# DEFENSE SPENDING AND ALLIANCE RELIABILITY: A MIXED-METHODS ANALYSIS

By

Mark Emerson Conklin

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 31, 2022

Nashville, Tennessee

Approved:

Andrew Coe, Ph.D.

Brenton Kenkel, Ph.D.

Jennifer Larson, Ph.D.

Scott Wolford, Ph.D.

This dissertation project is dedicated to my wife, Courtney, and my daughters, Juliette and Bernadette, who endured ”Grumpy Dad” throughout so many days and nights of focused academic effort.

## ACKNOWLEDGMENTS

I would like to thank the outstanding committee with whom I collaborated for the completion of this dissertation project. Dr. Andrew Coe, Vanderbilt University, my dissertation chair who oversaw this project, provided timely and thoughtful guidance to keep me calm and on course. Dr. Brenton Kenkel, Vanderbilt University, supplied the expert advice that helped to create and hone the formal model that spawned this project. Dr. Jennifer Larson, Vanderbilt University, offered the brilliant instruction and novel insights that brought about the empirical analysis. I would also like to thank the many political scientists cited herein, but in particular, Dr. Scott Wolford, University of Texas at Austin, whose work not only shaped my own, but whose participation on this committee and unique perspective helped to deepen my analysis.

I would also like to thank my fellow graduate student cohort and the Vanderbilt University International Relations faculty with whom I was fortunate enough to study, who brought true joy to this experience, even in the midst of a global pandemic. Special thanks to Dr. Brett Benson, Dr. Cassie Dorff, Dr. Jon Hiskey, Dr. Noam Lupu, Dr. Emily Ritter, Dr. Peter Schram, Dr. Brad Smith, and Dr. Alan Wiseman. Additional thanks to Jennifer Barnes, Haonan Dong, Margaret Frost, Colin Henry, Mellissa Meisels, LTC Rick Montcalm, Giovani Roggia, and Heesun Yoo.

The United States Army and its Advanced Strategic Plans and Policy Program (ASP3) provided for this academic opportunity. Special thanks to Dr. Robert Davis for his diligent preparations in readying me and my fellow Army officers for the rigors of doctoral education. Additional thanks to the Soldiers, Non-Commissioned Officers, and Officers with whom I have served who carried me forward to this point and taught me that good ideas can come from anywhere.

Finally, and most importantly, I would like to thank my wife, Courtney, and my daughters, Juliette and Bernadette, whose love, support, and encouragement motivated and inspired me to succeed in this arduous academic endeavor. I offer special thanks to my parents, Bob and Kathleen, and my siblings, Melissa and Brian, whose example of hard work and interest in this project helped drive me toward completion. I hope that this accomplishment establishes a legacy of academic achievement for generations to come.

## TABLE OF CONTENTS

## LIST OF TABLES

## LIST OF FIGURES

# CHAPTER 1

## Formal Analysis of Defense Spending and Alliance Reliability

### 1.1 Introduction

A state anticipating a challenge to its security may act to remedy perceived imbalances in power. The occurrence and implications of such actions have inspired a large body of international relations research over the past several decades. There are numerous ways for a state to accomplish such rebalancing; the most prevalent is to acquire additional means to wage war (Morgenthau, 1948). Doing so serves a dual purpose, both increasing a state's leverage at the negotiating table and improving its chances of success should bargaining fail and war result (Fearon 1995). Redressing a security imbalance may be achieved by arming oneself or by forming defense pacts with interested states, and these actions are often characterized as substitutes for one another (Barnett & Levy 1991, Morrow 1993, Sorokin 1994). Interestingly, states continue to make arming decisions even after entering into cooperative agreements with other states, and this topic has received little attention beyond motives for sharing the burdens of defense (Olson & Zeckhauser 1966).

