable to State 2, Lemma 1.6.5 shows that the probability of war is greater than α, and the probability of peaceful power shift is 0. To sum up, imposing uncertainty about the reasons for delay increases the probability of war, and decreases the probability of peaceful power shifts.

When $r > r^*$, if the sources of delay are distinguishable to State 2, Lemma 1.6.4 shows that the probability of war is α, and the probability of peaceful power shift is 0. If the sources of delay are indistinguishable to State 2, Lemma 1.6.5 shows that the probability of war is α, and the probability of peaceful power shift is 0. To sum up, imposing uncertainty about the reasons for delay does not impact the probability of war and peaceful power shift. This completes the proof. □

1.6.4 Extension: Positive Shifts without Delay at Probability $\beta > 0$

I prove the results of the extension model through a set of preliminary lemmas. The intuition is that when $\beta > 0$, it does not influence State 2's tradeoff upon delay, so all lemmas and propositions still hold. However, a positive β will change State 1's payoff when Nature does not cause exogenous delay, thus eliminating some equilibrium and increasing the risk of war involving the static type State 1. Still, the distribution of all equilibria remains the same as shown in Proposition 1.

Distinguishable Delay

I first show the impact of allowing the rising type State 1 to obtain bargaining power upon no-delay on State 2's offer in the ultimatum bargaining game. Denote State 2 posterior belief about State 1 being the rising type after no-delay as μ'_R.

Lemma 1.6.6. *Define $\mu^*(\beta) = \frac{1-w_1-w_2}{1-w_1-w_2+\beta\delta(w'_1-w_1)}$, in Period One after no-delay:*

• *When $\mu'_R > \mu^*(\beta)$, State 2 offers $x_L = w_1 - \frac{\delta\beta}{1-\delta}(w'_1 - w_1)$, which the rising type State 1 will accept, but the static type State 1 will reject.*

• *When $\mu'_R < \mu^*(\beta)$, State 2 offers $x_H = w_1$, which both types of State 1 will accept.*

Proof. In Period Two, the static type State 1 accepts x^2 such that $x^2 \geq w_1$ and rejects otherwise. If the rising type State 1 obtains power, it accepts x^2 such that $x^2 \geq w'_1$, if the rising type State 1 fails to obtain power, it accepts x^2 such that $x^2 \geq w_1$. Since the type and the power of State 1 is revealed to State 2, State 2 can make the offer that renders State 1 indifferent between reject and accept.

In Period One, the static type State 1 accepts x^1 such that

$$(1-\delta)x^1 + \delta w_1 \geq w_1$$

implying $x^1 \geq w_1$. The rising type State 1 accepts x^1 such that

$$(1-\delta)x^1 + \delta[\beta w'_1 + (1-\beta)w_1] \geq w_1$$

implying $x^1 \geq w_1 - \frac{\delta\beta}{1-\delta}(w'_1 - w_1)$. Denote $x_H = w_1$ and $x^L = w_1 - \frac{\delta\beta}{1-\delta}(w'_1 - w_1)$.

Then I solve for which offer State 2 is willing to make. If State 2 offers $x_H = w_1$, both types of State 1 will accept, and State 2 receives the expected payoff

$$U_2^{x_H} = (1-\delta)(1-w_1) + \delta[\mu'_R\beta(1-w'_1) + (1-\mu'_R\beta)(1-w_1)] = 1 - w_1 - \mu'_R\delta\beta(w'_1 - w_1)$$

If State 2 offers $x_L = w_1 - \frac{\delta\beta}{1-\delta}(w_1' - w_1)$, the static type State 1 rejects but the rising type State 1 accepts, State 2 receives the expected payoff

$$\begin{aligned} U_2^{x_L} &= (1-\mu_R')w_2 + \mu_R'[(1-\delta)(1-w_1 + \frac{\delta\beta}{1-\delta}(w_1'-w_1)) + \delta(\beta(1-w_1') + (1-\beta)(1-w_1))] \\ &= (1-\mu_R')w_2 + \mu_R'(1-w_1) \end{aligned}$$

Thus, State 2 offers $x_H = w_1$ if and only if $U_2^{x_H} > U_2^{x_L}$

$$\begin{aligned} 1 - w_1 - \mu_R'\delta\beta(w_1'-w_1) &> (1-\mu_R')w_2 + \mu_R'(1-w_1) \\ \mu_R'\delta\beta(w_1'-w_1) + \mu_R'(1-w_1-w_2) &< 1-w_1-w_2 \\ \mu_R' &< \frac{1-w_1-w_2}{1-w_1-w_2+\beta\delta(w_1'-w_1)} \end{aligned}$$

State offers $x_L = w_1 - \frac{\delta\beta}{1-\delta}(w_1' - w_1)$ if and only if $\mu_R' > \frac{1-w_1-w_2}{1-w_1-w_2+\beta\delta(w_1'-w_1)}$. Denote $\mu^*(\beta) \equiv \frac{1-w_1-w_2}{1-w_1-w_2+\beta\delta(w_1'-w_1)}$, this completes the proof. □

Then, I identify an upper bound of β such that the rising type State 1 still has incentive to cause intentional delay to obtain extra bargaining power if given the opportunity to do so, and show that below this upper bound, State 2 never wait after the intentional delay with probability one.

Lemma 1.6.7. *Define $\overline{\beta} = \frac{(1-\delta)q+\delta w_1' - w_1}{\delta(w_1'-w_1)}$. When $\beta < \overline{\beta}$, in all equilibria of the game, State 2 fights after the intentional delay with a positive probability $\sigma_{ID} \in (0,1]$.*

Proof. Prove by contradiction. Suppose there exists an equilibrium in which State 2 fights after the intentional delay with probability zero. Then the rising type State 1 would receive

$$V_{R1}^D = (1-\delta)q + \delta w_1'$$

from the action Delay, but the highest payoff it can receive from the action Not Delay is

$$V_{R1}^{ND} = (1-\alpha)[w_1 + \delta\beta(w_1'-w_1)] + \alpha[(1-\delta)q + \delta w_1']$$

under the assumption $\beta < \overline{\beta}$, $V_{R1}^D > V_{R1}^{ND}$, implying that the rising type State 1 strictly prefers the action Delay. The static type State 1 would receive

$$V_{S1}^D = (1-\delta)q + \delta w_1$$

from the action Delay, but the highest payoff it can receive from the action Not Delay is

$$V_{S1}^{ND} = (1-\alpha)w_1 + \alpha[(1-\delta)q + \delta w_1]$$

under the assumption $w_1 > q$, $V_{S1}^{ND} > V_{S1}^D$, implying that the static type State 1 strictly prefers the action Not Delay. So State 1 adopts a separating strategy profile. Then $\mu_{R|ID} = 1$ and State 2 should fights after the intentional delay with probability one, contradicting the presumption that State 2 fights after the intentional delay with probability zero. This completes the proof. □

State 2 either makes a high offer $x_H = w_1$ or a low offer $x_L = w_1 - \frac{\delta\beta}{1-\delta}(w_1' - w_1)$ when Nature does not cause delay. When State 2 offers x_L, in all equilibria, the strategic tradeoffs of all players remain the same as when $\beta = 0$, thus all results still hold, with the exception that there is a positive risk of war with the static type State 1 after no-delay. Next, I focus on the case when State 2 offers x_H, since this offer increases the rising type State 1's payoff from choosing Not Delay. However, I show that even with the higher offer, the equilibrium distribution remains the same as when $\beta = 0$.

Lemma 1.6.8. *In all equilibria when State 2 offer $x_H = w_1$, $\sigma_R = \sigma_S = 0$.*

Proof. According to Bayes rule, $\mu_{R|ID} = \frac{r\sigma_R}{r\sigma_R + (1-r)\sigma_S}$ and $\mu_R' = \mu_{R|ED} = \frac{r(1-\sigma_R)}{r(1-\sigma_R)+(1-r)(1-\sigma_S)}$. Lemma 1.6.8 implies that in all equilibria when State 2 offers $x_H = w_1$, $\mu_{R|ID}$ is not defined. Prove by contradiction. Suppose there exists equilibria in which $\mu_{R|ID}$ is well-defined.

First, in such equilibria, $\sigma_R \neq 0$. Otherwise $\mu_{R|ID} = 0$, and State 2 waits after the intentional delay with probability one, contradicting the result of Lemma 1.6.7.

Second, in such equilibria, $\sigma_S \neq 1$. Otherwise, Lemma 1.6.3 shows that the static type State 1 has no incentive to deviate to Not Delay if and only if $1 - \sigma_{ID} \leq \alpha(1 - \sigma_{ED})$. When State 2 offers x_H, the rising type State 1 strictly prefers Not Delay such that $\mu'_R = 1 > \mu^*(\beta)$ and State 2 offers x_L, contradicting the presumption that State 2 offers x_H in equilibrium.

Third, in such equilibria, $\sigma_S \neq 0$. Otherwise $\mu_{R|ID} = 1$, State 2 fights after the intentional delay with probability one, when State 2 offers x_H, the rising type State 1 strictly prefers Not Delay, implying $\sigma_R = 0$, contradicting the first result that $\sigma_R \neq 0$.

Then $\sigma_S \in (0,1)$, implying that the static type State 1 uses a mixed strategy. Lemma 3 shows that static type State 1 is different between Delay and Not Delay when $1 - \sigma_{ID} = \alpha(1 - \sigma_{ED})$. When State 2 offers x_H, the rising type State 1 strictly prefers Not Delay, contradicting the previous result that $\sigma_R \neq 0$.

This left the only possibility that in equilibrium $\sigma_R = \sigma_S = 0$, implying $\mu_{R|ED} = \mu'_R = r$.

□

Finally, I stretch the proof that there exists pooling equilibrium on Not Delay and the equilibrium distribution remains the same as in Proposition A.1.

Proof. Suppose $r > r^*$, State 2 fights after the exogenous delay and offers $x_H = w_1$ after no-delay. Both types of State 1 have no incentive to deviate if State 2's off-path belief is sufficiently high such that it fights after the intentional delay. There exists equilibrium when $r > r^*$ and State 2 fights after both types of delay.

Suppose $r < r^*$, State 2 waits after the exogenous delay and offers $x_H = w_1$ after no-delay. Both types of State 1 have no incentive to deviate if State 2's off-path belief equals r^* such that it fights after the intentional delay at probability $1 - \alpha$, in which case the static type State 1 is indifferent, while the rising type State 1 strictly prefers Not Delay. There exists equilibrium when $r < r^*$ and State 2 waits after the exogenous delay and fights after the intentional delay at probability $1 - \alpha$. □

Previous analysis proves that when $\beta < \overline{\beta}$, in the baseline model where sources of delay are distinguishable, the distribution of all equilibria remains the same as in Proposition A.1. The rising type State 1 can obtain power only through the exogenous delay.

Indistinguishable Delay

In this section, I investigate the main model in which the sources of delay are indistinguishable. I first show that as long as $\beta < \overline{\beta}$, two two types of State 1 prefer different actions if State 2 waits after delay at a positive probability.

Lemma 1.6.9. *When $\beta < \overline{\beta}$, $\forall\ \sigma_D \in [0,1)$, State 1 adopts a separating strategy profile: $\sigma_R = 1$ and $\sigma_S = 0$.*

Proof. Consider the two cases in which State 2 makes a high or low offer after no-delay. First, assuming $\mu'_R > \mu^*(\beta)$ and State 2 offers x_L. Both types State 1 would receive w_1 when Nature does not cause exogenous delay, thus have the same strategic tradeoff as when $\beta = 0$. Lemma 1.6.2 implies that they prefer different actions.

Second, assuming $\mu'_R < \mu^*(\beta)$ and State 2 offers x_H. If the rising type State 1 chooses Delay, it would receive

$$V_{R1}^D = \sigma_D w_1 + (1 - \sigma_D)[(1 - \delta)q + \delta w'_1]$$

if it chooses Not Delay, it would receive

$$V_{R1}^{ND} = (1 - \alpha)[w_1 + \beta\delta(w'_1 - w_1)] + \alpha[\sigma_D w_1 + (1 - \sigma_D)((1 - \delta)q + \delta w'_1)]$$

The rising type State 1 prefers Delay if and only if $V_{R1}^D > V_{R1}^{ND}$, implying

$$\beta < \frac{(1 - \sigma_D)[(1 - \delta)q + \delta w'_1 - w_1]}{\delta(w'_1 - w_1)} \equiv \beta(\sigma_D)$$

since $\sigma_D \in [0,1)$, $\beta(\sigma_D) \leq \overline{\beta}$ obviously, and $\max \beta(\sigma_D) = \overline{\beta}$.

The static type State 1 receives the same payoff as when $\beta = 0$, it is easy to verify that the static type State 1 prefers Not Delay. This completes the proof. □

Lemma 1.6.10. *When $\beta < \overline{\beta}$ and $r < r_*$, there exists a unique separating equilibrium in which the rising type State 1 chooses Delay, the static type State 1 chooses Not Delay, and State 2 waits after delay with probability one.*

Proof. Given State 1's strategy profile, State 2's posterior belief upon delay is calculated by Bayes rule, $\mu_R = \frac{r[\sigma_R+(1-\sigma_R)\alpha]}{r[\sigma_R+(1-\sigma_R)\alpha]+(1-r)[\sigma_S+(1-\sigma_S)\alpha]}$; State 2's belief upon no-delay is $\mu'_R = 0$, so State 2 offers x_H upon no-delay.

Lemma A.1 shows that when $r < r_*$, State 2 waits after delay at probability one. Lemma 12 shows that $\sigma_1 = (\sigma_R = 1, \sigma_S = 0)$. This implies a unique separating equilibrium in which the rising type State 1 chooses Delay and the static type State 1 chooses Not Delay.

The rising type State 1 receives the payoff

$$V^D_{R1} = (1-\delta)q + \delta w'_1$$

if it deviates to Not Delay, it would receive the payoff

$$V^{ND}_{R1} = (1-\alpha)[w_1 + \beta\delta(w'_1 - w_1)] + \alpha[(1-\delta)q + \delta w'_1]$$

the rising type State 1 has no incentive to deviate if and only if $V^D_{R1} > V^{ND}_{R1}$, implying

$$(1-\delta)q + \delta w'_1 > (1-\alpha)[w_1 + \beta\delta(w'_1 - w_1)] + \alpha[(1-\delta)q + \delta w'_1]$$
$$\beta < \frac{(1-\delta)q + \delta w'_1 - w_1}{\delta(w'_1 - w_1)}$$

which holds under the assumption $\beta < \overline{\beta}$. It is easy to verify that the static type State 1 has no incentive to deviate to Delay. This completes the proof. □

Previous analysis shows that when $r < r_*$, uncertainty about the reasons for delay allows the rising type State 1 to obtain bargaining power via intentional delay, therefore increasing the chance of power shifts and weakly decreasing the risk of war.

1.6.5 Extension: Reverse the Proposal Power

In this section, I prove that if (the informed) State 1 obtains all bargaining surplus, all results in the main model still hold when α satisfies certain conditions. I first pin down the equilibrium distribution in the prior belief space of the baseline model.

Denote State 2's posterior belief about State 1 being the rising type after either type of delay as $\mu_{R|\cdot}$, the following lemma replicates Lemma 1.6.1, expressing the threshold of the posterior belief in terms of w'_2. Assuming w'_2 is sufficiently small such that

$$w'_2 < \underline{w'_2} \equiv \frac{(1-q)\delta - (1-w_2-q)}{\delta}$$

where $(1-q)\delta > 1-w_2-q$.

Lemma 1.6.11. *Define $\mu^*_{R|\cdot} = \frac{(1-\delta)(1-w_2-q)}{\delta(w_2-w'_2)}$. Facing delay,*

• *State 2 prefers to fight if $\mu_{R|\cdot} > \mu^*_{R|\cdot}$; State 2 prefers to wait if $\mu_{R|\cdot} < \mu^*_{R|\cdot}$; State 2 is indifferent between fighting and waiting if $\mu_{R|\cdot} = \mu^*_{R|\cdot}$, $\mu^*_{R|\cdot}$ is valid probability under assumption $w'_2 < \underline{w'_2}$.*

Proof. I prove the case where State 2 faces the intentional delay. If State 2 chooses to fight, it receives the war payoff

$$W_2 = (1-\delta)w_2 + \delta w_2 = w_2$$

if State 2 chooses to wait, it receives the continuation payoff

$$V_2 = (1-\delta)(1-q) + \delta[\mu_{R|ID} w_2' + (1-\mu_{R|ID} w_2')w_2]$$

State 2 prefers to fight if $W_2 > V_2$, implying

$$\mu_{R|ID} > \frac{(1-\delta)(1-w_2-q)}{\delta(w_2-w_2')} \equiv \mu_{R|\cdot}^*$$

State 2 prefers to wait if $W_2 > V_2$, implying $\mu_{R|ID} < \frac{(1-\delta)(1-w_2-q)}{\delta(w_2-w_2')}$; State 2 is indifferent and mixes between fighting and waiting if $W_2 = V_2$, implying $\mu_{R|ID} = \frac{(1-\delta)(1-w_2-q)}{\delta(w_2-w_2')}$.

The case in which State 2 faces the exogenous delay follows the same logic. This completes the proof. □

Next, I replicate Lemma 1.6.3, showing that State 2 must fight after the intentional delay with a positive probability.

Lemma 1.6.12. *When the sources of are distinguishable, in all equilibria, State 2 fights after the intentional delay with a positive probability,* $\sigma_{ID} \in (0,1]$

Proof. Prove by contradiction. Suppose there exists an equilibrium in which State 2 fights after the intentional delay with probability zero. The rising type State 1 would receive V_{R1}^D from the action Delay, where

$$V_{R1}^D = (1-\delta)q + \delta(1-w_2')$$

but the highest payoff it can receive from the action Not Delay is

$$V_{R1}^{ND} = (1-\alpha)(1-w_2) + \alpha[(1-\delta)q + \delta(1-w_2')]$$

it is easy to verify that $V_{R1}^D > V_{R1}^{ND}$ always under the assumption $w_2' < \underline{w_2'}$, implying that the rising type State 1 always prefers the action Delay. The static type State 1 would receive V_{S1}^D from the action Delay, where

$$V_{S1}^D = (1-\delta)q + \delta(1-w_2)$$

but the lowest payoff it can receive from the action Not Delay is[10]

$$V_{S1}^{ND} = (1-\alpha)(1-w_2) + \alpha w_1$$

It is easy to verify that $V_{S1}^{ND} > V_{S1}^D$ when $\alpha < \frac{(1-\delta)(1-w_2-q)}{1-w_2-w_1} \equiv \alpha^*$. Conditional on α being sufficiently small, the static type State 1 always prefer the action Not Delay.

From now on, assuming $\alpha < \alpha^*$. Thus, State 1 adopts a separating strategy profile. By Bayes rule, it indicates $\mu_{R|ID} = 1 > \mu_{R|\cdot}^*$. Lemma 1.6.11 shows that State 2 fights after the intentional delay, contradicting the presumption that State 2 does not fight. This completes the proof. □

Then, I investigate the equilibrium distribution as r varies, which is summarized in the following proposition.

Proposition 1.6.2. *Define* $r^* = \frac{(1-\delta)(1-w_2-q)}{\delta(w_2-w_2')}$. *In all equilibria:*

• *If* $r < r^*$, *State 2 waits after the exogenous delay—*$\sigma_{ED} = 0$, *and fight after the intentional delay with a positive probability—*$\sigma_{ID} \in (0,1]$.

• *If* $r > r^*$, *State 2 fights after the exogenous delay—*$\sigma_{ED} = 1$, *and fight after the intentional delay with a positive probability—*$\sigma_{ID} \in (\alpha,1]$.

[10] here assumes that $(1-\delta)q + \delta(1-w_2) - w_1 > 0$. If otherwise, it is easy to verify that $V_{S1}^{ND} > V_{S1}^D$ always, therefore State 2 always prefers the action Not Delay

Proof. Consider State 2's general strategy $\sigma_2(\mu_{R|ID}, \sigma_{ID}; \mu_{R|ED}, \sigma_{ED})$, where $\sigma_{ID} \in (0,1]$. If the rising type State 1 chooses the action Delay, it would receive continuation payoff

$$V_{R1}^{D} = \sigma_{ID} w_1 + (1-\sigma_{ID})[(1-\delta)q + \delta(1-w_2')]$$

if the rising type State 1 chooses the action Not Delay, it would receive continuation payoff

$$V_{S1}^{ND} = (1-\alpha)(1-w_2) + \alpha[\sigma_{ED} w_1 + (1-\sigma_{ED})((1-\delta)q + \delta(1-w_2'))]$$

the rising type State 1 prefers the action Delay if $V_{R1}^{D} > V_{S1}^{ND}$, implying

$$[1-\sigma_{ID} - \alpha(1-\sigma_{ED})][(1-\delta)q + \delta(1-w_2') - w_1] > (1-\alpha)(1-w_1-w_2)$$

under assumption $w_2' < \underline{w_2'}$, $(1-\delta)q + \delta(1-w_2') - w_1 > (1-w_1-w_2)$,

$$1-\sigma_{ID} - \alpha(1-\sigma_{ED}) > \frac{(1-\alpha)(1-w_1-w_2)}{(1-\delta)q + \delta(1-w_2') - w_1} \tag{1.1}$$

the rising type State 1 prefers the action Not Delay if

$$1-\sigma_{ID} - \alpha(1-\sigma_{ED}) < \frac{(1-\alpha)(1-w_1-w_2)}{(1-\delta)q + \delta(1-w_2') - w_1} \tag{1.2}$$

and is indifferent between the action Delay and Not Delay when the equality holds.

If the static type State 1 choose the action Delay, it would receive continuation payoff

$$V_{S1}^{D} = \sigma_{ID} w_1 + (1-\sigma_{ID})[(1-\delta)q + \delta(1-w_2)]$$

if the static type State 1 chooses the action Not Delay, it would receive continuation payoff

$$V_{S1}^{ND} = (1-\alpha)(1-w_2) + \alpha[\sigma_{ED} w_1 + (1-\sigma_{ED})((1-\delta)q + \delta(1-w_2))]$$

the static type State 1 prefers the action Delay if $V_{S1}^{D} > V_{S1}^{ND}$, implying

$$[1-\sigma_{ID} - \alpha(1-\sigma_{ED})][(1-\delta)q + \delta(1-w_2) - w_1] > (1-\alpha)(1-w_1-w_2) \tag{1.3}$$

under assumption $q < w_1$, $(1-\delta)q + \delta(1-w_2) - w_1 < 1-w_1-w_2$[11], this holds if and only if $1-\sigma_{ID} - \alpha(1-\sigma_{ED}) > 1-\alpha$, implying $\sigma_{ID} < \alpha\sigma_{ED}$. The static type State 1 prefers the action Not Delay if

$$[1-\sigma_{ID} - \alpha(1-\sigma_{ED})][(1-\delta)q + \delta(1-w_2) - w_1] < (1-\alpha)(1-w_1-w_2) \tag{1.4}$$

and is indifferent between the action Delay and Not Delay when the equality holds.

Suppose 1.3 holds, which implies 1.1 holds, then both types State 1 prefer the action Delay. By Bayes rule, $\mu_{R|ID} = r$, $\mu_{R|ED}$ is off-path. Since 1.3 holds only if $\sigma_{ID} < \alpha\sigma_{ED} < 1$, it indicates $r = \mu_R^*$, and $\sigma_{ID} \in (0, \alpha\sigma_{ED})$. This constitutes an equilibrium.

Suppose 1.1 and 1.4 hold, then the rising type State 1 prefers the action Delay, the static type State 1 prefers the action Not Delay. By Bayes rule, $\mu_{R|ID} = 1$ which implies $\sigma_{ID} = 1$, $\mu_{R|ED} = 0$ which implies $\sigma_{ED} = 0$. Then 1.1 can not hold, and the rising type State 1 prefers the action Not Delay, a contradiction. This does not constitute an equilibrium.

Suppose 1.2 holds, which implies $\sigma_{ID} > \sigma\sigma_{ED}$ and 1.4 holds. Then, both types State 1 prefer the action Not Delay. By Bayes rule, $\mu_{R|ED} = r$, $\mu_{R|ID}$ is off-path. When $r < \mu_R^*$, $\sigma_{ED} = 0$, $\sigma_{ID} \in (0,1]$, this constitutes an equilibrium. When $r > \mu_R^*$, $\sigma_{ED} = 1$, $\sigma_{ID} \in (\alpha, 1]$, this constitutes an equilibrium.

Suppose 1.3 holds with equality, then rising type State 1 prefers the action Delay, the static type State 1 mixes between Delay and Not Delay. By Bayes rule, $\mu_{R|ED} = 0$ which implies $\sigma_{ED} = 0$. Then, 1.3 can not

[11] Here assumes $(1-\delta)q + \delta(1-w_2) - w_1 > 0$. If otherwise, it is easy to verify that the equilibrium distribution remains the same across r's space

hold with equality, a contradiction. This does not constitute an equilibrium.

Suppose 1.1 holds with equality, then rising type State 1 mixes between Delay and Not Delay, the static type State 1 prefers the action Not Delay. By Bayes rule, $\mu_{R|ID} = 1$ which implies $\sigma_{ID} = 1$. Then, 1.1 can not hold with equality, a contradiction. This does not constitute an equilibrium.

To sum up, when the sources of delay are distinguishable, there exists the pooling equilibrium on Not Delay. If $r < \mu_R^*$, State 2 waits after the exogenous delay; if $r > \mu_R^*$, State 2 fights after the exogenous delay. This completes the proof.

□

Next, I turn to the equilibrium distribution when the sources of delay are indistinguishable, which is summarized in the following proposition.

Proposition 1.6.3. *Define* $r_* = \frac{\alpha(1-\delta)(1-w_2-q)}{\delta(w_2-w_2')-(1-\alpha)(1-\delta)(1-w_2-q)}$. *In all equilibria:*

- *If* $r < r_*$, *State 2 waits after delay.*
- *If* $r_* < r < r^*$, *State 2 mixes fighting and waiting after delay at* $\sigma_D = \sigma_D^*$.
- *If* $r > r^*$, *State 2 fights after delay.*

Proof. Consider State 2's general strategy $\sigma_2(\mu_R, \sigma_D)$, State 1's general strategy $\sigma_1(\sigma_R, \sigma_S)$. The rising type State 1 would receive continuation payoff V_{R1}^D from the action Delay,

$$V_{R1}^D = \sigma_D w_1 + (1-\sigma_D)[(1-\delta)q + \delta(1-w_2')]$$

the rising type State 1 would receive continuation payoff V_{R1}^{ND} from the action Not Delay

$$V_{R1}^{ND} = (1-\alpha)(1-w_2) + \alpha[\sigma_D w_1 + (1-\sigma_D)((1-\delta)q + \delta(1-w_2'))]$$

the rising type State 1 prefers the action Delay if $V_{R1}^D > V_{R1}^{ND}$, implying

$$\sigma_D < \frac{(1-\delta)q + \delta(1-w_2') - (1-w_2)}{(1-\delta)q + \delta(1-w_2') - w_1} \equiv \sigma_D^* \tag{1.5}$$

$\sigma_D^* \in (0,1)$ under assumption $w_2' < \underline{w_2'}$. The rising type State 1 prefers Not Delay if

$$\sigma_D > \frac{(1-\delta)q + \delta(1-w_2') - (1-w_2)}{(1-\delta)q + \delta(1-w_2') - w_1} \tag{1.6}$$

and it is indifferent when the equality holds.

The static type State 1 would receive continuation payoff V_{S1}^D from the action Delay

$$V_{S1}^D = \sigma_D w_1 + (1-\sigma_D)[(1-\delta)q + \delta(1-w_2)]$$

the static type State 1 would receive continuation payoff V_{S1}^{ND} from the action Not Delay

$$V_{S1}^{ND} = (1-\alpha)(1-w_2) + \alpha[\sigma_D w_1 + (1-\sigma_D)((1-\delta)q + \delta(1-w_2))]$$

the static type State 1 prefers the action Not Delay if $V_{S1}^{ND} > V_{S1}^D$, implying

$$(1-\delta)[q-(1-w_2)] < \sigma_D[(1-\delta)q + \delta(1-w_2) - w_1]$$

under the assumption $q < w_1 < 1 - w_2$, this holds always[12]. Therefore, the static type State 1 always prefers the action Not Delay.

Suppose $\sigma_D < \sigma_D^*$, previous analysis implies the rising type State 1 prefers the action Delay, the static type State 1 prefers the action Not Delay. By Bayes rule, $\mu_R = \frac{r}{r+(1-r)\alpha}$. σ_D has two cases. When $\sigma_D = 0$,

[12]Here again assumes $(1-\delta)q + \delta(1-w_2) - w_1 > 0$. If otherwise, it is easy to verify that $V_{S1}^{ND} > V_{S1}^D$ still always holds

perfect Bayesian equilibrium requires that $\mu_R < \mu_R^*$, implying

$$r < \frac{\alpha(1-\delta)(1-w_2-q)}{\delta(w_2-w_2')-(1-\alpha)(1-\delta)(1-w_2-q)} \equiv r_*$$

under assumption $w_2 < \underline{w_2'}$, r_* is a valid probability and $r_* < r^*$. This constitutes an equilibrium. When $\sigma_D \in (0, \sigma_D^*)$, PBE requires that $\mu_R = \mu_R^*$, implying $r = r_*$, this constitutes an equilibrium.

When $\sigma_D > \sigma_D^*$, previous analysis implies that both types State 1 prefer the action Not Delay. By Bayes rule, $\mu_R = r$. σ_D has two cases. When $\sigma_D = 1$, PBE requires that $r > \mu_R^*$, this constitutes an equilibrium. When $\sigma_D \in (\sigma_D^*, 1)$, PBE requires that $r = \mu_R^*$, this constitutes an equilibrium.

When $\sigma_D = \sigma_D^*$, previous analysis implies that the rising type State 1 mixes between the action Delay and Not Delay, the static type State 1 chooses the action Not Delay. By Bayes rule, $\mu_R = \frac{r[\sigma_R+(1-\sigma_R)\alpha]}{r[\sigma_R+(1-\sigma_R)\alpha]+(1-r)\alpha}$. $\sigma_D = \sigma_D^*$ implies that $\mu_R = \mu_R^*$, equivalent to $r = r(\sigma_R)^*$. It is easy to verify that here, μ_R increases in σ_R, and $\mu_R < \frac{r}{r+(1-r)\alpha}, \forall \sigma_R \in (0,1)$. Therefore, $r(\sigma_R)^* \in (r_*, r^*), \forall \sigma_R \in (0,1)$. This constitutes an equilibrium. This completes the proof. □

Finally, I compare the equilibrium distribution in Proposition 1.6.2 and Proposition 1.6.3, showing the qualitative impacts of the uncertainty about delay reasons on the risk of war and chance of power transition do not change under certain conditions.

Proposition 1.6.4. *Uncertainty about delay sources has the following impacts on the equilibrium outcomes:*

• *When $r < r_*$, does not change the probability of preventive war, increases the probability of peaceful power shifts.*

• *When $r_* < r < r^*$, increases the probability of preventive war; decreases the probability of peaceful power shifts if α is high enough, but increases the probability of peaceful power shifts if α is low enough.*

• *When $r > r^*$, does not affect the probability of preventive war and peaceful power shifts.*

Proof. When $r < r_*$, Proposition 1.6.2 shows that without uncertainty about delay sources, State 1 pools on the action Not Delay, State 2 waits after the exogenous delay and fights after the intentional delay at some positive probability. The probability of war is zero, and the chance of peaceful power shifts is $r\alpha$. Proposition 1.6.3 shows that with uncertainty about delay sources, the rising type State 1 chooses Delay, while the static type State 1 chooses Not Delay, State 2 waits after delay. The probability of war is zero, and the chance of peaceful power shifts is r.

When $r > r^*$, Proposition 1.6.2 shows that without uncertainty about delay sources, State 1 pools on the action Not Delay, State 2 fights after the exogenous delay and fights after the intentional delay at some positive probability. The probability of war is α, and the chance of peaceful power shifts is zero. Proposition 1.6.3 shows that with uncertainty about delay sources, State 1 pools on the action Not Delay, State 2 fights after the delay at probability one. The probability of war is α, and the chance of peaceful power shift is zero.

When $r_* < r < r^*$, without uncertainty about delay sources, the risk of war and chance of power shifts remain the same according to Proposition 1.6.2. With uncertainty about delay sources, Proposition 1.6.3 shows that the rising type State 1 mixes between Delay and Not Delay, the static type State 1 chooses Not Delay, State 2 mixes between fighting and waiting at σ_D^*. The probability of war is $\sigma_D^*[r(\sigma_R+(1-\sigma_R)\alpha)+(1-r)\alpha]$, which is positive, and the chance of power shifts is $r(1-\sigma_D^*)[\sigma_R+(1-\sigma_R)\alpha]$. $r(1-\sigma_D^*)[\sigma_R+(1-\sigma_R)\alpha] < r\alpha$ if and only if $\alpha > \frac{(1-\sigma_D^*)\sigma_R}{1-(1-\sigma_D^*)(1-\sigma_R)}$. Otherwise, $r(1-\sigma_D^*)[\sigma_R+(1-\sigma_R)\alpha] > r\alpha$. This completes the proof.

□

Discussion on Bargaining Protocols

I demonstrate that tweaking who obtains all bargaining surplus alone may not qualitatively change the results in my paper—all results in my paper still hold as along as the probability of exogenous delay, α, satisfies certain conditions. However, if α fails to not meet those conditions, then some results will break down—to be specific, it changes the effects of uncertainty about delay reasons when r is in the middle range (r_*, r^*). To sum up, in the context of ultimatum bargaining game, some of my results are sensitive to the chosen rule that all bargaining power goes to the uninformed player, whereas some are not sensitive to this rule.

Other bargaining rules could make a qualitative difference on the results of this paper. As pointed out by the reviewer, Rubinstein bargaining can produce "delay" by its nature, examples include Tarar (2001), and Leventoglu and Tarar (2008). In the Rubinstein bargaining game with incomplete information, when players are patient enough, a player can hold on the bargaining to obtain a better offer when it is his turn to make the proposal, and this Rubinstein incentive for delay applies to all players involved. If adopting the Rubinstein bargaining game to my model, that would cause multiple incentives for delay: delay is not just holding off for a power rise in the second period, but also holding off for a better offer in both periods. If further assuming that State 2 can not distinguish the delay caused by State 1's incentive for a power rise from the delay caused by State 1's incentive for a better offer, the interaction would be much more complicated and it would be confusing what drives results.

Overall, I anticipate that adopting the Rubinstein bargaining rule would drive both types State 1 to lean towards the action Not Delay, because if then there is no-delay and bargaining, both sides can have some bargaining leverage, State 1 knows that it could obtain some bargaining surplus from the threat of delay, yielding a bargaining payoff that is higher than its war payoff w_1. Under certain conditions, this may qualitatively change the equilibrium distribution and the effect of uncertainty about delay reasons—one extreme case is when State 1 obtains all bargaining surplus, as I have explained in the previous paragraph and shown in the "Extension: Reverse the Proposal Power." Since that the purpose of delay in my paper is to obtain a future power rise, and to investigate its effects on crisis bargaining outcomes, there are good reasons not to employ the Rubinstein bargaining game.

1.6.6 Extension: Figures of Probability of War & Probability of Delay

This section presents more figures of the probability of conflict and the probability of delay.

Figure 1.5 shows the probability of war in the Pareto Dominant equilibrium in models with and without uncertainty about reasons for delay.

Figure 1.6 shows the probability of delay that is tolerated by State 2 in models with and without uncertainty about reasons for delay.

Figure 1.7 shows the ex ante probability of delay in Pareto Dominant Equilibrium in models with and without uncertainty about reasons for delay.

Figure 1.8 shows the ex ante probability of delay in the general form among multiple equilibria, in models with and without uncertainty about reasons for delay.