Just as relative power assessments bear upon states' behaviors, so too does the constitution of states' military power. Measures of a state's military capabilities abound, and the study of their influence on war and peace has yielded inconsistent results at best (Buzan 1987, Brooks & Wohlforth 2016, Slantchev 2003, Gartzke & Lindsay 2020). Such studies, however, collectively demonstrate that both foreign and domestic policy goals, actions, and outcomes are all shaped by the specific military capabilities that states possess (Betts 1997). Not all defense dollars are equal nor does any particular military capability function uniformly across all conflicts. We should be interested, then, in both the magnitude and makeup of a state's military and its consequences for both allies and adversaries alike.

This paper presents a formal model of defense spending decision-making in the context of a military alliance under threat. A targeted state, who anticipates a challenge, makes an investment in military capability before bargaining with adversaries and allies to avert war. Rather than contending that states simply substitute arms and allies for one another, the results presented here illuminate specific conditions under which arms and allies complement one another and those when arms and allies best serve as substitutes. Furthermore, the results describe situations in which both a targeted state and her ally are better served by a smaller investment in military capability than a larger one, and this result is reached strictly through analysis of security considerations rather than economic "*guns versus butter*" concerns. Two factors interact to produce interesting and at times counterintuitive results. First, the allies fare better in war when they fight together. How much better they fare depends upon the ally's strength relative to the other belligerents. Defense expenditures serve to increase a state's fighting ability, but they may also reduce an ally's incentive to participate in conflict. Second, investments in complementary military capabilities offer efficiencies to allies fighting together that redundant substitute capabilities do not, yielding benefits on the battlefield that may exceed their relative cost. The magnitude and make-up of the target's defense expenditure together influence both a challenger's demands and a partner's decision to cooperate.

In the next section, I briefly discuss the state of the relevant formal literature relating to crisis bargaining, military alliances, and arming as they pertain to the model. I then describe the model, its key features, and its solution. Next, I present the model's most interesting results. I conclude with a discussion of the model's implications for future research and alliance policy.

### 1.1.1 Bargaining, Alliances, and Arming

The model presented in this paper takes the form of a rational-choice, crisis bargaining game. Players are represented as independent states in dispute over an issue of international importance faced with an optimization problem - accept the terms of a revisionist challenger or engage in costly war to preserve the status quo (Reiter 2003). As rational actors, states' decisions are derived from a comparison of the expected benefits of war versus peace (Bueno de Mesquita 1985). Scholars have employed such models to explain the onset of war as a failure of bargaining attributed to private information whereby states cannot accurately ascertain the likely cost or outcome of conflict or they cannot commit to maintain the status quo in the future (Fearon 1995, Powell 2002). Research frequently delineates between uncertainty over players' resolve (Powell 1996, Schultz 1999) or their probability of prevailing in conflict (Wagner 2000, Reed 2003, Smith  Stam 2006). This paper considers both resolve and capability, but players in the game presented here have complete knowledge of the intentions and abilities of other players. Instead, this paper considers relationships between players' capability and their resolve, seeking to understand how investments in military capability influence a challenger's demands and a partner's will to cooperate. Framing this problem within the context of crisis bargaining places it within a dominant contemporary approach to the study of international conflict (Lake, 2010). The model presented here is distinct in that it entails a three-player interaction, and the onset of war is not the outcome of interest. With complete information, the model reveals equilibrium behavior under optimal conditions, where all military capabilities are observed, communications are reliable, and actions are predictable.