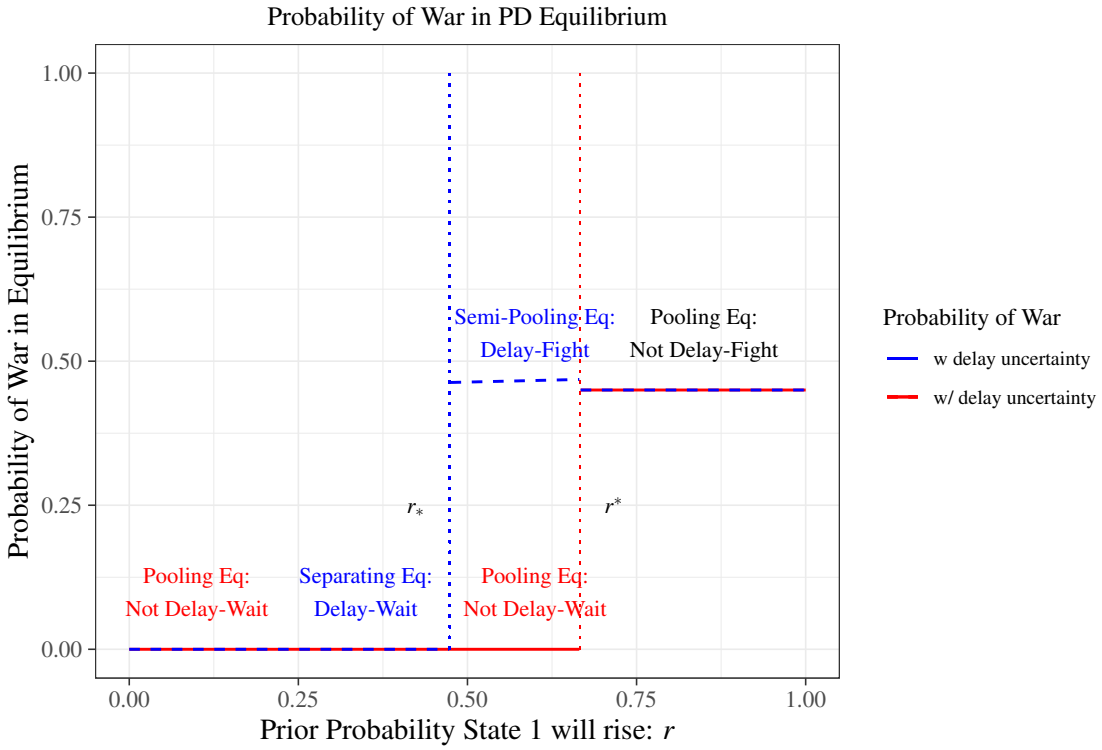

Figure 1.5: Probability of War in Pareto Dominant Equilibrium. The labels on the lines represent player's equilibrium strategy in each part of r parameter space. "R(S)S1" refers to the "rising (static)" type State 1, "S2" refers to State 2. "S1" refers to both types of State 1.

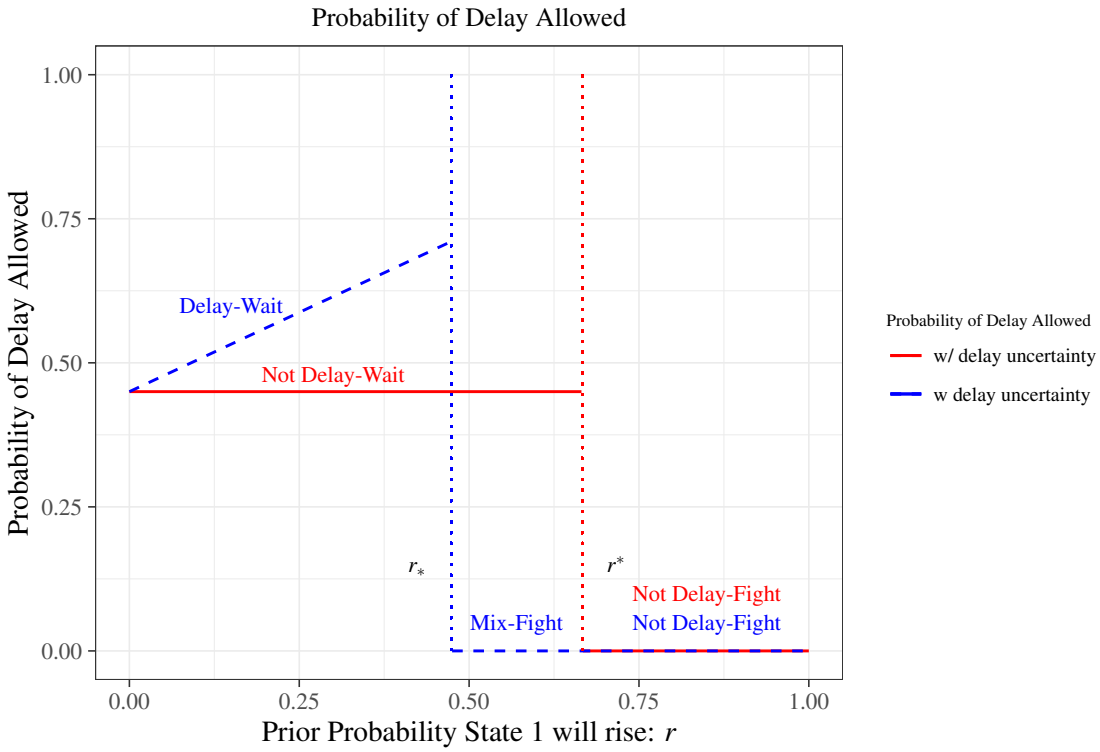

Figure 1.6: Probability of Tolerated Delay. The labels on the lines represent player's equilibrium strategy in each part of r parameter space. "R(S)S1" refers to the "rising (static)" type State 1, "S2" refers to State 2. "S1" refers to both types of State 1.

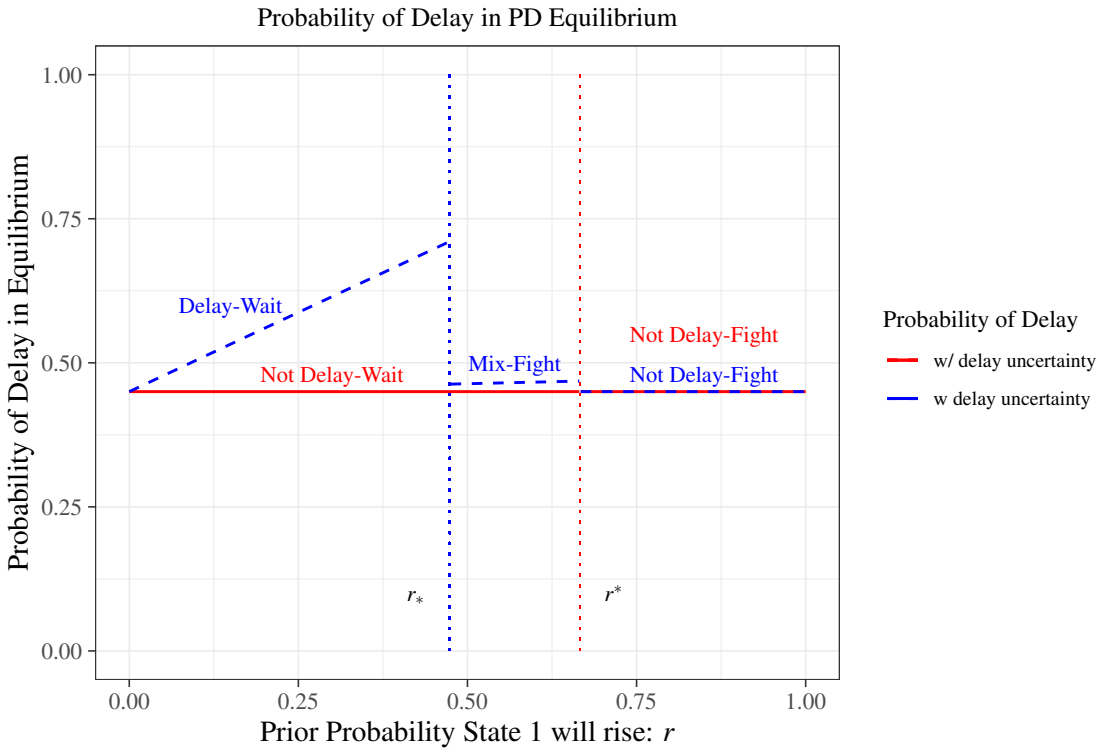

Figure 1.7: Probability of Delay in Pareto Dominant Equilibrium. The labels on the lines represent player's equilibrium strategy in each part of r parameter space. "R(S)S1" refers to the "rising (static)" type State 1, "S2" refers to State 2. "S1" refers to both types of State 1.

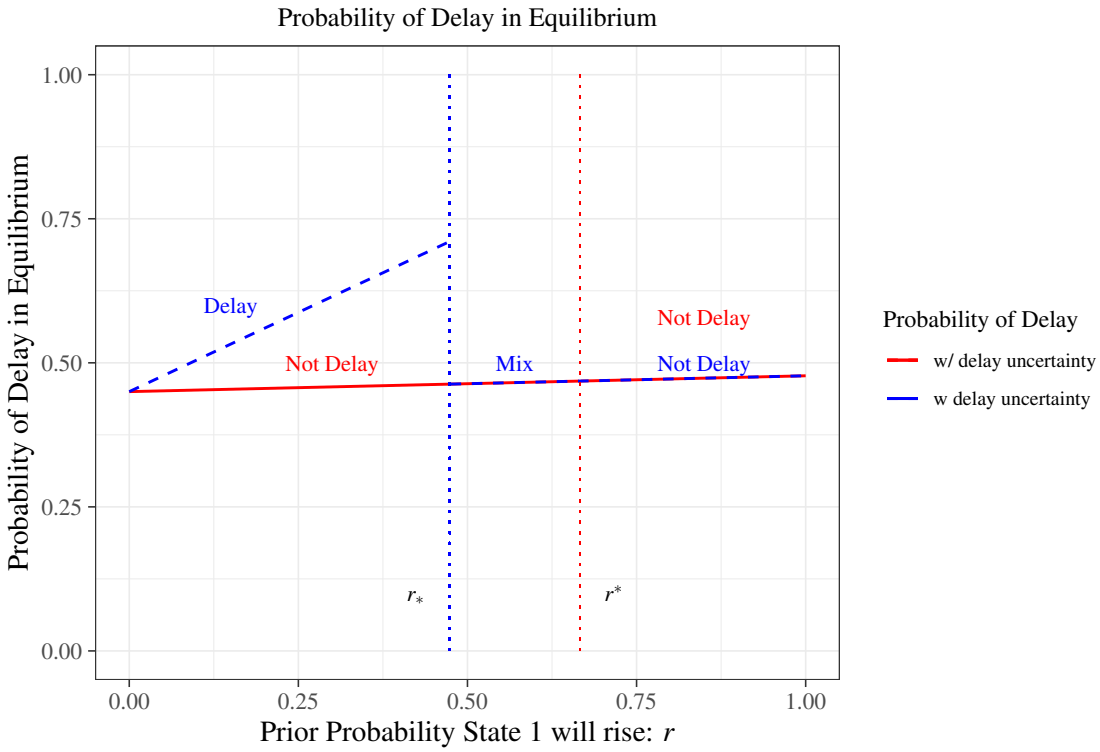

Figure 1.8: Probability of Delay. The labels on the lines represent player's equilibrium strategy in each part of r parameter space. "R(S)S1" refers to the "rising (static)" type State 1, "S2" refers to State 2. "S1" refers to both types of State 1.

CHAPTER 2

Uncertainty about Power Shifts and Preventive War: Empirical Measurement and Hypothesis Test

Large shifts in relative power drive states to wage wars to avert disadvantageous bargaining positions thereafter. Meanwhile, states encounter uncertainty about power shifts, which complicates their strategic motivation for waging wars. Despite extensive theoretical studies, there is less attempt to assess the empirical effect of uncertainty about power shifts on war initiations. I estimate states' contemporaneous uncertainty about military power, and devise a measure of uncertainty about expected power shift. I incorporate both the size and uncertainty of expected power shift into a statistical test of the preventive war hypothesis, and find a pacifying effect of uncertainty about expected power shift: the risk of war arising from large shifts in the distribution of power is mitigated by high uncertainty about those power shifts, even though they do not decrease the risk of war *per se*. My results highlight that the motivation for preventive war is not solely dependent on the size of expected power shift, and we may miscalculate the risk of war by overlooking states' uncertainty about expected power shift.

2.1 Introduction

In the bargaining theory of war, uncertainty is widely associated with a heightened risk of conflicts. A considerable body of theoretical research investigating the causes of war has examined the effects of various types of uncertainty on the outcomes of crisis bargaining. Uncertainty about adversaries' intentions can instigate a security dilemma, prompting states to engage in arms races and gamble on conflicts (Jervis, 1976, 1978). Uncertainty about opponents' resolve, or the cost of fighting, can cause bargaining failure and conflicts when opponent states are more resolved than anticipated (Fearon, 1995). Uncertainty about relative capabilities results in divergent assessments of bargaining power, thereby constituting another catalyst for international conflicts. (Blainey, 1988; Fey and Ramsay, 2011; Slantchev and Tarar, 2011; Meirowitz, Sartori et al., 2008).

Large shifts in relative power is another rationalist explanation for international conflict. Ruling states, anticipating substantial decline in their power, may opt to initiate a war against its emerging adversaries to circumvent an unfavorable bargaining position in the future (Powell, 2004, 2006). However, states often grapple with uncertainty about the trajectory of power and the concrete manifestation of future power shifts. This uncertainty can stem from factors such as inadequate access to information concerning opponent states' military strategies, and the potential disruption of states' military growth due to unpredictable elements like economic downturns and domestic upheavals. The uncertainty about power shifts adds complexity to states' strategic considerations when contemplating warfare: when the expected power shift is not a certain eventu-

ality, how should ruling states navigate the decision-making between peaceful means and military forces to manage their relationships with opponent states?

Extensive theoretical research has investigated the causes and consequences of uncertainty regarding expected power shifts. Debs and Monteiro (2014) examine the uncertainty about military power arising from opponents' internal armament decisions, and demonstrate that adversaries might be incentivized to initiate preventive wars to eliminate potential shifts in relative power. Moreover, Wolford, Reiter and Carrubba (2011) uncover that uncertainty about power shifts can intensify conflicts triggered by the uncertainty about opponents' resolve of fighting. Dong (2023) identifies specific circumstances where heightened uncertainty about power shifts can weakly decrease the risk of war while enhancing the prospects for peaceful power shifts.

Despite its theoretical richness, empirical investigation into the uncertainty about expected power shifts remains limited due to the inherent difficulties in measuring states' uncertainty concerning future military power. This dearth of empirical efforts becomes especially pressing in light of the growing demand for a statistical evaluation of the preventive war hypothesis. On the one hand, scholars have identified several historical cases where preventive logic does not cause wars due to ruling states' uncertainty about the forthcoming ascent in their opponents' power (Ripsman and Levy 2007; Dong 2023). On the other, existing empirical research studying the relationship between power shifts and wars overlooks the impact of uncertainty about power shifts on the incentive to initiate conflicts, implicitly assuming that states are certain about the magnitude of expected power shifts (Lemke, 2003; Bell and Johnson, 2015).

Whether states can accurately estimate the future balance of power is central to address wars driven by shifting-power dynamics. If states are certain of the magnitude of future power shifts, then ruling states may prefer attacking to prevent unfavorable shifts in relative power. However, it is improbable that states are fully certain about the magnitude of future power shifts. Many factors, including unforeseeable economic crises, variations in national budgets, the transparency of government information, and the potential for international conflicts, can pose difficulties for states in gauging the trajectory of their own and their opponents' power. Thus, states can face substantial uncertainty concerning how the future balance of power will ultimately shift. In cases characterized by pronounced uncertainty about the magnitude of forthcoming power shifts, resorting to warfare may not effectively fulfill its intended preventive function and could instead incur unnecessary costs. Without a measurement of uncertainty about power shifts, we risk an inaccurate attribution of wars to the preventive logic. This misinterpretation could obscure the empirical relationship between power shifts and international conflicts.

In this paper, I develop a measure of uncertainty about expected power shifts, and integrate this measure into an empirical test of the preventive war hypothesis. I predict states' future military power by considering

the present values of various observable indicators (Bell and Johnson, 2015). Furthermore, I devise a measure of uncertainty about power shifts by innovatively employing the heteroskedasticity estimation. Essentially, I relegate the uncertainty about the state-level military power into the error term of the function predicting future military power, then generate hypothetical values of expected power shifts through Monte Carlo Simulation and use their standard deviation to gauge states' uncertainty about expected power shifts. Finally, I incorporate both the size and uncertainty of expected power shifts to test the preventive war hypothesis.

My study reveals a novel result concerning the interactive effect between the size and uncertainty of expected power shifts. Consistent with existing research, I find that an increase in the size of expected power shifts is associated with a higher risk of war (Bell and Johnson, 2015). However, the overall impact of large shifts in the distribution of power is mitigated by increasing uncertainty about these shifts. When there is a substantial power shift, its net effect on the risk of war depends on the level of uncertainty regarding that expected shift: as states become more uncertainty about where the future power balance will locate, it diminishes their preventive motivation for engaging in costly and unnecessary wars. In other words, uncertainty about expected power shifts acts as a pacifying factor, dampening the conflict-inducing effect of an increase in the size of expected power shifts. This highlights an limitation in the conventional wisdom regarding the negative impacts of various types of uncertainty on international peace.

My study has three main contributions. First, it advances the empirical evaluation of the preventive war hypothesis by incorporating uncertainty about expected power shifts and highlighting the interactive effect of both the size and uncertainty of these shifts. Expectation about power shifts comprises two components that jointly shape the impetus behind preventive war: (1) the size or magnitude of expected shifts in the distribution of power, and (2) the level of states' uncertainty regarding these expected shifts. Thus, a rigorous test on the preventive war hypothesis necessitates the incorporation of both conceptual elements. In addition to reaffirming Bell and Johnson's (2015) empirical discovery that the risk of war increases with the size of expected power shifts, my study complements this finding by revealing that such risk is not solely dependent on the size of forthcoming shifts. We may misjudge preventive war and its risk by overlooking the uncertainty about expected power shifts.

Second, my study uncovers a pacifying effect of uncertainty about expected power shifts. While increasing this type of uncertainty does not inherently lead to a lower risk of war, it does exert a "muting" effect on the provocative impact of expected shifts in relative power. This is a novel result within the broader context of the effects of information uncertainty. Existing research primarily elaborates how various types of information uncertainty tend to increase the risk of war (Jervis, 1976; Fearon, 1995; Fey and Ramsay, 2011; Slantchev and Tarar, 2011), or highlight the negative impact of uncertainty about military power on peace when combined with potential power shifts or other types of uncertainty (Blainey, 1988; Debs and Monteiro,

2014; Wolford, Reiter and Carrubba, 2011). My study demonstrates the intricate interplay between the size and the uncertainty of power shifts, underscoring the pivotal role this interaction plays in shaping the strategic decisions of states when confronted with power shifts.

Third, I develop a new measure of *contemporaneous* uncertainty about military power and expected power shifts. It serves as a proxy for state leaders' uncertainty at the moment of critical decision-making, facilitating the examination of their strategic rationale during international crises. This is related to, yet distinct from, prior studies on the uncertainty about military power and war outcomes. Kaplow and Gartzke (2021) explore the determinants of *retrospective uncertainty* about military power, which refers to the relative change between the contemporaneous estimate and an estimate revisited years later. Bas and Schub (2016b) employ uncertainty about the prevalence of secret alliances to measure states mutual optimism about power. Bas and Schub (2016a) assess uncertainty about war outcomes by measuring power parity at the systemic level. In contrast, my study focuses on the contemporaneous uncertainty residing in each state's military power, which predominantly captures the inherent imprecision within policymakers' subjective assessments that shape their decisions concerning war or peace.

2.2 Research Design

I assume that states, regardless of how they predict the military power of adversaries, encounter imprecision in their estimates, and acknowledge the uncertainty inherently tied to each state's future military power. A state's future military power can be evaluated based on observable indicators, such as its current number of military personnel, economic productivity and the surrounding world situation. However, states are also cognizant that unpredictable events such as economic crisis, military coups or potential regional conflicts can alter the trajectory of their power growth. States are aware that the possible occurrence of those events introduces uncertainty over future military power, so the assessment solely based on observable clues may contain judgment errors.

My first step is to articulate how states predict future military power of their own and other states. In line with existing research, I assume that states are rational actors and believe that a state's current military strength is influenced by a set of observable economic, political and structural factors in the previous year. Thus, states rely on the observable indicators in the current year to predict the military power in the next year (Fordham, 2011; Levy, 1987). Following Bell and Johnson's (2015) approach to predicting military power, I treat a state's military power as a linear function of observable factors. States form an expectation about the magnitude of future military power based on the current values of observable factors.

Then I extend existing research by estimating states' uncertainty about future military power. To capture this uncertainty, I relegate it to the error term in the linear model used to predict military power. In a linear

model, the conditional expectation measures the systematic component of the outcome variable, and the error term represents its degree of randomness. Consequently, evaluating the potential variation in the future military power involves assessing the variation of the error term. In essence, the empirical strategy entails estimating a two-equation model of the following form:

$$\begin{cases} Power_{i,t} = \mathbb{X}_{i,t-1}\beta_t + \varepsilon_{i,t} & (2.1.1) \\ \sigma^2_{i,t} = \sigma^2 exp(\mathbb{Z}_{i,t-1}\gamma_t) & (2.1.2) \end{cases} \tag{2.1}$$

$\mathbb{X}_{i,t-1}$ are the values of a set of independent variables in year $t-1$ that can influence state i's military power in year t, denoted as $Power_{i,t}$. $\varepsilon_{i,t}$ is the error term and assumed to be drawn from a normal distribution with mean zero. Specifically, $\varepsilon_{i,t}$ captures the stochastic nature of state i's military power in year t, so its distribution varies across states and time. $\sigma^2_{i,t}$ denotes the variance of $\varepsilon_{i,t}$ and can be modeled as a non-linear function of a set of observable factors $\mathbb{Z}_{i,t-1}$ (Harvey, 1976). Equation (2.1.1) estimates military power through the maximum likelihood estimation, Equation (2.1.2) estimates the *variance* of the error term in the aforementioned linear model. In essence, my empirical strategy relegates the uncertainty over a state's future power to the variance of the error term in a regression with heteroskedasticity (Gartzke 1999; Bas 2012).

2.2.1 Measuring Uncertainty about Power Shifts

I estimate separate models for each observed year in the dataset. For year t, I use all of the data available up until that year, and Equation (2.1.1) returns estimated coefficients $\hat{\beta}_t$ and $\hat{\gamma}_t$. I predict state i's military power in year $t+1$, $\widehat{Power_{i,t+1}}$, by multiplying estimated coefficients $\hat{\beta}_t$ with the present values of independent variables $\mathbb{X}_{i,t}$. Moreover, I derive the state i's estimated error variance $\widehat{\sigma^2_{i,t+1}}$ by multiplying estimated coefficients $\hat{\gamma}_t$ with present values of predictors $\mathbb{Z}_{i,t}$. This approach allows me to estimate the future military power and uncertainty levels for each state in the dataset for the following year based on the available information up to year t.

The size of the expected power shift between the target state i and the initiator state j from year t to year $t+1$, estimated in year t by state j, is defined in the following way:

$$\widehat{Power\ Shift}_{i,j,t} = \frac{\widehat{Power_{i,t+1}}}{\widehat{Power_{i,t+1}} + \widehat{Power_{j,t+1}}} - \frac{Power_{i,t}}{Power_{i,t} + Power_{j,t}} \tag{2.2}$$

Equation (2.2) provides a point estimate of the expected power shift between the target state i and the initiator state j in year t. This estimation is obtained by calculating the difference in the expected change in the dyadic distribution of power from the perspective of state j. The right-hand side (RHS) of the equation represents the difference in the capability ratio from year t to year $t+1$. It is worthwhile to note the distinction

between Equation (2.2) and the corresponding expression in Bell and Johnson (2015). In their study, Bell and Johnson assume that the potential initiator knows its own military power at $t+1$, $Power_{j,t+1}$, whereas I assume that even the potential initiator is not entirely certain about its own military power at $t+1$, and must rely on observable factors to assess the future power of itself, $\widehat{Power_{j,t+1}}$.

In addition to the measure of the size of the expected power shift, states also seek a measure of the uncertainty about the expected power shift, which is proxied by the *variance* in the expected power shift

$$\mathbf{V}[\frac{\widehat{Power_{i,t+1}}}{\widehat{Power_{i,t+1}}+\widehat{Power_{j,t+1}}}-\frac{Power_{i,t}}{Power_{i,t}+Power_{j,t}}]=\mathbf{V}[\frac{\widehat{Power_{i,t+1}}}{\widehat{Power_{i,t+1}}+\widehat{Power_{j,t+1}}}] \tag{2.3}$$

where the equality holds because from the standpoint of making a prediction in year t, both $Power_{i,t}$ and $Power_{j,t}$ are observed and known by states, so the capability ratio in year t is a constant term. The variance of the expected power shift thus depends on the variance of the ratio between $\widehat{Power_{i,t+1}}$ and $\widehat{Power_{j,t+1}}$.

The variance of the ratio of future power is derived through Monte Carlo Simulation. Given the assumptions of the two-equation model (2.1), state i's military power in year $t+1$ follows a normal distribution

$$Power_{i,t+1} \sim \mathbb{N}(\widehat{Power_{i,t+1}}, \widehat{\sigma^2_{i,t+1}})$$

whose mean is the conditional expectation of the forthcoming military power, $\widehat{Power_{i,t+1}}$, and variance is the estimated variance of the error term, $\widehat{\sigma^2_{i,t+1}}$, from the two-equation model. This distribution encompasses various realizations of the potential values of state i's military power in year $t+1$. In plain terms, states believe that the predicted military power based on current values of observable factors represents the typical expectation of future military power. However, many other factors can cause future military power to deviate from this typical expectation. In numerous counterfactual scenarios where future military power can be influenced by some factors or events, the dispersion of those counterfactual realizations gives an approximation of the uncertainty over future military power. In technical terms, I draw state i's future military power from its distribution for N times, producing a vector of state i's future military power

$$(\widehat{Power_{i,t+1}}^{1}, \widehat{Power_{i,t+1}}^{2}, \widehat{Power_{i,t+1}}^{3}, ..., \widehat{Power_{i,t+1}}^{N})$$

and similarly for state j, $(\widehat{Power_{j,t+1}}^{1}, \widehat{Power_{j,t+1}}^{2}, \widehat{Power_{j,t+1}}^{3}, ..., \widehat{Power_{j,t+1}}^{N})$. Using Equation (2.2), I thus can simulate the expected power shift between state i and state j in year t, generating a vector of expected power shift

$$(\widehat{Power\ Shift_{i,j,t}}^{1}, \widehat{Power\ Shift_{i,j,t}}^{2}, \widehat{Power\ Shift_{i,j,t}}^{3}, ..., \widehat{Power\ Shift_{i,j,t}}^{N})$$

each element of the vector represents a potential realization of the expected power shift, enabling states to use the variation among those simulated power shifts to develop a sense of uncertainty about the expected power shift. Thus, I measure the initiator state j's uncertainty about the expected power shift facing the target state i by taking the standard deviation of N simulated power shifts. State i's uncertainty about the expected power shift is assessed in the same manner.

2.2.2 Predicting Military Power

Equation (2.1.1) of the two-equation model is a regression of military power on a set of observable factors, which produces predicted military power that approximates those estimates held by state leaders. The dependent variable $Power_{i,t}$—state i's military power in year t—is constructed using two components of the Composite Index of National Capabilities (CINC) sourced from the Correlates of War (COW) database (Singer, Bremer and Stuckey 2012): military spending and military personnel. Specifically, $Power_{i,t}$ denotes the mean of state i's percentage share of system totals of military spending and military personnel in year t.

Bell and Johnson (2015) identified a comprehensive set of variables covering states characteristics and international environment that can effectively influence a state's military power. Since their study has already demonstrated the statistical significance of most of these variables in the regression of military power, I adopt the same $\mathbb{X}_{i,t-1}$ to pursue consistence and establish a connection between my study and theirs, and show that my study generates new knowledge on the basis of existing research. Future research should identify the set of variables that can most effectively predict a state's military power. Below, I offer a briefly discussion on each independent variable used in the analysis, highlighting its significance and potential impact on a state's military power.

The first independent variable in $\mathbb{X}_{i,t-1}$ is an indicator of a state's economic potential. Given the scarcity of resources, states face the optimization problem of investing in civilian sector or military sector, and a state's economic potential largely implies the upper bound of resources it can allocate to the military sector. This variable utilizes the rest four components of the CINC score to capture a state's economic potential: total population, urban population, iron and steel production, and energy consumption. It is the mean of the state's percentage share of system totals on each of the four subcomponents in a given year.

The second independent variable is the natural log of the sum of battle deaths suffered by the state in a given year. The intuition is that states will allocate more resources to the military sector when the situation in the battle field becomes more severe. A natural proxy for battle situation is the number of battle deaths. This variable is coded in thousands of interstate battle death information from the COW project (Sarkees and Wayman 2010). Taking the natural log ensures states experience diminished ability to grow their military when experiencing heavy casualties.

The third independent variable is an indicator of the regime type of states. There has been arguments that democratic states face more domestic constraints in allocating resources to the military sector than autocratic states, which can limit the development of their military power (Fordham and Walker 2005). Regime type is measured and coded by *polity2* variable in the Polity IV project (Marshall, Jaggers and Gurr 2002).

The fourth independent variable is an indicator about whether a state is under an international threat in a given year. States facing threats from more opponent states are more likely to allocate more of their resources to improve military capability. It is a dummy variable indicating whether or not a state is involved in an international rivalry in a given year (Thompson and Dreyer 2012).

The fifth independent variable codes the alliance status of a state in a given year. Bell and Johnson (2015) argue that states involved in alliances may devote fewer resources to military buildup because they can receive external support in the event of war. I use the information about alliance from the Alliance Treaty Obligations and Provisions project (Leeds et al. 2002) and create a dummy variable that codes whether a state is involved in an alliance that requires active military assistance in a given year.

The final independent variable is a state's level of military power in the previous year. In most cases, it is expected that states' military power demonstrates some "stickiness"—a state's military power in the current year is highly informative about its military power in the next year, if nothing unexpected happens. This variable is just $Power_{i,t-1}$.

2.2.3 Estimating Error Variance

Equation (2.1.2) of the two-equation model aims to estimate the variance of the error term $\sigma^2_{i,t}$ based on a set of observable factors $Z_{i,t-1}$. I adopt a non-linear modeling approach for $\sigma^2_{i,t}$, following the multiplicative heteroskedasticity specification proposed by Harvey (1976).

The central debate revolves around identifying the observable factors that determine $\sigma^2_{i,t}$. Given the absence of a definitive theory guiding the search for $Z_{i,t-1}$, I adopt a logical approach that explores the internal characteristics of states systematically impacting the transparency of their future military power, and the external conditions influencing the observing states' accessibility to information channels concerning future military power. My framework largely aligns with the arguments presented by Kaplow and Gartzke (2021) regarding the determinants of uncertainty about military power. I categorize three sets of predictors specific to a target state that are likely to affect assessing states' uncertainty about its military capability, encompassing the characteristics unique to the target state and its strategic environment. Below, I introduce each set of observable factors in $Z_{i,t-1}$, and elaborate how they each complicates the task of evaluating future military capabilities.

The first set of predictors in $Z_{i,t-1}$ encompasses both the *level* and *fluctuation* of states' economic potential

and military power in preceding years. Previous research has demonstrated the substantial roles of current economic potential and military power in shaping future military power (Bell and Johnson, 2015). Likewise, these current attributes can exert an influence on the uncertainty surrounding states' forthcoming military power. On the one hand, economically advanced states can allocate more resources into military development, and militarily dominant states are motivated to uphold their advantageous military positions, both leading to lower uncertainty about their future power. On the other, higher current economic potential and military power suggest more variability in states' future military power, leading to higher uncertainty about the future military power of economically and militarily stronger states. For instance, it is more feasible for the $Power_{i,t}$ of a nation like the U.S to fluctuate by 0.05 in year $t+1$ due to shifts in policies or changes in leadership, as opposed to a nation like Maldives whose $Power_{i,t}$ may not exceed 0.05. Therefore, I incorporate the values of a state's economic potential and military power in year $t-1$.

Furthermore, if current values of economic potential and military strength influence the trajectory of states' military power, it naturally follows that their recent fluctuation can also provide valuable information about the potential variation in the future military power. To capture this aspect, I include the moving standard deviation of a state's economic potential and military power within a window of previous years[1]. This allows the model to consider the volatility in a state's economic and military capabilities over time and assess how such fluctuations may contribute to assessing states' uncertainty about future military power.

The second set of predictors in $Z_{i,t-1}$ pertains to the transparency of domestic political institutions that may serve an important channel in revealing states' future military power. Government agencies collect information about opponent states from various sources, and the ease of gathering intelligence about an opponent state's military power depends on the nature of its political institutions. States with closed political systems and media censorship may pose higher costs and challenges in obtaining accurate information about their military capabilities. Conversely, states with public budget processes that track military expenditure or competitive procurement procedures that require detailed auditing of military hardware acquisitions are likely to provide more transparent information about their military power. Notably, features that tend to reduce the ambiguity of military power are often associated with democratic systems. Therefore, I include a state's regime type in year $t-1$ as a proxy for the information transparency in its domestic institution. This variable also utilizes the *polity2* variable (Marshall, Jaggers and Gurr, 2002).

The third set of predictors in $Z_{i,t-1}$ pertains to the strategic environment in which information about military power flows among states. A state's surrounding environment provides external sources of information affecting other states' uncertainty about its military power, given that military intelligence is frequently exchanged and shared between states. For instance, a state's surrounding hostility can affect the uncertainty

[1] Specifically, I calculate their moving standard deviations in previous five years.

about its future military power. States facing more rivalries have stronger incentive to enhance their armaments in response to potential threats. Meanwhile they also suffer from a heightened risk of intelligence compromise since there are more rivals collecting or analyzing their military information. However, states with more rivalries tend to be more isolated from international organizations and institutions, limiting their access to the resources—such as labor, capital, and technology—that foster national power growth. To capture the corresponding uncertainty, I include a state's total number of international rivalries in year $t-1$ to approximate a state's environment of international adversary (Thompson and Dreyer, 2012).

Additionally, alliances introduce a layer of complexity to the uncertainty about future military power. On one hand, states with allies may not need to allocate substantial resources to build their own military capability, as many military alliances involve explicit contributions from member states, making the member states' military power more transparent and predictable. On the other, if an alliance partner is powerful enough to deter aggression, then that alliance may free up other members to conceal their own capabilities (Bell and Johnson, 2015). As such, I include a variable indicating a state's total number of alliance in year $t-1$ (Leeds et al., 2002).

2.3 Testing Preventive War Hypothesis

2.3.1 Data

The unit of analysis in my study is the directed dyad-year because the preventive war theory is specific about which state has the motivation to fight its opponents in order to prevent an unfavorable power shift. My sample covers directed dyad-year from 1818-2007.

The dependent variable *WAR* is a dichotomous variable that codes whether the potential initiator in a directed dyad launches a war against the potential target in a given year. I rely on the interstate war data from the COW project (Sarkees and Wayman, 2010). Specifically, I use *COW Version 4.02*[2]. I use the *war* variable which is adjusted to reflect the actual warring dyads in multilateral disputes to identify whether there is an actual war between two states in the dyad, and I use the *dyad rolea* and *dyad roleb* variables to identify whether the potential initiator in a dyad initiates the war against the potential target in the dyad[3]. In my data, the potential initiator starts a war if only if it plays the role of initiator and there is an actual war between the potential initiator and the potential target.