Alliance bargaining models typically analyze efforts among allies to resolve disputes over internal alliance policy (Thies 2015), or they introduce alliance formation as a means to improve leverage when bargaining with adversaries (Wagner 2004). Formal theories of alliances, like those of crisis bargaining, commonly investigate the onset of war. Early efforts sought to test the informal assertions of system-level, realist theories suggesting that states may either balance against powerful aggressors or bandwagon with them against weaker targets (Smith 1995, Powell 1999). Modelers have demonstrated that not only may alliances deter conflict by threatening third-party military intervention (Morrow 1994), they mitigate challengers' demands in crisis bargaining (Werner 2000, Yuen 2009), and alternatively may motivate risky target behavior by improving the target's chances of prevailing in war (Snyder 1984, Smith 1995, Benson 2012). While this paper considers an alliance's effect on crisis bargaining and acknowledges its role in deterring conflict, this research is primarily concerned with intra-alliance dynamics. Others have examined states' ability to influence behavior within and through alliances, finding that allies may leverage their military support to manage the behavior of targets and challengers alike (Fang et al 2014). This paper builds upon this research by considering the role of the target in shaping behavior, allowing the target the opportunity to influence the military balance by arming itself, and examining the influence of arming on the conduct of the alliance.

Theoretical research addressing both allies and armaments often describes a trade-off between them, seeking to identify the conditions under which states choose one over the other (Altfeld 1984, Conybeare 1994). Narrow empirical tests provide some support for this assertion (Altfeld, 1984, Morrow 1993, Sorokin 1994), while others suggest that arms and allies are best pursued simultaneously as complements to one another (Gonzales & Mehay 1991, Horowitz et al 2017). We know that, in practice, states maintain both arms and alliances and make decisions that affect both simultaneously. The research presented in this paper reflects this reality, modeling the consequences of one's arming decisions on the conduct of its alliance partners. In its analysis of arming, this research also addresses burden sharing, another common thread in the arms and alliances literature. Prevailing wisdom asserts that bigger, stronger alliance partners bear disproportionate burdens of collective security owing to disparate marginal benefits of defense spending and the greater ability of larger states to influence the power balance (Olson and Zeckhauser, 1966). Rather than investigating how one state's defense spending influences the spending of its partners, this paper instead examines how the specific character of a state's spending may influence its partner's propensity to participate in conflict and whether spending at all is indeed an optimal action.

Numerous scholars have examined the factors that affect the reliability of alliance commitments, but few efforts have directly considered the relationship between defense spending and alliance reliability. Empirical research has established that changes in intra-alliance power ratios have adversely affected the survivability of alliance commitments and increased the incidence of conflict (Morrow 1991, Leeds 2003, Johnson & Joiner 2019), but any direct effect that arming has on ally behavior has not been formally investigated. A notable exception examined the opposite concern, contending that signalling enhances the credibility of an alliance partnership and motivates defense spending by other alliance partners (DiGiuseppe & Shea 2021). How defense spending affects the subsequent credibility of the alliance remains open for investigation.