The main variable of interests in my analysis is the interaction between the size and the uncertainty of expected power shifts. Existing theoretical and empirical studies confirm that states are incentivized to initiate

[2]There has been some significant modification on the coding rules of dyadic war over past revisions. Thus, I recode the dependent variable instead of relying on the data of previous empirical studies.

[3]a potential initiator may be the joiner on the target's side, but it initiates the war against its dyadic target who can be the initiator of a multilateral dispute. In this case, $rolea = 4$ but $dyad\ rolea = 1$ and $war = 1$. I code such case as a preventive war between the initiator and the target.

wars when they anticipate large shifts in the distribution of power to arrive (Powell, 2006; Bell and Johnson, 2015). However, states are also uncertain about whether future relative power will indeed shift according to their anticipation. Theoretical studies incorporating power shifts and the uncertainty surrounding them yield different predictions. (Debs and Monteiro, 2014) find that secretive armament decisions increase the probability of war. Dong (2023) find that under some conditions, increasing uncertainty surrounding a large power shift weakly decreases the risk of war. To address mixed findings from theoretical models, I investigate the combing effect of the size and uncertainty of expected power shifts. For a directed dyad-year, involving state i and j in year t, the three key independent variables in my analysis are: (1) the size of expected power shift *Magnitude*, (2) the uncertainty about expected power shift *Uncertainty*, and (3) the interaction between them *Magnitude* $\times$ *Uncertainty*.

I also control for a set of variables that are widely recognized to correlate with the war initiation. International Relations theories argue that states are less likely to engage in war if they are further apart, or they are both democratic countries, or they share similar foreign interests. Thus, I code the natural log of the capital-to-capital distance between the two states *Capital Distance* and whether two states are contiguous *Contiguity* using the COW dataset (Sarkees and Wayman, 2010), whether two states are both democratic *Joint Democracy* using the Polity IV project (Marshall, Jaggers and Gurr, 2002), and the similarity in two states' foreign interests *Foreign Policy Similarity* using Signorino and Ritter (1999) S-score based on alliance portfolios.

In addition, states sometimes are entangled into conflicts because they are bounded by alliance obligations to allies who may act aggressively (Snyder, 1984, 2007). To capture this aspect, I include a variable indicating whether the potential initiator has any alliance with defensive or offensive obligations in a given year *Alliance Obligation*. Moreover, there are debates about whether power parity or preponderance is more likely to cause wars, of which the direction is unclear though. I control for whether a dyad contains at least one major power in the international system *Major Power Dyad*. Lastly, I account for temporal dependence by including a variable that counts the number of years of peace in the dyad as well as the squared and cubed term of this variable (Carter and Signorino 2010).

2.4 Results

In this section, I report the results of testing the preventive war hypothesis after accounting for uncertainty about expected power shifts. To evaluate the face validity of my approach, I compare my measure of the size of expected power shifts to that of Bell and Johnson (2015). The overall correlation between the two measures is 0.201, indicating a relatively low level of agreement. This discrepancy suggests that accounting for the heteroskedasticity in military power leads to notable differences in the resulting measure of the size

of expected power shifts, as compared to the assumption of homoskedasticity used in the previous study.

Table 2.1 reports the regression results of military power (2.1.1) in several important years. It shows that after explicitly accounting for heteroskedasticity, the impacts of most independent variables on states' future military power are still statistically significant and in the expected direction. States with high battle deaths, international rivalry, high economic potential and military power are expected to have stronger future military power. However, the effects of democracy level and alliances on future military power show mixed findings, suggesting that the impact of these factors may vary depending on specific circumstances. The last line of the table shows a close correlation between the coefficients of the equation (2.1.1) and the coefficients of Bell and Johnson's model (2015), even after accounting for the heteroskedasticity issue.

Table 2.1: Regression of Military Power with Heteroskedasticity

	$Year \leq 1914$	$Year \leq 1945$	$Year \leq 1990$	$Year \leq 2000$
Battle Death Count$_{t-1}$	0.0087^{**}	0.0028^{***}	0.0003^{***}	0.0003^{***}
	(0.0031)	(0.0006)	(0.0001)	(0.0001)
Military Power$_{t-1}$	0.9727^{***}	0.9851^{***}	0.9864^{***}	0.9867^{***}
	(0.0063)	(0.0030)	(0.0015)	(0.0013)
Economic Potential$_{t-1}$	0.0224^{***}	0.0003	$0.0001^{\cdot}$	0.0001^{**}
	(0.0050)	(0.0003)	(0.0000)	(0.0000)
Rivalry Involvement$_{t-1}$	0.0334^{***}	$0.0036^{\cdot}$	0.0015^{***}	0.0014^{***}
	(0.0094)	(0.0020)	(0.0003)	(0.0002)
Alliance Membership$_{t-1}$	0.0068	0.0028	0.0008^{**}	0.0006^{**}
	(0.0108)	(0.0024)	(0.0003)	(0.0002)
Democracy Level$_{t-1}$	-0.0013	0.0002	0.0000	0.0000
	(0.0008)	(0.0002)	(0.0000)	(0.0000)
Constant	-0.0081	0.0027	0.0011^{***}	0.0010^{***}
	(0.0066)	(0.0017)	(0.0003)	(0.0002)
Log Likelihood	-1411	5310	26013	31944
N	3062	4697	9604	11097
Correlation with BJ estimates	0.9199	0.9298	0.9880	0.9905

Note: $^{\cdot}$p<0.1; *p<0.05; **p<0.01; ***p<0.001

Since the main contribution of my two-equation model is to estimate states' uncertainty about future military power, I report the regression results of the variance of the error term, $\sigma^2_{i,t}$, in Table 2.2. Since equation (2.1.2) is a non-linear model, its coefficients do not have a straightforward interpretation—each coefficient is a function of the specific variable of interest and all other covariates. Still, these regression coefficients reveal some general patterns.

Fluctuations in prior economic potential and military power tend to exhibit a positive correlation with uncertainty about states' future military power. This relationship may be attributed to the instability in economic productivity and the volatility in military budget and personnel movement. Current economic potential dis-

plays a negative correlation with the uncertainty about future military power in post-World War I era, possibly because higher economic productivity indicates a state's capacity to allocate greater resources to military development. In contrast, current military power demonstrates a positive correlation with the uncertainty about future military power in pre-Cold War era. This may arise from the fact that weaker states lack the instruments to alter their percentage shares of system totals of military power. The correlation between the level of democracy and uncertainty about future military power appears to be mixed, suggesting that the measure of democracy may not capture enough aspects of domestic information transparency.

Turn to strategic environment factors. Total number of rivalries is positive correlated with the uncertainty about future military power, which may be the result of countervailing forces engendered by international rivalries. On the one hand, states facing more rivalries are motivated to increase investment into arming, thereby diminishing the uncertainty about its future power; on the other, states with more opponents tend to experience more isolation in the international system, potentially hindering their economic and military advancement. Total alliances is negatively correlated with the uncertainty about future military power. This aligns with the argument that states with more formal alliances may not need to dedicate substantial resources to developing their own military capabilities and many military alliances necessitate explicit contributions from member states, making the their military power more transparent and predictable.

Table 2.2: Regression Coefficients of Error Variance Equation

	$Year \leq 1914$	$Year \leq 1945$	$Year \leq 1990$	$Year \leq 2000$
Military Power$_{t-1}$	0.0622^{***}	0.4770^{***}	0.4241^{***}	0.1172
	(0.0056)	(0.0279)	(0.0744)	(0.0801)
Military Variation$_{t-1}$	1.0949^{***}	5.5776^{***}	28.2413^{***}	32.9928^{***}
	(0.0289)	(0.1678)	(0.5362)	(0.5890)
Economic Potential$_{t-1}$	0.0307^{***}	-0.0195^{***}	-0.0095^{***}	-0.0067^{**}
	(0.0035)	(0.0029)	(0.0026)	(0.0025)
Economic Variation$_{t-1}$	0.2254^{**}	0.0308	0.0736	0.1195^{*}
	(0.0871)	(0.0575)	(0.0507)	(0.0469)
Democracy Level$_{t-1}$	-0.0151^{***}	0.0146^{***}	0.0060^{***}	0.0005
	(0.0025)	(0.0017)	(0.0011)	(0.0010)
Total Rivalries$_{t-1}$	0.1535^{***}	0.0210^{**}	0.0471^{***}	0.0562^{***}
	(0.0099)	(0.0075)	(0.0057)	(0.0054)
Total Alliances$_{t-1}$	-0.0190^{***}	-0.0055^{*}	-0.0106^{***}	-0.0116^{***}
	(0.0048)	(0.0026)	(0.0008)	(0.0007)
Constant	-1.8469^{***}	-3.0971^{***}	-4.5181^{***}	-4.6414^{***}
	(0.0194)	(0.0175)	(0.0149)	(0.0140)
Global Deviance	2764.641	−10672.75	−52077.21	−63914.41
AIC	2794.641	−10642.75	−52047.21	−63884.41
SBC	2885.023	−410545.97	−51939.72	−63774.75

Note: $^{\cdot}$p<0.1; *p<0.05; **p<0.01; ***p<0.001

Now, I turn to the analysis results of the logistic regression of war initiation using all observations in the

dataset. First, using the new version of COW dataset with adjustments for actual warring dyads, I replicate the main results of Bell and Johnson (2015), which is reported in Table A1 in the Appendix—large shift in the distribution of power still has a positive and statistically significant impact on the occurrence of war either individually, or collectively with a set of control variables. However, Bell and Johnson (2015) do not account for the impact of the uncertainty about expected power shifts on war initiations.

Next, I present the analysis results accounting for both the size and the uncertainty of expected power shifts. Table 2.3 reports the results of logistic regression integrating both measures that are derived from my two-equation model. Column (1) shows the regression of war initiation solely on the size of expected power shifts, which no longer displays a statistically significant correlation between war initiation and the size of expected power shifts. Column (2) adds more control variables to Column (1). Although most control variables display statistically significant coefficients in the expected direction, the result again shows that the size of expected power shifts does not have a statistically significant impact on the occurrence of war. These results contrast the main finding in Bell and Johnson (2015) that large expected power shift significantly increases the risk of war.

Column (3) further incorporates states' uncertainty about expected power shifts into the decision-making process of waging wars. While retaining the satisfactory performance of control variables, the result not only recovers the positive and statistically significant effect of the size of expected power shifts, but also reveals a subtle effect of the interaction between the size and uncertainty of expected power shifts. The overall impact of large shifts in relative power now is jointly determined by its independent coefficient, which is positive and statistically significant, and the coefficient of its interaction with the uncertainty surrounding it, which is negative and statistically significant[4]. This suggests that the partial effect of the size of expected power shifts on war initiation is contingent upon the level of uncertainty surrounding it.

Specifically, the positive effect of a large expected power shift on war initiation diminishes as its surrounding uncertainty increases. In other words, uncertainty about expected power shifts can pacify the provocative effect of the size of expected power shifts on war initiation. The intuition is simple: if an potential initiator state is highly uncertain about a large power rise of the target state such that it may view the unfavorable power shift unlikely to realize in the future, it faces a dilemma regarding the appropriate course of action, as it cannot be certain about the necessity of waging preventive wars. This uncertainty may lead it to adopt a more cautious approach and refrain from taking military action. The regression results demonstrate the intricate relationship between the size and the uncertainty of expected power shifts in shaping states' decisions

[4]World War II makes up a large portion of wars in my sample. Therefore, as a robustness check to ensure WWII is not driving my result, I drop these war years from my analysis. I continue to find the independent coefficient of expected power shift to be positive and statistically significant, and the interactive coefficient to be negative and statistically significant. The results are reported in Table A2 in the Appendix.

on waging preventive wars: the real risk of war arising from large expected power shifts is contingent upon the level of uncertainty surrounding those shifts.

Table 2.3: Logistic Regression on Power Shifts and Uncertainty

	(1)	(2)	(3)
Magnitude of Power Shifts	1.547	1.528	23.103**
	(1.824)	(1.668)	(10.120)
Uncertainty about Power Shifts			2.132***
			(0.570)
Magnitude*Uncertainty			−58.211**
			(26.701)
Capital Distance		−0.557***	−0.470***
		(0.069)	(0.071)
Contiguity		1.198***	1.068***
		(0.181)	(0.183)
Joint Democracy		−3.032***	−3.495***
		(0.715)	(1.006)
Foreign Policy Similiarity		−0.008	−0.095
		(0.316)	(0.329)
Alliance Obligation		0.244*	0.358**
		(0.131)	(0.145)
Major Power Dyad		2.169***	2.299***
		(0.140)	(0.166)
Constant	−8.453***	−3.446***	−4.231***
	(0.073)	(0.626)	(0.664)
Log Likelihood	−2,324.945	−1,799.069	−1,628.983
Akaike Inf. Crit.	4,653.890	3,620.138	3,283.965
Note:			*p<0.1; **p<0.05; ***p<0.01

Since the coefficients of logistic regression do not have intuitive interpretations, to better illustrate the muting effect of uncertainty about expected power shifts, I calculate the average marginal effect (AME) of the size of expected power shifts on the probability of war as the uncertainty about these shifts increases from the $10th$ percentile to the $90th$ percentile on its distribution. Figure 2.1 shows that the size of expected power shifts has a positive average marginal effect on the probability of war, but its AME decreases as the uncertainty about these shifts increases. Column (1) in Table 2.4 shows that when the uncertainty about expected power shifts is at the $10th$ percentile, a marginally larger shift in future relative power increases the probability of war by 0.81%; when the uncertainty increases to $90th$ percentile, a marginally larger shift in future relative power only increases the probability of war by 0.33%, leading to a 59% decrease in the average marginal effect of elevating expected power shifts. Column (2) in Table 2.4 shows that the same story still holds with all control variables set at their median in the sample, and a plot of that decreasing trend is reported in the Appendix [5].

[5]The MEM using all observations is reported in Appendix A3. The corresponding results excluding WWII observations are reported in Appendix A4-A6.

Table 2.4: Marginal Effect of the Size of Expected Power Shift across Uncertainty Percentile

	Marginal Effect of the Size of Expected Power Shift			
	AME		MEM	
	AME	95 CI	MEM	95 CI
10th Percentile	0.0081***	(0.0075, 0.0087)	0.0023***	(0.0017, 0.0029)
	(0.0003)		(0.0003)	
30th Percentile	0.0075***	(0.0067, 0.0082)	0.0020***	(0.0013, 0.0026)
	(0.0004)		(0.0003)	
50th Percentile	0.0068***	(0.0062, 0.0074)	0.0016***	(0.0009, 0.0023)
	(0.0003)		(0.0003)	
70th Percentile	0.0060***	(0.0053, 0.0066)	0.0012**	(0.0005 0.0019)
	(0.0004)		(0.0004)	
90th Percentile	0.0033***	(0.0026, 0.0040)	0.0005	(-0.0003 0.0013)
	(0.0004)		(0.0004)	
Note:			*p<0.05; **p<0.01; ***p<0.001	

Overall, my results highlight the importance of considering uncertainty as an essential element alongside the size of expected power shifts when examining states' motivations regarding preventive war. While low uncertainty about large expected power shifts can strengthen states' incentive for preventive action, supporting the theoretical conclusion (Powell, 2004, 2006), the presence of high uncertainty introduces additional complexities in their decision-making. In summary, my results show that the risk of war is not exclusively dependent on the size of shifts in the distribution of power—the interaction between the size and the uncertainty of expected power shifts plays a crucial role in shaping states' motivations for preventive war.(Bell and Johnson, 2015).

2.4.1 Extension: A Non-Parametric Estimation

The two-equation model of the uncertainty about expected power shifts is demanding in the sense that it requires the correct model specification of both equations, especially the equation of the error variance. However, there is no unanimous answer so far to the question of what factors $\mathbb{Z}_{i,t-1}$ shape states' uncertainty about future military power. Take one step back, even if we can identify the most plausible set of variables in Equation (2.1.2), we may still lack the available measure of them due to the data limitation issues that disturb empirical research in international conflicts.

As an extension, I look into a non-parametric approach to measuring uncertainty about expected power shifts, and compare its results to the parametric two-equation model. The non-parametric estimation follows a simple intuition: historically, how far are a state's predicted power shifts from the actual power shifts that are observed *ex post*? To develop a sense of its uncertainty about the expected power shift from the standpoint

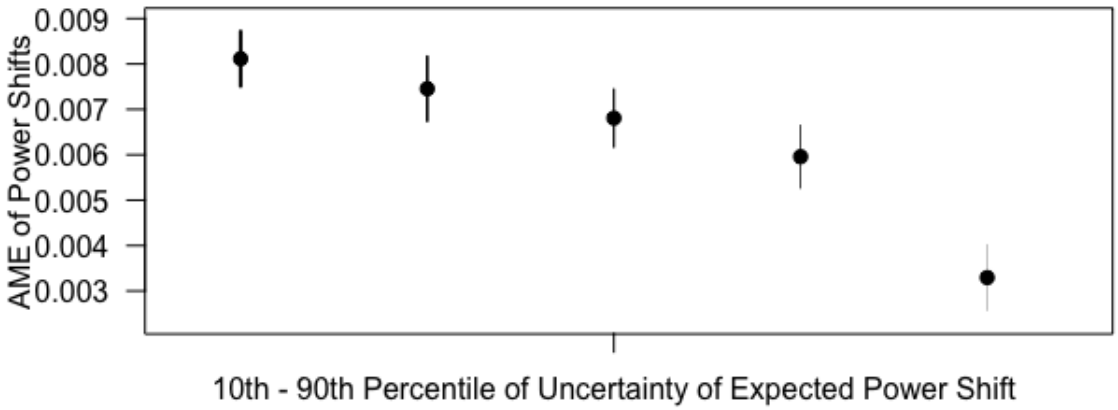

Figure 2.1: AME of Expected Power Shift across Uncertainty Percentile

of the current year, a state looks into its past estimations of the expected power shifts, then reflect on how accurate were those estimations compared to the realized power shifts.

State i's future military power $\widehat{Power_{i,t+1}}$ is still the conditional expectation of Equation (2.1.1) and the expected power shift $\widehat{Power\ Shift}_{i,j,t}$ is calculated by Equation (2.2). Instead of using Monte Carlo Simulation to evaluate uncertainty about expected power shifts in year t, states rely on the estimated and actual power shifts in S years prior to year t: for a year $t' < t$, state j extracts its *estimated* power shift $\widehat{Power\ Shift}_{i,j,t'}$ which is calculated by Equation (2.2), then calculates the *actual* power shift $Power\ Shift_{i,j,t'}$ by replacing $\widehat{Power}_{.,t'+1}$ with $Power_{.,t'+1}$ that were observed in year $t'+1$. The squared error (SE) between the *estimated* power shift $\widehat{Power\ Shift}_{i,j,t'}$ and the *actual* $Power\ Shift_{i,j,t'}$ tells state j's judgement error in year t' *ex post*:

$$SE_{i,j,t'} = (\widehat{Power\ Shift}_{i,j,t'} - Power\ Shift_{i,j,t'})^2 \tag{2.4}$$

With Equation (2.4), state j calculates the squared error for each year $t' \in [t-S, t)$, and those historical records reflects state j's judgement error in estimating power shifts. Finally, state j uses average of those squared errors (MSE) to measure its uncertainty about the expected power shift in year t[6].

Table 2.5 reports the results of logistic regression using the non-parametric measure of uncertainty. However, neither large expected power shifts significantly increase the risk of war, nor high uncertainty about

[6]In the table below, I report the regression results using $S = 5$

expected power shifts assuages the risk of war caused by large power shifts. The coefficients of both the size of expected power shifts and its interaction with uncertainty, are statistically insignificant.

One possible explanation is that the non-parametric measure does not accurately capture states' uncertainty about expected power shifts. This is because with retrospect, if states find their previous estimations of expected power shifts wildly deviating from the *ex post* power shifts, they may avert to rely on historical experience to measure present uncertainty about expected power shifts due to previous inaccuracies there. Cautious states may even devote more resources and efforts to monitor and evaluate the power rise of opponent states in the current year. The ambiguity behind the non-parametric measure may cause some blurring on the correlation between the size of expected power shifts and war initiation.

Table 2.5: Logistic Regression with Non-Parametric Uncertainty

	(1)	(2)
Magnitude of Power Shifts	0.458	0.263
	(1.217)	(1.273)
Uncertainty about Power Shifts	−0.434	−1.460
	(1.006)	(1.452)
Magnitude*Uncertainty	2.675	3.858
	(3.145)	(3.894)
Capital Distance	−0.480***	−0.543***
	(0.074)	(0.082)
Contiguity	0.980***	0.962***
	(0.188)	(0.227)
Joint Democracy	−3.398***	−3.178***
	(1.007)	(1.008)
Foreign Policy Similiarity	0.143	0.121
	(0.342)	(0.401)
Alliance Obligation	0.275*	0.281*
	(0.144)	(0.158)
Major Power Dyad	2.120***	1.815***
	(0.168)	(0.181)
Constant	−3.730***	−3.258***
	(0.674)	(0.756)
Log Likelihood	−1,463.156	−1,207.280
Akaike Inf. Crit.	2,952.312	2,440.559

Note: *p<0.1; **p<0.05; ***p<0.01

2.5 Conclusion

My study delves into the intricate nexus between the size and uncertainty of expected power shifts and how it affects the risk of preventive war. Drawing upon the bargaining theory of war and rationalist explanations, my paper explores how uncertainty influences states' strategic decisions in the face of changing power dynamics.

By introducing an innovative approach that quantifies both the size and uncertainty of anticipated power shifts, my study presents a comprehensive statistical evaluation of the preventive war hypothesis.

Three significant contributions emerge from this investigation. First, my study advances empirical inquiry of shifting-power conflicts by incorporating uncertainty surrounding expected power shifts and unveiling the combined influence of their size and uncertainty on the likelihood of war. This dual consideration challenges traditional empirical assessments centered solely on the size of projected power shifts. Second, a novel insight surfaces regarding the pacifying impact of uncertainty pertaining to forthcoming power shifts. I find that when fixing the elevation of an expected shift in future relative power, increasing the uncertainty surrounding it decreases the conflict-inducing impetus arising from that large shift in the future power distribution. This novel observation reveals the intricate interaction between the size and uncertainty of expected power shifts, and how they jointly shape states' strategic motivation for waging preventive wars. Third, my study introduces a novel measurement of contemporaneous uncertainty concerning expected power shifts. The measure can serve as a proxy for state leaders' uncertainty at the moment of critical decision-making, facilitating our understanding about states' strategic rationale during international crises. Altogether, my research contributes to a nuanced understanding of how uncertainty underpins international conflicts, particularly those arising from shifts in relative power. It also underscores the necessity of accounting for both the size and uncertainty of such shifts to perceive the risk of war driven by shifting-power problems.

Furthermore, this paper opens avenues for future explorations into the empirical measurement of military power and the uncertainty about expected power shifts. First, my estimation strategy treats a state's military power and the uncertainty about it as a monadic property. This implies that given the available information regarding a state i, all states hold the same prediction and uncertainty surrounding state i's future military power. In reality, this uncertainty can be dyadic or relational (Baldwin, 2013; Kaplow and Gartzke, 2021). For instance, some assessing states possess stronger intelligence capacity or exclusive access to information channels, leading them to have less uncertainty about a target state's future military power. Similarly, a target state's enduring rivalries often devote more attention on its power growth, so its adversaries have less uncertainty about the target state's future military power than its non-adversaries. In all, states can have different perceptions of power and are not equally uncertain about it.

Thus, one limitation of the study is that I assume a state's future military power is equally transparent across all assessing states regardless of their identifies, given the available information about its internal characteristics and external environment. This serves as a starting point for understanding uncertainty about power and its determinants. While my current analysis considers the assumption of equal transparency across assessing states, I recognize the potential for future research to delve into scenarios where the perception of military power and the uncertainty surrounding it become dyadic or relational. In such contexts, varying

factors unique to each dyad influence the assessing state's assessment of a target state's future military power.

Second, in this paper I utilize a state's military spending and military personnel to measure its military power. In general, a state's military power consists of both *internal* and *external* components. The internal military power refers to its own military resources and technology that can be mobilized for combat. The external military power, on the other hand, relates to the strength from outside sources that a state can rally to support itself in times of war. My choice in the paper solely concentrates on states' internal military power and fails to account for the influence of alliances—such as the scope of obligations, the depth of commitments, and potential military capacity (Benson and Clinton, 2016), thus presenting a scope condition. While acknowledging this limitation, I leave it to future research to incorporate states' external strength and develop a composite measure of military power that encompasses more external factors.

Moreover, my measurement only focuses on the traditional metrics of military spending and personnel. For instance, it may not be accurate to consider two states as having equal military power solely because they have the same number of military personnel and spend the same amount on military expenditure. It is reasonable to argue that a state with more technical specialities in air/naval forces, intelligence and logistics, has more military power than a state whose most personnel are plain soldiers, even if they have the same number of military personnel. Similarly, a state devoting more resources into the development of sophisticated nuclear arsenal, advanced aircraft carriers and long-range missiles is likely to be more powerful than a state whose defense budget is spent on producing light and maintaining obsolete weapons, even if they spend approximately the same military expenditure.

Thus, another limitation of my approach is that it overlooks other qualitative distinctions that can significantly impact a state's military capabilities such as technical expertise, advanced weaponry and specialized training. A burgeoning body of research is providing finer-grained data on military capabilities, encompassing aspects like a state's nuclear proficiency(Smith and Spaniel, 2020) and the distribution of its military equipment (Gannon, 2023). Although this paper focuses on the traditional metrics of military power, I acknowledge the significance of accounting for more refined factors for a more accurate assessment of military power.

2.6 Appendix

2.6.1 Replication of Bell & Johnson (2015) Main Results

Table 2.6 shows the regression results using Bell and Johnson's (2015) measure of the size of expected power shift, with standard errors clustered by dyad. In the specification of Column (2), the coefficients of most variables are statistically significant and in the expected direction, consistent with Bell and Johnson (2015).

Table 2.6: Replication of Bell and Johnson's Results

	(1)	(2)
Magnitude of Power Shifts	2.360^{***}	1.319^{**}
	(0.431)	(0.418)
Capital Distance		-0.426^{***}
		(0.080)
Contiguity		1.603^{***}
		(0.241)
Joint Democracy		-3.340^{***}
		(0.998)
Foreign Policy Similiarity		-1.509^{***}
		(0.314)
Alliance Obligation		0.371^{**}
		(0.138)
Constant	-8.457^{***}	-2.641^{***}
	(0.072)	(0.741)
Log Likelihood	$-2{,}304.629$	$-1{,}816.175$
Akaike Inf. Crit.	4,613.259	3,652.349

Note: *p<0.05; **p<0.01; ***p<0.001

2.6.2 A2: Logistic Regression of War Initiation Excluding World War II Observations

Table 2.7: Logistic Regression on Non-WWII Dyads

	(1)	(2)	(3)
Magnitude of Power Shifts	2.088	1.680	26.831**
	(2.162)	(1.691)	(10.498)
Uncertainty about Power Shifts			1.737**
			(0.682)
Magnitude*Uncertainty			−67.824**
			(27.994)
Capital Distance		−0.593***	−0.527***
		(0.077)	(0.078)
Contiguity		1.262***	1.057***
		(0.214)	(0.218)
Joint Democracy		−2.814***	−3.298***
		(0.716)	(1.007)
Foreign Policy Similiarity		−0.130	−0.130
		(0.359)	(0.380)
Alliance Obligation		0.234*	0.353**
		(0.142)	(0.156)
Major Power Dyad		1.852***	1.994***
		(0.155)	(0.182)
Constant	−8.641***	−3.121***	−3.731***
	(0.081)	(0.706)	(0.724)
Log Likelihood	−1,937.219	−1,518.874	−1,373.023
Akaike Inf. Crit.	3,878.437	3,059.749	2,772.047

Note: *p<0.1; **p<0.05; ***p<0.01

2.6.3 A3: The Plot of MEM of the size of expected power shift across uncertainty percentile

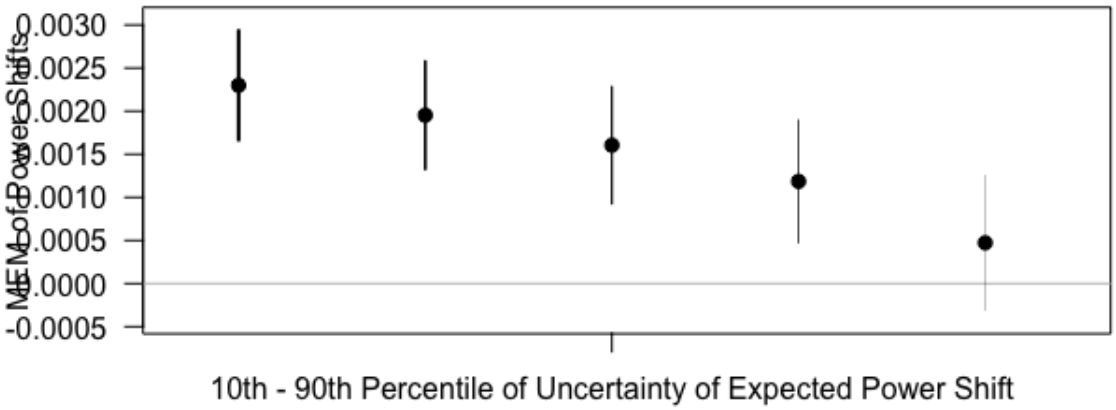

Figure 2.2: MEM of Expected Power Shift across Uncertainty Percentile

2.6.4 A4: Marginal Effect of Power Shifts on Probability of War excluding WWII Observations

Table 2.8: Marginal Effect of Power Shift across Uncertainty Percentile Excluding WWII Observations

	Marginal Effect of the Size of Expected Power Shift			
	AME		MEM	
	AME	95 CI	MEM	95 CI
10th Percentile	0.0100 ***	(0.0094, 0.0106)	0.0031***	(0.0025, 0.0038)
	(0.0003)		(0.0003)	
30th Percentile	0.0091***	(0.0085, 0.0097)	0.0027***	(0.0021, 0.0034)
	(0.0003)		(0.0003)	
50th Percentile	0.0082***	(0.0076, 0.0087)	0.0023***	(0.0016, 0.0029)
	(0.0003)		(0.0003)	
70th Percentile	0.0069***	(0.0063, 0.0075)	0.0017***	(0.0011, 0.0023)
	(0.0003)		(0.0003)	
90th Percentile	0.0031***	(0.0025, 0.0037)	0.0005	(-0.0002 0.0012)
	(0.0003)		(0.0004)	

Note: *p<0.05; **p<0.01; ***p<0.001

2.6.5 A5: The plot of AME of the size of expected power shift across uncertainty percentile excluding World War II years

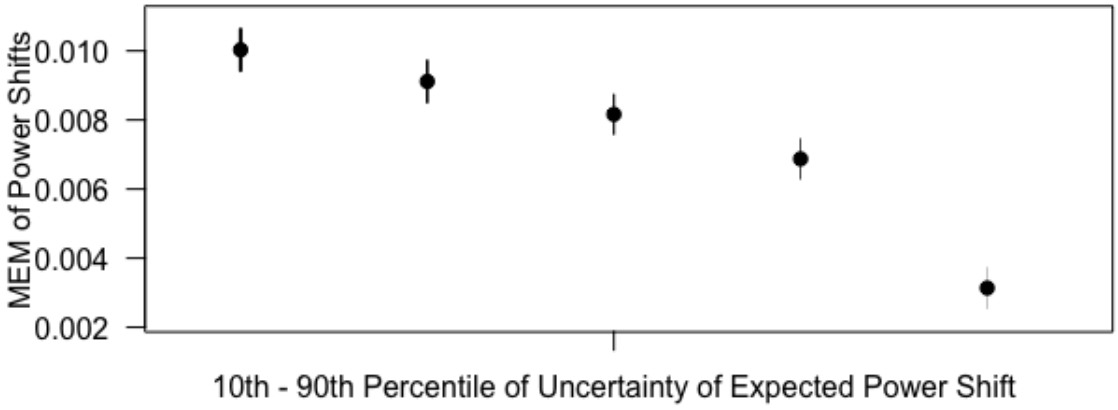

Figure 2.3: AME of Expected Power Shift across Uncertainty Percentile on Non-WWII Dyads

2.6.6 A6: The Plot of MEM of the size of expected power shift across uncertainty percentile excluding World War II years

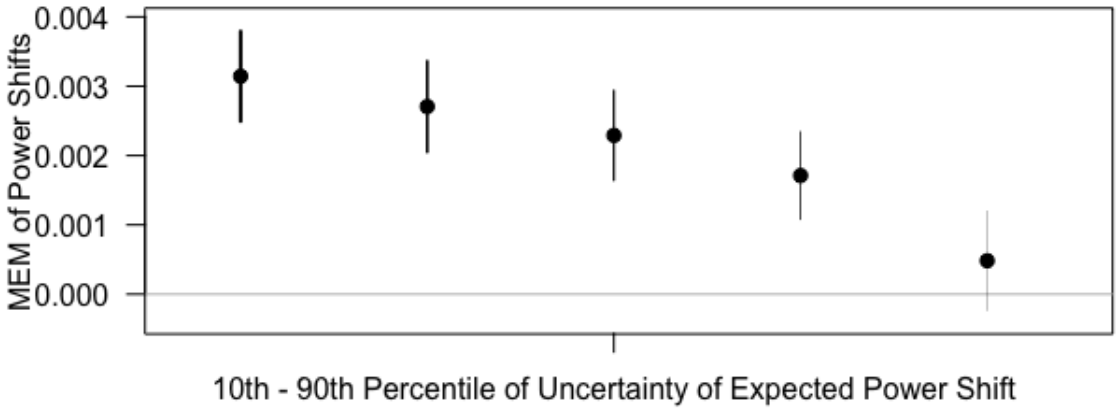

Figure 2.4: MEM of Expected Power Shift across Uncertainty Percentile on Non-WWII Dyads

CHAPTER 3

Co-exist with Rivals: The Politics of Cooperation and Competition

Most bilateral interstate relationships involve both competition and cooperation, with interdependent consequences. I develop a game-theoretic model to explore how countries allocate resources between a public good game, where mutual contribution is most beneficial, and a military contest game, where countries succeed by outmatching the other's resources. Due to resource scarcity, contributions to the public good game impact the resources available for the military contest, thereby affecting each player's position in the competition. A country seeking to revise the status quo faces a trade-off between pretending to be a benign partner and withholding resources from the public good to bolster its military contest position. I examine how countries' perceptions and the ex ante balance of power shape the patterns of bilateral interactions.

3.1 Introduction

Most interstate relationships involve both competition and cooperation. Take, for example, the most influential bilateral relationship: U.S.-China relations. On the one hand, they compete in military, technological, and geopolitical realms. China's military expenditure has been increasing for many years, second only to that of the U.S. Both countries are significantly investing in advanced technology industries such as semiconductors, electric vehicles, and artificial intelligence. Furthermore, this national power competition influences the ownership of geopolitical leadership. On the other hand, American leaders have acknowledged and emphasized the importance of cooperation with China in areas such as climate change, global health, and counter-terrorism on various occasions, and the world has witnessed China's efforts in these areas.

Despite the strategic competition in some fields and issues, the cooperative partnership between the U.S. and China has been a stabilizing force in this bilateral relationship for decades. However, in recent years, there has been increasing criticism from U.S. politicians regarding China's attitudes and efforts towards international cooperation, leading to a low point in U.S.-China relations. For instance, former U.S. politicians have accused China of showing no interest in collaborating with the U.S. on climate change, counter-narcotics, and other issues. In early 2019, more Chinese and American observers warned that the two countries might be moving toward a long-term, full-scale confrontation.