## 1.2 Model Setup

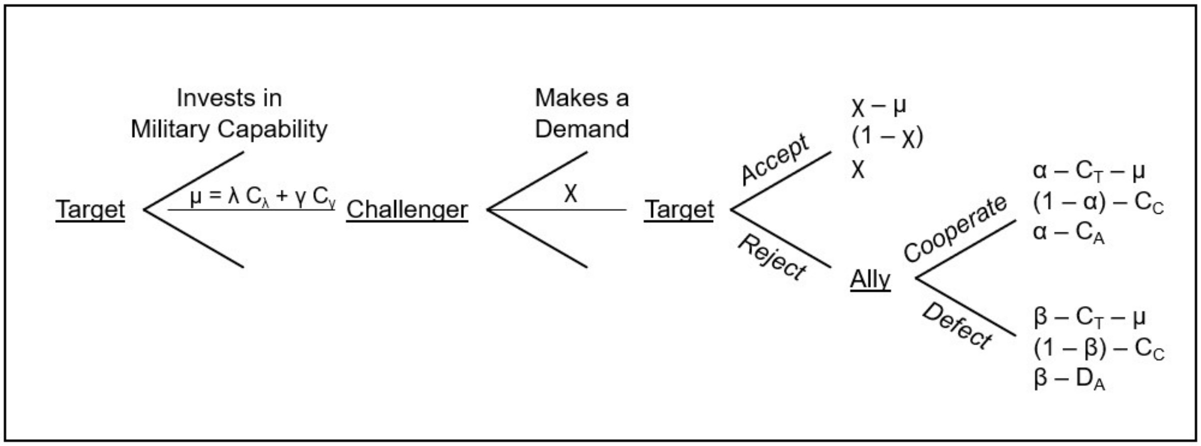



Figure 1.1: Game Tree

With this model, I attempt to capture some conventional wisdom often used to describe the state of international politics and relate it to cooperation and burden sharing in military alliances. The global environment is characterized by anarchy, and security is relative. As such, states take action to redress their perceived vulnerabilities relative to potential adversaries. In the model, targeted states feel threatened and thus compelled to augment their security through military alliance or expenditure. International agreements are possible, but they are not enforceable. They are upheld only by common interest. In this model, states can choose not to uphold commitments, but doing so comes at a cost, which is ostensibly political.

Suppose that two states are engaged in bargaining over an issue of international importance that represents an imbalance in their relative security. This issue could be disputed territory, treatment of ethnic minorities, or some other contentious policy. One state is the Target ($T$ - feminine), who endeavors to minimize any losses. In anticipation of a challenge, a Target state makes an investment in military capability ($\mu$). This investment improves her negotiating position, when holding the behavior of other players as fixed, and also improves her prospects for success should bargaining break down and war result. The Challenger ($C$ - masculine) is a revisionist state, proximate to the Target and willing to risk war to improve his position. The Challenger proposes a division of the territory or an alteration of policy in accordance with his wishes ($\chi$). The Target may either accept this offer and settle the issue in accordance with the Challenger's proposal, or the Target may reject the Challenger's offer and instead opt for war.

Suppose also that the Target has an Ally ($A$ - masculine) with whom a defense pact was formed in anticipation of a potential challenge from a mutual adversary. Like the Target, the Ally prefers to maintain the status quo and deems a Challenger to be shared a adversary. The Ally can bring military force ($M_A$) to bear in support of the Target in the event of a challenge. The Ally may either *cooperate*, joining the Target to fight collectively against the Challenger, or he may *defect*, leaving the Target to fight the Challenger on her own. The Ally benefits from the Challenger's defeat whether he participates or not. The settlement is therefore a club good. It is excludable because only the winners reap the benefits, and it is non-rival, in that both the Target and the Ally gain from the Challenger's concessions regardless of effort. When making decisions, all players must consider their military power relative to other players ($M_i$) and the cost of conflict ($C_i$) while predicting the behaviors of other players .[1] The Ally must also consider any costs incurred from defecting from his alliance commitment ($D_A$), such as a loss of domestic political support or a weakening of his other alliance partnerships and international standing.

The game begins with the Target making a decision to invest in military capability ($\mu$). The Target may invest any amount within her means. She divides her investment between military capabilities that substitute for those of her Ally ($\lambda$) and those that complement those of her Ally ($\gamma$). Substitute military capabilities best serve the Target's unilateral security needs, while complementary military capabilities serve alliance security needs. Each capability has its own cost factor ($C_\lambda$ and $C_\gamma$, respectively). The Challenger observes the Target's investment and, next, proposes a resolution to the disputed issue ($\chi \in [0,1]$). To simplify, I forego the possibility of preventive war to prevent the power shift from taking effect.[2] If the Target accepts the Challenger's demands,

[1]Each player's war cost ($C_i$) captures the unique value they assign to the disputed issue. A low valuation translates to a higher relative war cost, while an issue of high importance lowers the relative cost of fighting.

[2]In reality, even through purchase of armaments or formation of alliances, states incur significant delays in reaping any practical benefits from their efforts to augment their defenses. The implications of such delays, particularly in forming alliances, has been modeled elsewhere (Benson & Smith 2021).

then the game ends. The Target receives her share of the stakes minus the upfront cost of her military investment ($EU_T(Accept) = \chi - \mu$). The Ally, whose policy preferences align with those of the Target, benefits equally from peaceful issue resolution, but foregoes any up front cost ($EU_A|T(Accept) = \chi$).[3] The Challenger receives the remaining share ($EU_C|T(Accept) = 1-\chi$).

Alternatively, if the Target rejects the Challenger's proposal, then war ensues. The Ally must then decide whether to uphold his commitment and fight alongside the Target against the Challenger or defect from the alliance and leave the Target to fight alone in a bilateral war. The victor of any war gains the whole prize, either capturing the disputed territory or implementing their ideal policy, while the loser gets nothing. War is of course costly, and belligerents must each pay their unique costs of fighting ($C_i$).[4] In bilateral war, the Ally faces a defection cost ($D_A$) for reneging on his alliance commitment. A war's expected outcome is determined by a probabilistic function that considers each belligerent's share of the total military capability ($\frac{M_i}{\sum_i^n M_i}$). The probability that the allies prevail together in combat against the Challenger is represented by $\alpha$ while the probability that the Target fighting alone prevails is $\beta$. Each player's war payoffs are depicted in figure 1 and listed below:

$$EU_T(CoalitionWar) = \alpha - C_T - \mu \qquad EU_T(BilateralWar) = \beta - C_T - \mu$$

$$EU_C(CoalitionWar) = (1-\alpha) - C_C \qquad EU_C(BilateralWar) = (1-\beta) - C_C$$

$$EU_A(CoalitionWar) = \alpha - C_A \qquad EU_A(BilateralWar) = \beta - D_A$$

### 1.3 Solving the Model

Players have complete information about the intentions and capabilities of the other players, meaning they accurately assess each other's capabilities and costs, and they perfectly observe each other's actions. Therefore, peaceful solutions should be reached through bargaining in equilibrium (Fearon 1995, Powell 2002). We limit our analysis to a single round of play, so players are not

[3] Individual valuations of the disputed issue are captured by each party's individual costs of fighting, with higher valuations reducing one's relative war costs. Both the Target and the Ally prefer total capitulation of the Challenger, for example, but the Ally may value this outcome weakly less than the Target ($V_T \geq V_A$). This assumes that the Target faces conflict on or over its own territory and policies, whereas the Ally's interests in the dispute are more remote.

[4] Fixing the Ally's war cost ($C_A$) indicates that the Ally's contribution to any conflict is predetermined independently of any Target or Challenger decisions. Examining the possibility that the Ally's war costs vary linearly with the military investment decision of the Target does not change any substantive results.

learning from habitual interaction. With complete information, this model can be solved through backward induction, determining each player's optimal action or best response at each decision node, beginning with the final decision, and working backward to the start of the game.

So, beginning at the end, in the final action of the game, the Ally decides whether he will participate in an ensuing conflict. He may choose to *cooperate*, fighting alongside the Target against the Challenger, or he may choose to *defect*, leaving the Target to fight the Challenger alone. To make this decision, the Ally, being rational, compares what he expects to earn from each choice given what he observed from all preceding actions, and then opts for the one yielding the highest payoff. Put simply, if the payoff that the Ally expects to earn by fighting meets or exceeds the payoff that he expects to earn by defecting from his alliance commitment ($\alpha - C_A \geq \beta - D_A$), then he will *cooperate* and join the fight. Both the Ally's war cost $(C_A)$ and his defection cost $(D_A)$ are exogenous parameters, and are not affected by decisions made within the model. Players can predict and potentially manipulate the Ally's behavior by solving for a known quantity, such as the Ally's marginal cost of participating in the conflict ($C_A - D_A$). If the Ally's marginal war cost is sufficiently low ($C_A - D_A \leq \alpha - \beta$), then the Ally will *cooperate*; if his costs exceed the threshold value ($C_A - D_A > \alpha - \beta$), then he will *defect*.