Why do both countries blame each other for the lack of collaborative efforts and put some cooperative issues on hold when cooperation is mutually beneficial? What explains China's decreasing cooperation and increased investment in preparing for competition with the U.S.? What are the implications of the mix of cooperation and competition for the future of U.S.-China relations? I develop a game-theoretic model

to study how countries' perceptions about each other's intentions and the balance of power between them influence their decisions to focus on cooperation or competition.

The model incorporates two types of games from the international relations and formal modeling literature: a public good game and a military contest game. Public goods are non-excludable and non-rivalrous, with benefits increasing in proportion to the total contributions made by the involved players. In the international arena, clean air and water, the prevention of pandemics, and the non-proliferation of nuclear weapons are examples of public goods because countries benefit from each other's contributions to these issues. I use the public good game to represent cooperative issues which countries gain from mutual contribution. The military contest occurs in disputes between countries, where military power determines how contested resources are divided. It can also symbolize competition between nations for power, which typically determines leadership in political and economic arenas.

In the model, two rival countries each control a finite amount of resources and decide how to allocate these resources between the public goods game and the military contest game. Each country's contribution to the public good benefits both itself and its rival, whereas contributions to the military contest benefit only itself and harm its rival. Countries may value the benefits of the public good and the outcomes of the military contest differently. My model assumes that a country can be either a "good" type, which values public good benefits more than military contest gains, or a "bad" type, which values the public good and military contest outcomes in the opposite way. Even a "bad" type country may have an incentive to mimic the "good" type and cooperate occasionally. Consequently, the opponent country faces strategic uncertainty about whether its rival will invest resources in the public good to increase the overall benefit or in the military contest to gain an advantageous position in settling disputes.

The model yields two key findings. First, I demonstrate that a country's beliefs about its rival's intentions can significantly influence the expected type of interaction. If a country believes that its rival is committed to increasing the benefits of the public good, then, in equilibrium, it will also commit to the public good, compelling the "bad" type rival to mimic the actions of the "good" type rival. Conversely, if a country believes that its rival is focused on improving its performance in the military contest, it will not fully commit to the public good. Depending on the perceived risk of facing a "bad" type rival, it may either balance its efforts between the public good and the military contest or fully allocate its resources to the military contest at the expense of the public good.

econd, I demonstrate when a rival's observed actions do or do not perfectly reveal the rival's true intentions. The "good" type rival has an inherent incentive to commit resources to the public good, while the "bad" type rival is motivated to imitate the actions of the "good" type, complicating the attribution of intentions. I find that the relative power between countries and their resource levels determine whether we can expect the

two rival types to take different actions in equilibrium. The "bad" type rival is free to allocate resources to the military contest, whereas the "good" type rival will commit resources to the public good only if the ex ante power of the rival is sufficiently low relative to the opponent country or if the rival lacks enough resources to invest in the military contest. As the rival country becomes more powerful or resource-rich, the other country becomes increasingly reluctant to allow the "bad" type rival to invest in military capabilities.

The model contributes to the existing literature on international cooperation and the security dilemma. First, modeling international cooperation as a public goods game aligns with the study by Stone, Slantchev and London (2008), which employs a repeated public goods model to investigate how the distribution of power affects the degree of cooperation. However, my study differs in that it also incorporates power competition between countries through a military contest game. Specifically, each country strategically allocates resources between the public goods game and the military contest game. By incorporating these two dimensions of interstate interaction, I am able to examine when bilateral relationships are cooperative or competitive and identify the factors driving their variation.

My study is also related to formal modeling studies on the security dilemma. Kydd (1997, 2007) apply game theory to the spiral model and investigate when war or peace would occur between security-seekers and between a security-seeker and an aggressive state. In their model, players can build up arms or wait until the next period, and not building arms can serve as a "costly signal" that demonstrates one's status as a security seeker. Thus, security-seeking states face a trade-off between being well-prepared for war and avoiding unnecessary conflicts. Similarly, in my model, the revisionist challenger uses contribution to the public good as a "costly" signal of (potentially false) benign intentions. The key strategic trade-off for the revisionist challenger is whether to mimic the benign type by allocating some resources to the public good before transitioning to the military contest, or to devote all resources entirely to the contest game from the outset. This incentive to cooperate half-heartedly parallels the incentive to feign weakness found in the study by Slantchev (2010).

Acharya, Ramsay et al. (2013) model countries' uncertainty about strategic fundamentals—the state of the offense-defense balance—using the Prisoner's Dilemma and the Stag Hunt games. In the Prisoner's Dilemma, the offense holds an advantage, making unilateral defection beneficial; in the Stag Hunt, the defense is favored, and mutual cooperation is advantageous. My model differs from theirs by explicitly framing cooperation as the provision of a public good. While Acharya, Ramsay et al. (2013) focus on the conditions under which cooperation is unlikely and why cheap talk diplomacy cannot facilitate cooperation, I explore the motivations behind countries' cooperative behaviors, particularly when their actions may or may not signal their true intentions.

3.2 Model

The model involves two players: a challenger and a defender. To capture the strategic trade-off between cooperation and competition, they must decide when and how to allocate a finite amount of resources between a public goods game and a military contest game. The public goods game represents issues where nations benefit from mutual cooperation and contribution, such as climate change, global health, and nuclear non-proliferation. In contrast, the military contest game addresses issues where nations are in dispute, with the resolution depending on their respective military capabilities.

The model begins with the challenger deciding whether to commit the first unit of resources to the public good. If the challenger opts not to commit to the public good, the model assumes that this unit is allocated to the military contest instead. After observing the challenger's decision, the defender then determines whether to commit one unit of resources to the public good. Following the defender's choice, the challenger decides whether to allocate a second unit of resources to the public good.

The challenger has two types: a revisionist type and a benign type. These types differ in their valuations of the public good versus the military contest. The revisionist type places a higher value on the payoff from the military contest than on that from the public good, while the benign type values the payoff from the public good more highly than that from the military contest. The defender does not know the challenger's exact type and holds a prior belief that the challenger is a revisionist type with a probability $r \in (0,1)$.

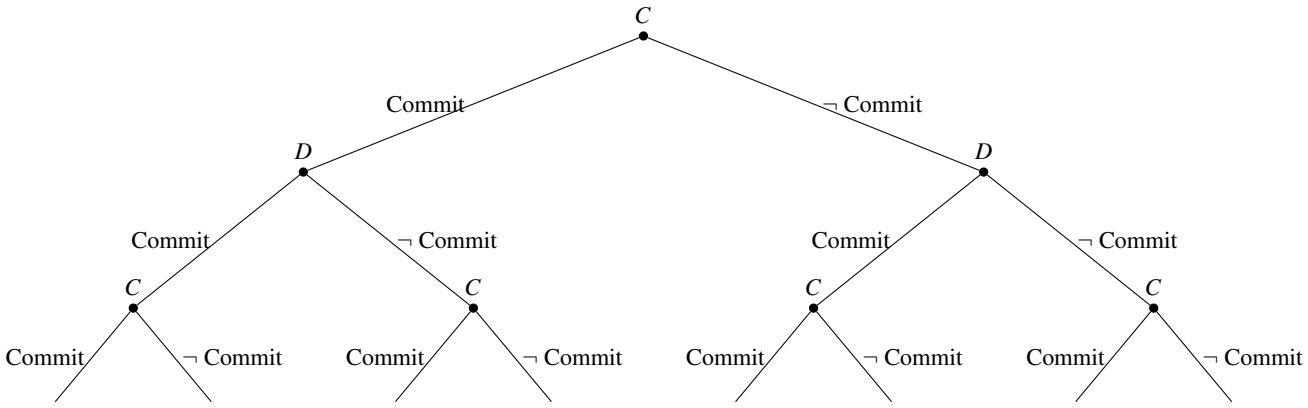

Figure 3.1: Game tree for the interaction, only one type of Challenger is shown

Each player's payoff derives from both the public goods game and the military contest game. The payoff function for the public good is denoted as $P_i(e_C, e_D)$, where $i \in \{C, D\}$, $e_C \in \{0,1,2\}$, and $e_D \in \{0,1\}$. The function $P_i(\cdot,\cdot)$ increases with both inputs. The payoff function for the military contest is represented as $M_i(m_C, m_D)$, with $i \in \{C, D\}$, $m_C \in \{0,1,2\}$, and $m_D \in \{0,1\}$. The function $M_i(\cdot,\cdot)$ increases in m_i but

decreases in m_{-i}, reflecting the assumption that a country's military power, relative to its rival, is greater the more resources it invests in the military contest, and lower the more resources its rival invests.

For the benign type challenger, the payoff at the end of the game is

$$P_C(e_C, e_D) + v_B M_C(m_C, m_D)$$

where $v_B \in [0,1]$ since the benign type challenger is assumed to place a higher value on the payoff from the public goods game. For the revisionist type challenger, the payoff at the end of the game is

$$v_R P_C(e_C, e_D) + M_C(m_C, m_D)$$

where $v_R \in [0,1]$ because the revisionist type challenger is assumed to value the payoff from the military contest more highly. The defender is neutral regarding both the public good and the military contest; therefore, its payoff is

$$P_D(e_C, e_D) + M_D(m_C, m_D)$$

For analytical simplicity, I first assume that the benign type challenger exclusively cares about the payoff from the public good, while the revisionist type challenger focuses solely on the payoff from the military contest, that is, $v_R = v_B = 0$. Second, I assume that the public goods function follows a linear form:

$$P_i(e_C, e_D) = \alpha(e_C + e_D)$$

where $\alpha \in (0,1]$ measures the effectiveness of the effort invested in the public good. Third, I assume that the military contest function follows a contest success form:

$$M_C = \frac{\mu + \theta m_C}{1 + \theta(m_C + m_D)}$$

with $M_D = 1 - M_C$. Here, μ represents the challenger's ex ante probability of contest success when neither player commits any resources to the military contest, and θ measures the effectiveness of the effort devoted to the military contest.

3.3 Analysis

I solve the model for the Perfect Bayesian Equilibrium (PBE). A Perfect Bayesian Equilibrium requires that players act optimally at each information set in the game and update their beliefs using Bayes' Rule whenever possible, based on their knowledge of the strategies employed by other players. I present three

main results. The first result demonstrates how the equilibrium varies as the defender's belief about the challenger's revisionist intention increases. The revisionist type challenger gains an advantage in the military contest by committing all resources to it only when the defender's belief is sufficiently low; otherwise, the revisionist type must mimic the strategy of the benign type, or both players may focus on the military contest. The second result illustrates how the ex ante military power between players influences when a separating equilibrium can be sustained–the revisionist type challenger can commit to the military contest without having to imitate the behavior of the benign type.

Before the equilibrium analysis, I first present a result regarding the challenger's actions at the final node. Specifically, given the action already taken by the defender, how will the different types of challengers allocate their resources to the public good or the military contest? The following lemma illustrates this result.

Lemma 3.3.1. *As $v_R = 0$ and $v_B = 0$, in the challenger's last action node:*

- *The revisionist type challenger always does not commit to the public good.*
- *The benign type challenger always commits all remaining resources to the public good.*

Since the revisionist type challenger is solely focused on its performance in the military contest, it will not allocate any resources to the public good in its final action. Instead, it will commit all remaining resources to the military contest. In contrast, the benign type challenger prioritizes gains from the public good and will allocate all remaining resources to the public good game, regardless of the previous actions taken by itself or the defender. If the benign type challenger did not commit resources in the first action, it will allocate two units to the public good in the second action.

Lemma 1 is contingent on the assumptions regarding v_R and v_B, as well as the functional forms of the public good and military contest. If players value the public good and the military contest more equally, the benign type challenger may also allocate resources to the military contest, as security considerations weigh into its strategic calculations. Furthermore, if the public good function takes a different form—where the benefits can be realized with two units of resources—it may not be the case that the benign type challenger commits two units to the public good, especially if the defender has already committed to it. In this scenario, the benign type challenger would only need to allocate one additional unit of resources to the public good to reap the benefits.

Proposition 3.3.1. *There exists thresholds $\underline{\alpha} = \frac{\mu\theta}{1+\theta}$, $\bar{\alpha} = \frac{\theta(2\theta+\mu)}{(1+2\theta)(1+3\theta)}$, $\underline{\theta} = 1-2\mu$, such that when $\alpha \in (\underline{\alpha}, \bar{\alpha})$ and $\theta > \underline{\theta}$, the equilibria take the form:*

- *If $r < \hat{r}$, there exists the pooling equilibrium in which both types of the challenger choose to take the same action—both committing to either the public good or military contest; the defender commits to the public good regardless of what it observes about the challenger's action.*

• *If* $r \in (\hat{r}, \widetilde{r})$*, there exists the semi-pooling equilibrium in which the revisionist type challenger commits to the public good only at a positive probability, the benign type challenger commits to the public good; the defender commits to the public good at a positive probability if observing the challenger commits, and does not commit if otherwise.*

• *If* $r \in (\widetilde{r}, 1)$*, there exists the pooling equilibrium in which both types of the challenger choose not to commit to the public good; the defender does not commit to the public good regardless of the challenger's action.*

The defender's responses depend on its belief about the challenger when α falls within a specified lower and upper bound. Both $\underline{\alpha}$ and $\bar{\alpha}$ are functions of μ and θ, indicating when public good investment is just mild enough to yield "strategic" responses. If α is outside this range—specifically, if $\alpha < \underline{\alpha}$ or $\alpha > \bar{\alpha}$–contributing to the public good becomes either too unattractive or overly attractive for the defender. In such cases, the defender will either choose not to commit at all or will commit regardless of the challenger's actions and its posterior beliefs. Throughout the analysis, I exclude these extreme cases of α to demonstrate how the defender's beliefs about the challenger influence its responses. $\underline{\theta}$ is a function of μ and $\theta > \underline{\theta}$ indicates that the challenger's efforts into improving its chance of success in the military contest poses enough threat to the defender's.

When the defender's prior belief is sufficiently low—specifically, $r < \hat{r}$–the defender is not concerned about facing a revisionist type challenger or the potential for being free-ride on the public good. As a result, the defender chooses to commit to the public good regardless of the strategy adopted by the challenger. This leads to the existence of two types of pooling equilibria: one in which both types of challengers commit to the public good, and another in which both types commit to the military contest. The revisionist type challenger receives a higher payoff in the pooling equilibrium when neither type commits to the public good, while the defender achieves a higher payoff in the pooling equilibrium when both types of challengers commit to the public good.

When the defender's prior belief is in the middle range—specifically, $\mathrm{r} \in (\hat{r}, \widetilde{r})$–the defender refrains from committing to the public good if it observes the challenger doing the same. However, if the challenger adopts a different strategy, the defender is uncertain about which type of challenger it is facing. This uncertainty compels the revisionist type challenger to mimic the benign counterpart and adopt a mixed strategy. The benign type challenger, on the other hand, continues to prefer committing to the public good. This strategy profile indicates that when the defender observes non-devotion to the public good, it can be certain that the challenger is the revisionist type. Conversely, when it observes a contribution to the public good, the defender's posterior belief regarding whether the challenger is the revisionist type leaves it indifferent between

committing to the public good or the military contest.

When the defender's prior belief is sufficiently high—specifically, $r > \tilde{r}$–the defender is certain enough that the challenger is the revisionist type who wants to commit all its resources to the military contest. Consequently, regardless of the challenger's initial action, the defender chooses not to commit to the public good. Instead, the defender allocates its resources to the military contest to improve its security prospects in the competition against the revisionist type challenger. Both types of challengers also decide not to commit to the public good, albeit for different reasons: the revisionist type is focused solely on winning the military competition, while the benign type is indifferent between committing its resources in two steps or all at once in the second step.

Another equilibrium of interest is the separating equilibrium, in which the revisionist type challenger commits to the military contest, while the benign type challenger commits to the public good. In the following analysis, I demonstrate that this separating equilibrium holds only when the ex ante power balance μ between countries is sufficiently low, and when military investment is not too effective in improving a country's probability of winning the contest.

Proposition 3.3.2. *There exists a threshold μ^*, such that when $\mu < \mu^*$ and $\theta < \underline{\theta}$, the equilibrium takes the form:*

• *The revisionist type challenger commits to the military contest, the benign type challenger commits to the public good.*

• *The defender commits to the public good if observing the challenger also commits to it, and commits to the military contest if observing the challenger does the same.*

This proposition links the equilibrium behavior to the ex ante power balance between countries and the effectiveness of military investment. μ represents the challenger's probability of contest success when neither player invests any resources in the military contest. The threshold $\underline{\theta}$ indicates the maximum effectiveness of the challenger's military investment in improving its military contest success that the defender will tolerate, given the challenger's ex ante military power μ. If θ is greater than this threshold, then allowing the revisionist type challenger to enhance its existing military strength becomes too risky to ignore for the defender. The threshold μ^* depends on the resources that players can allocate to the military contest and is given by the ratio of the defender's resources to the challenger's resources—specifically, $\mu^* = \frac{1}{2}$.

The defender tolerates the revisionist type challenger committing resources to the military contest only if the challenger is relatively weak ex ante and the military investment is not very effective in improving the challenger's power in the military contest. If $\theta > \underline{\theta}$, then allowing the revisionist type challenger to invest in the military contest becomes too dangerous for the defender because it means that the defender's ability

to resolve the dispute in its favor will decline relative to the challenger. If the challenger is already strong enough ex ante $\mu > \mu^*$, then any investment in the military contest poses a significant threat to the defender's security, causing it to never allow the revisionist type challenger to commit to the military contest. In other words, the defender has no concern about the revisionist type challenger committing resources to the military contest only if the challenger does not possess sufficient resources to be allocated to the military contest.

Proposition 2 also explains the expected equilibrium behavior as the challenger's power varies over time. The revisionist-type challenger can freely invest in the military contest regardless of the benign type's behavior only when its relative power is significantly lower than the defender's. As the revisionist-type challenger grows stronger, it increasingly needs to mimic the behavior of the benign-type challenger in equilibrium—either by adopting a mixed strategy or by taking the same actions as the benign-type challenger.