The preceding choice is made by the Target. She must *accept* or *reject* the Challenger's demands ($\chi$). Just like the Ally, the Target compares the payoffs expected from making each choice given her knowledge of previous moves and her prediction about the Ally's behavior. Remember, the Target knows her Ally's costs. If the Ally's war costs fulfill the condition for his cooperation in war ($C_A - D_A \leq \alpha - \beta$), and the Target's expected payoff from fighting a coalition war exceeds her expected payoff from accepting the Challenger's demands ($\alpha - C_T - \mu > \chi - \mu$), then she will *reject* the Challenger's demands and opt for war: if war does not pay enough, then she will *accept* the Challenger's demands and settle the dispute peacefully. Similarly, if the Ally's war cost is high enough to induce him to *defect* ($C_A - D_A > \alpha - \beta$), but the Target's expected payoff when facing the Challenger alone exceeds her expected payoff from accepting the Challenger's demands ($\beta - C_T - \mu > \chi - \mu$), then she will *reject* the Challenger's demands and fight: if such a war is too costly, then she will *accept* the Challenger's demands. In sum, the Target's decision here is one between war and peace given her knowledge of her Ally's intent to participate and the costs of war.

In the action prior, the Challenger, endeavoring to redress a grievance or perceived imbalance, makes his demands $(1 - \chi)$. If he asks for too little, he leaves potential gains on the negotiating table; if he asks for too much, he risks war. The Challenger with complete information can perfectly calibrate his demands to extract the maximum possible concessions from his opponent(s) and mitigate the risk of war. He does this by proposing a resolution to the disputed issue $(\chi)$ to which the Target is indifferent between accepting the Challenger's proposal, resulting in a peaceful settlement, and rejecting it, leading to battle $(EU_T(Accept) = EU_T(Reject))$. If the Ally's war cost fulfills the condition for his cooperation in war $(C_A \leq \alpha - \beta + D_A)$, then the Challenger knows he will face a coalition if he demands to much; therefore, the Challenger attunes his demands to the match the value of acceptance with the Target's expected coalition war payoff $(\chi = \alpha - C_T)$. A rational Target will *accept* these demands, war will be avoided, and the Challenger will reap his reward $(EU_C|T(\mathit{Accept}) = 1 - \chi)$. Alternatively, if the Ally's war cost is sufficiently high to keep him out of the fight $(C_A > \alpha - \beta + D_A)$, then the Challenger, knowing he faces the Target alone, equates acceptance with the Target's expected bilateral war payoff $(\chi = \beta - C_T)$ with the same outcome as above $(EU_C|T(\mathit{Accept}) = 1 - \chi)$.

In the game's first action, in anticipation of a challenge, the Target makes an investment in military capability, deciding both the appropriate size of the overall investment $(\mu)$ and its composition of substitute and complementary capability $(\mu = \lambda C_\lambda + \gamma C_\gamma)$. The Target faces a dilemma: the up front cost of military investment $(\mu)$ reduces her expected payoffs while simultaneously increasing her chances of prevailing in combat. She must weigh the marginal cost of each dollar spent on military capability against the marginal benefit it yields on the battlefield and its effect on players' behavior. The Target knows precisely how her investment decisions will influence the behavior of both the Challenger and her Ally. She makes her decisions with knowledge of her Ally's intentions, the probable outcome of any potential conflict, and the Challenger's optimal demands.

### 1.3.1 Key Model Features

Remember, the probability of victory in this model varies according to relative military capability and expectations of Ally cooperation. To start, think of conflict as a contest function where players' military capabilities ($M_i$) proxy for their effort in the contest. A players' chances of success are then determined by their share of the total military capability in play ($\frac{M_i}{\sum_i^n M_i}$). The Target's probability of victory in bilateral war is thus expressed as ($\beta = \frac{M_T}{M_T+M_C}$), and the Allies' combined probability of victory in coalition war is ($\alpha = \frac{M_T+M_A}{M_T+M_A+M_C}$).

A Target has finite resources that she may invest in defense. Her investment ($\mu$) may be divided between technologies that substitute for those of her Ally and improve her unilateral fighting capabilities ($\lambda$) and those that complement the capabilities of her Ally and enhance the military strength of the alliance ($\gamma$). Each capability has an associated cost factor, therefore a Target's defense expenditure is measured as the sum the quantity of each acquired capability multiplied by its cost factor ($\mu = \lambda C_\lambda + \gamma C_\gamma$).

Any military investment or additional participation increases the probability of success for both the Target and the alliance. Importantly, however, the degree to which any particular investment increases overall fighting capacity depends upon whether the Target fights alone or with her Ally and how the Target chooses to invest. For the Target fighting alone, defense spending yields a corresponding increase in her share of the total military capability and a proportional increase in her probability of unilateral victory ($\mu = \lambda C_\lambda + \gamma C_\gamma$ yields $\beta' = \frac{M_T+\lambda+\gamma}{M_T+\lambda+\gamma+M_C} > \frac{M_T}{M_T+M_C} = \beta$). Alternatively, the Target who fights alongside her Ally may increase allied fighting capacity by a greater margin than the value of her investment if she procures military technologies that complement the Ally's capabilities. Therefore, complementary capability ($\gamma$) is assigned a positive weight ($\omega > 1$) when the allies fight together, yielding an outsized increase in the allies' probability of victory (the same monetary investment $\mu = \lambda C_\lambda + \gamma C_\gamma$ now yields $\alpha' = \frac{M_T+\lambda+M_A+\omega\gamma}{M_T+\lambda+M_A+\omega\gamma+M_C} > \frac{M_T+M_A}{M_T+M_A+M_C} = \alpha$). The optimal investment, then, depends upon its comparative net effects on the probability of victory in war as well as its relative cost.

To better illustrate this concept, consider a Target who is an armored land power, whose military capability focuses on tanks ($M_T$). Suppose her Ally is an also an armored land power ($M_A$). An investment in additional tanks represents a substitute military capability ($\mu = \lambda C_\lambda + 0$). This investment yields additional capability equal to the number of new tanks ($\lambda$). This is true whether or not the Ally participates in the conflict ($\beta' = \frac{M_T+\lambda}{M_T+\lambda+M_C} > \frac{M_T}{M_T+M_C} = \beta$ and $\alpha' = \frac{M_T+\lambda+M_A}{M_T+\lambda+M_A+M_C} > \frac{M_T+M_A}{M_T+M_A+M_C} = \alpha$). Alternatively, suppose the Ally is an air power, with bombers and attack aircraft that can strike deep targets. An investment in mobile air defenses represents a complementary capability designed to help the Ally achieve air superiority and enhance the maneuverability of their combined forces ($\mu = 0 + \gamma C_\gamma$). Indeed, these air defenses will protect a lone Target from attack by enemy aircraft ($\beta' = \frac{M_T+\gamma}{M_T+\gamma+M_C} > \frac{M_T}{M_T+M_C} = \beta$), but they will also enable a greater number of Ally aircraft to penetrate enemy lines than would have in their absence. This investment, therefore, adds value ($\omega$) in excess to the Ally's fighting capability absent the air defenses ($\alpha' = \frac{M_T+\lambda+M_A+\omega\gamma}{M_T+\lambda+M_A+\omega\gamma+M_C} > \frac{M_T+M_A}{M_T+M_A+M_C} = \alpha$). Likewise, revisiting the land power example, suppose the Target invests in common communication technology. This investment represents a complementary capability that will enable the allies to fight together more efficiently. Absent the Ally, this communication capability still enhances the Target's ability to employ and control its forces, but when fighting alongside the Ally, this common communication capability enables the allies to employ their land forces in concert. It helps the allies eliminate redundancy, share intelligence and tactics, and engage more enemy forces, thus gaining efficiencies greater than the value of the equipment on its own.

### 1.4 Results

The complete results of the model are provided in the appendix to this paper. The most interesting results are described below.