3.4 Discussion

The model has significant implications for the evolution of U.S.-China relations. The trajectory of U.S.-China relations aligns closely with the predictions of my theoretical model. U.S. uncertainty about China's intentions explains the initial cooperation between the two countries, as well as China's rapid development of military technology and national power. However, as the U.S. grows increasingly suspicious of China's intentions behind its growth, both sides begin to slow down their previously mutually beneficial cooperation and allocate more resources to competition. The U.S. implements more containment measures to curb China's rise and increases its investment in advanced technologies to secure a more favorable competitive position. In response, China intensifies its efforts to compete with the U.S. and seeks to gain local advantages over it.

From the 1990s to the early 2000s, the relationship between China and the U.S. was marked by a combination of engagement, economic collaboration, and strategic dialogue, despite underlying tensions and disagreements. Many U.S. politicians shared the belief that China could become more liberal and democratic if the U.S. allowed it to prosper within the economic order established by the United States. In turn, China aimed to reassure the U.S. of its peaceful intentions through cooperation on various economic and political issues.

There was strong economic cooperation, particularly with China's accession to the World Trade Organization in 2001. The Chinese government made a series of promises to open its domestic market, reduce tariffs, eliminate quotas, treat foreign capital and companies equally, expand and open up financial markets, and protect intellectual property. In response, the U.S. increased its bilateral trade with China. U.S. companies grew rapidly in China's vast market, while China benefited from American investment and technology. By 2006, China had become the third-largest trade partner of the U.S., and American consumers benefited from low-cost Chinese goods.

On other global issues, China and the U.S. also cooperated with each other. Particularly after the September 11, 2001, attacks, China actively collaborated with the U.S. on counter-terrorism through intelligence sharing and supporting the U.S. in the War on Terror, including in Afghanistan. Both countries engaged in cooperation to address the North Korean nuclear issue through the Six-Party Talks, demonstrating their collaboration on regional security concerns. Another significant area of U.S.-China cooperation was climate change. Both countries played crucial roles at the Copenhagen Climate Conference in 2009. In 2014, the U.S. and China announced joint climate commitments, pledging to reduce carbon emissions by 2030 and increase the use of green energy.

During the same period, China also focused on accelerating the modernization of its military to narrow the gap with the United States, preparing for potential tensions or confrontations over the Taiwan Strait Crisis or the South China Sea. In the 1990s, China began purchasing advanced weaponry from Russia, including the prototype of its first aircraft carrier from Ukraine in 1998. Additionally, China acquired various military technologies from Israel, such as missiles, unmanned aerial vehicles, electronic warfare systems, and surveillance equipment. These acquisitions significantly boosted China's military capabilities. Meanwhile, China also initiated indigenous development of aircraft and vessels.

Since the mid-2000s, strategic competition has increasingly dominated U.S.-China relations. Despite ongoing cooperation in areas such as climate change, global health, and anti-narcotics, the U.S. has come to realize that China seeks to revise the existing international order and establish its own as its power grows. As a result, both sides have shifted their focus toward enhancing their capabilities and outcompeting each other. The U.S. has restricted China's access to advanced technologies, including artificial intelligence and semiconductor design and manufacturing, while simultaneously increasing investments in next-generation military technologies. In response, China has expanded its resources to achieve self-sufficiency in its economic and military needs and has shown a lukewarm attitude toward certain collaborative efforts. Both countries remain firm in their positions on trade issues, despite the potential benefits of cooperation for global economic stability. Even regarding global health issues, such as investigating the origins of the COVID-19 pandemic, both sides accuse each other of spreading conspiracy theories and politicizing the matter.

3.5 Conclusion

I develop a game-theoretic model of the public goods game and the military contest game with incomplete information to explore the strategic considerations underlying interstate relationships, specifically the dynamics of cooperation and competition, and the factors that drive shifts in these relationships. Countries engage in both games during their interactions and must decide how to allocate their finite resources to maximize overall welfare. I find that countries' perceptions of each other's intentions, the ex ante balance of power,

and the size of resource pools can explain the varying patterns of cooperation and competition in interstate relations. When the defender believes that the rival is unlikely to be a revisionist challenger, it prioritizes contributions to the public good while allowing its rival to commit resources to the military contest to a certain extent. Conversely, when the defender perceives the rival as likely to be a revisionist challenger, both sides focus on enhancing their competitive power. The defender will permit a revisionist challenger to invest in the military contest only if the challenger is sufficiently weak and possesses limited resources to do so.

The model has several limitations that can be addressed in future extensions. First, the incomplete information in the game is asymmetric. In the current setup, only the challenger possesses private information about its intentions, while the defender is assumed to place equal weights on the payoffs from the public good game and the military contest. The benign type challenger consistently seeks to commit resources to the public good game, knowing that the defender lacks the incentive to avoid cooperation. However, there are valid reasons to consider a two-sided incomplete information scenario: the challenger may also be uncertain about the defender's intentions, leading the benign type to hesitate in cooperating if it believes the defender intends to free-ride on its efforts. This uncertainty complicates the defender's beliefs about the challenger's intentions, particularly if the defender observes the challenger avoiding cooperation.

Second, the payoff function for the public good follows a linear form that increases with players' contributions. This structure leads the benign type challenger to commit all resources to the public good in its final action node, even if the defender has already made a contribution. Consequently, the benign type challenger's decision not to commit in the first stage lacks strategic significance. An alternative approach would be to assume that the public good payoff function takes a threshold form, where benefits materialize only if a certain amount of resources is committed. In this scenario, additional contributions beyond that threshold would not increase the benefits received. This modification could incentivize the benign type challenger not to commit in the first stage; if the defender commits one unit to the public good, the benign type challenger would only need to contribute one additional unit in the second stage, thus conserving one unit of resource that could be allocated to the military contest, assuming it values military contest payoffs positively.

Third, the parameters v_B and v_R represent the exogenous weights that challengers assign to the payoffs from the public good and the military contest. Similarly, the defender can have its own preferences regarding the benefits derived from cooperation versus competition. The model could include parameters that reflect the level of importance the defender places on enhancing its power in disputes or competition, which may be endogenous to the marginal returns of public good investments and military contest efforts. When the marginal return on public good investments is sufficiently high and the defender can easily overpower the challenger in military contests, the defender will place greater weight on the benefits of public goods and less on military contest outcomes. Conversely, if the marginal return on public good investments declines or the

challenger's technological capabilities equal those of the defender, the defender may struggle to maintain a competitive advantage with the same level of investment. To optimize overall payoffs from both cooperation and competition, the defender will increase its emphasis and resources dedicated to the military contest.

References

Acharya, Avidit, Kristopher W Ramsay et al. 2013. "The calculus of the security dilemma." *Quarterly Journal of Political Science* 8(2):183–203.

Baldwin, David A. 2013. "Power and international relations." *Handbook of international relations* 2:273–297.

Bas, Muhammet A. 2012. "Measuring uncertainty in international relations: Heteroskedastic strategic models." *Conflict Management and Peace Science* 29(5):490–520.

Bas, Muhammet A and Andrew J Coe. 2016. "A dynamic theory of nuclear proliferation and preventive war." *International Organization* 70(4):655–685.

Bas, Muhammet A and Robert J Schub. 2016a. "How uncertainty about war outcomes affects war onset." *Journal of Conflict Resolution* 60(6):1099–1128.

Bas, Muhammet A and Robert Schub. 2017. "Peaceful uncertainty: When power shocks do not create commitment problems." *International Studies Quarterly* 61(4):850–866.

Bas, Muhammet and Robert Schub. 2016b. "Mutual optimism as a cause of conflict: Secret alliances and conflict onset." *International Studies Quarterly* 60(3):552–564.

Bell, Sam R and Jesse C Johnson. 2015. "Shifting power, commitment problems, and preventive war." *International Studies Quarterly* 59(1):124–132.

Benson, Brett V and Bradley C Smith. 2022. "Commitment Problems in Alliance Formation." *American Journal of Political Science* forthcoming:1–14.

Benson, Brett V and Joshua D Clinton. 2016. "Assessing the variation of formal military alliances." *Journal of Conflict Resolution* 60(5):866–898.

Best, Antony. 2016. *Britain's retreat from Empire in East Asia, 1905-1980*. Taylor & Francis.

Blainey, Geoffrey. 1988. *Causes of war*. Simon and Schuster.

Blumenthal, Tuvia and Madeleine Chi. 1970. *China Diplomacy, 1914-1918*. Harvard Univ Asia Center.

Carter, David B and Curtis S Signorino. 2010. "Back to the future: Modeling time dependence in binary data." *Political Analysis* 18(3):271–292.

Chadefaux, Thomas. 2011. "Bargaining over power: When do shifts in power lead to war." *IT* 3:228.

Coe, Andrew J. 2018. "Containing rogues: A theory of asymmetric arming." *The Journal of Politics* 80(4):1197–1210.

Craft, Stephen G. 2014. *VK Wellington Koo and the emergence of modern China*. University Press of Kentucky.

De Mesquita, Bruce Bueno. 1996. "Counterfactuals and international affairs." *Counterfactual thought experiments in world politics: Logical, methodological, and psychological perspectives* p. 211.

Debs, Alexandre and Jessica Chen Weiss. 2016. "Circumstances, domestic audiences, and reputational incentives in international crisis bargaining." *Journal of Conflict Resolution* 60(3):403–433.

Debs, Alexandre and Nuno P Monteiro. 2014. "Known unknowns: Power shifts, uncertainty, and war." *International Organization* pp. 1–31.

Dull, Paul S. 1950. "Count Kato Komei and the Twenty-one Demands." *Pacific Historical Review* 19(2):151–161.

Fearon, James D. 1991. "Counterfactuals and hypothesis testing in political science." *World politics* 43(2):169–195.

Fearon, James D. 1995. "Rationalist explanations for war." *International organization* 49(3):379–414.

Fey, Mark and Kristopher W Ramsay. 2011. "Uncertainty and incentives in crisis bargaining: Game-free analysis of international conflict." *American Journal of Political Science* 55(1):149–169.

Fordham, Benjamin O. 2011. "Who wants to be a major power? Explaining the expansion of foreign policy ambition." *Journal of Peace Research* 48(5):587–603.

Fordham, Benjamin O and Thomas C Walker. 2005. "Kantian liberalism, regime type, and military resource allocation: Do democracies spend less?" *International Studies Quarterly* 49(1):141–157.

Gannon, Andres. 2023. "Planes, trains, and armored mobiles: Introducing a dataset of the global distribution of military capabilities (rdmc)." *Available at SSRN 3930390* .

Gartzke, Erik. 1999. "War is in the Error Term." *International Organization* 53(3):567–587.

Goemans, Hein and William Spaniel. 2016. "Multimethod research: A case for formal theory." *Security Studies* 25(1):25–33.

Gowen, Robert Joseph. 1971. "Great Britain and the Twenty-One Demands of 1915: cooperation versus effacement." *The Journal of Modern History* 43(1):76–106.

Gurko, Vladimir Iosifovich. 1939. *Hoover library on war revolution and peace publication No. 4: Features and figures of the past, Government and opinion in the reign of Nicholas II*. Stanford University Press, California.

Haftel, Yoram Z and Alexander Thompson. 2013. "Delayed ratification: The domestic fate of bilateral investment treaties." *International Organization* 67(2):355–387.

Harvey, Andrew C. 1976. "Estimating regression models with multiplicative heteroscedasticity." *Econometrica: Journal of the Econometric Society* pp. 461–465.

Jervis, Robert. 1976. *Perception and misperception in international politics: New edition*. Princeton University Press.

Jervis, Robert. 1978. "Cooperation under the security dilemma." *World politics* 30(2):167–214.

Joseph, Michael F. 2021. "A Little Bit of Cheap Talk Is a Dangerous Thing: States Can Communicate Intentions Persuasively and Raise the Risk of War." *The Journal of Politics* 83(1):166–181.

Kaplow, Jeffrey M and Erik Gartzke. 2021. "The determinants of uncertainty in international relations." *International Studies Quarterly* 65(2):306–319.

Koo, Wellington. 1976. *The Wellington Koo Memoir*. Translation and Publisher of Tianjin.

Kowner, Rotem. 1998. "Nicholas II and the Japanese body: Images and decision-making on the eve of the Russo-Japanese War." *The Psychohistory Review* 26(3):211.

Krainin, Colin. 2017. "Preventive war as a result of long-term shifts in power." *Political Science Research and Methods* 5(1):103–121.

Kydd, Andrew. 1997. "Game theory and the spiral model." *World Politics* 49(3):371–400.

Kydd, Andrew H. 2007. *Trust and mistrust in international relations*. Princeton University Press.

Langer, William Leonard. 1960. *The diplomacy of imperialism, 1890-1902*. New York, Knopf.

Leeds, Brett, Jeffrey Ritter, Sara Mitchell and Andrew Long. 2002. "Alliance treaty obligations and provisions, 1815-1944." *International Interactions* 28(3):237–260.

Lemke, Douglas. 2003. "Investigating the preventive motive for war." *International Interactions* 29(4):273–292.

Levy, Jack S. 1987. "Declining power and the preventive motivation for war." *World politics* 40(1):82–107.

Levy, Jack S. 2008. Counterfactuals and case studies. In *The Oxford handbook of political methodology*. Oxford University Press.

Lorentzen, Peter, M Taylor Fravel and Jack Paine. 2017. "Qualitative investigation of theoretical models: the value of process tracing." *Journal of Theoretical Politics* 29(3):467–491.

Lowe, Peter. 1969. *Great Britain and Japan 1911–15: A Study of British Far Eastern Policy*. Springer.

Malozemoff, Andrew. 2020. *Russian Far Eastern Policy, 1881–1904*. University of California Press.

Marshall, Monty G, Keith Jaggers and Ted Robert Gurr. 2002. "Polity IV project: Dataset users manual." *College Park: University of Maryland* 86.

Martin, John Patrick. 1980. *Politics of Delay: Belgium's Treaty Negotiations with China, 1926-29*. St. John's University (New York).

McCormack, Daniel and Henry Pascoe. 2017. "Sanctions and preventive war." *Journal of Conflict Resolution* 61(8):1711–1739.

Meirowitz, Adam, Anne E Sartori et al. 2008. "Strategic uncertainty as a cause of war." *Quarterly Journal of Political Science* 3(4):327–352.

Nish, Ian. 2002. *Japanese foreign policy, 1869-1942: Kasumigaseki to Miyakezaka*. Vol. 11 Psychology Press.

Nish, Ian. 2014. *The origins of the Russo-Japanese war*. Routledge.

Powell, Robert. 2004. "The inefficient use of power: Costly conflict with complete information." *American Political science review* pp. 231–241.

Powell, Robert. 2006. "War as a commitment problem." *International organization* pp. 169–203.

Powell, Robert. 2012. "Persistent fighting and shifting power." *American Journal of Political Science* 56(3):620–637.

Ripsman, Norrin M and Jack S Levy. 2007. "The preventive war that never happened: Britain, France, and the rise of Germany in the 1930s." *Security Studies* 16(1):32–67.

Romanov, Boris A. 1947. *A Survey of the Diplomatic History of the Russo-Japanese War, 1895-1907*. Moscow.

Sarkees, Meredith and Frank Wayman. 2010. "Resort to War, 1816-2007." *(No Title)* .

Schemo, Diana Jean. 1997. "How Peruvian hostage crisis became trip into the surreal." *New York Times (April 26)* 6.

Shi, Jianguo. 1999. *The Biography of Lu Tseng-Tsiang*. People's Publisher of Hebei.

Signorino, Curtis S and Jeffrey M Ritter. 1999. "Tau-b or not tau-b: Measuring the similarity of foreign policy positions." *International Studies Quarterly* 43(1):115–144.

Singer, J David, Stuart A Bremer and John Stuckey. 2012. Capability Distribution, Uncertainty, and Major Power War, 1820–1965 1. In *Advancing Peace Research*. Routledge pp. 161–174.

Slantchev, Branislav L. 2010. "Feigning weakness." *International Organization* 64(3):357–388.

Slantchev, Branislav L and Ahmer Tarar. 2011. "Mutual optimism as a rationalist explanation of war." *American Journal of Political Science* 55(1):135–148.

Smith, Bradley C and William Spaniel. 2020. "Introducing ν-Clear: a latent variable approach to measuring nuclear proficiency." *Conflict Management and Peace Science* 37(2):232–256.

Snyder, Glenn H. 1984. "The security dilemma in alliance politics." *World politics* 36(4):461–495.

Snyder, Glenn H. 2007. *Alliance politics*. Cornell University Press.

Spaniel, William. 2019. *Bargaining over the bomb: the successes and failures of nuclear negotiations*. Cambridge University Press.

Stone, Randall W, Branislav L Slantchev and Tamar R London. 2008. "Choosing how to cooperate: A repeated public-goods model of international relations." *International Studies Quarterly* 52(2):335–362.

Takeuchi, Tatsuji. 2010. *War and diplomacy in the Japanese Empire*. Routledge.

Tarar, Ahmer. 2023. "Crisis Bargaining in the Shadow of Third-Party Opportunism." *International Studies Quarterly* 67(2):sqad039.

Taylor, Jay. 2009. *The generalissimo: Chiang Kai-shek and the struggle for modern China*. Harvard University Press.

Thompson, William R and David R Dreyer. 2012. "Handbook of international rivalries, 1494-2010." *(No Title)* .

White, John Albert. 2015. *Diplomacy of the Russo-japanese War*. Princeton University Press.

Wolford, Scott, Dan Reiter and Clifford J Carrubba. 2011. "Information, commitment, and war." *Journal of Conflict Resolution* 55(4):556–579.

Yoder, Brandon K. 2019a. "Hedging for Better Bets: Power Shifts, Credible Signals, and Preventive Conflict." *Journal of Conflict Resolution* 63(4):923–949.

Zhou, Ian Fleming and Jo-Ansie van Wyk. 2021. "North Korea's Entrapment and Time Delay Tactics during Nuclear Negotiations." *Asian Journal of Peacebuilding* 9(2):411–426.