***Proposition 1: A Target's best response may be to invest nothing in defense.***

Foregoing defense investment, or *free-riding*, may be a Target's best option, even if a Target or an alliance faces a superior Challenger. Any time the cost of additional military capability exceeds the additional benefits that the expense yields, the Target does best not to invest. For example, a

Challenger's demands may be sufficiently small to warrant acceptance over defense spending, such as a request for a minor policy correction or a public statement. A military buildup would likely be unjustifiable versus granting such small concessions. Or, the Challenger's demands might be quite large, such as ceding territory or fundamentally changing one's government, but the cost of sufficient resources necessary to deter a challenge or achieve a favorable settlement could be even larger.

This result helps explain why certain military alliance members free-ride, and why it is most often the smaller alliance members. A small targeted state may be so assured by its alliance commitments from larger powerful states that it does not feel sufficiently threatened to invest in its own military. That same state may be completely insecure in its alliance commitments, but may also deem a military buildup to be so costly in the face of its powerful neighbor that it would be better to risk making some concessions. A small state's inability to meaningfully alter the military balance of power relative to larger adversaries and allies makes the small state more likely to fulfill this condition.

***Proposition 2: A Target's best response may be to spend positively on defense.***

Instead, it may be in a Target's best interest to spend on defense. A Target or alliance facing an eager Challenger may invest to reduce the Challenger's imminent demands.[5] Contrary to the conditions set forth in proposition 1, when an investment in defense yields benefits that exceed its cost, then the Target does best by investing in such military capability that maximizes this difference. When partnered with a cooperative Ally, the Target's optimal investment is in complementary capability whenever the added benefit of that capability relative to any substitute capability ($\omega$) exceeds any additional cost ($C_\gamma - C_\lambda$). She may acquire a capability that exploits a critical vulnerability of the Challenger, or instead procure technology that enables an Ally to bring some overwhelming force to bear. If there are multiple possible investments that fulfill this criteria, then the Target does best by opting for the investment whose benefits exceed his costs by the greatest margin. This

[5]Depending on players' risk behavior, a Target may even deter a challenge altogether. Consider a risk averse Challenger who only issues a challenge if he believes he will prevail in conflict. If the Target can invest in sufficient capability to match or exceed the capability of the Challenger, then the Target or the alliance has achieved deterrence and preserved the status quo. In this analysis, however, I assume a risk accepting Challenger.

may mean the best investment is a relative large one. The remainder of the results assume that the conditions of Proposition 2 are met, warranting a positive defense expenditure.

***Proposition 3: Simultaneously investing in both substitute and complementary military capabilities is not a Target's best response.***

The model assumes that Targets have some finite pool of resources available to convert to military capabilities. Each military capability has discrete costs, yields distinct benefits, and is evaluated in the context of a specific alliance facing a particular Challenger. One might assume that some combination of capabilities yields the greatest benefit and ultimately the most utility; however, as demonstrated in proposition 3, alternative investments most often yield disparate values, and the Target does best to invest all of her available resources in the capability of highest value. Any resources diverted to a capability of lower value sacrifices the additional utility that the higher value investment would provide. For example, a Target fighting alongside her Ally does best to invest in substitutes only if the cost of substitute capability relative to complementary capability exceeds the weight assigned to complements; otherwise, she does best to invest in complementary capability. Even if the two alternatives have equal cost, the weight assigned to complements makes their investment the better choice. Similarly, a Target fighting alone does best to invest in substitute capability when the cost factor of complements exceeds the cost factor of substitutes by a greater margin than their individual utilities. If substitutes are more expensive in relative terms, then the Target does best to invest in complements. If the two costs are equal, then the Target is technically indifferent, but, as the next proposition demonstrates, she may do best by investing a sufficient amount in complementary capability to induce her Ally to cooperate.

### 1.4.1 Comparative Statics

Further analysis comparing the Target's equilibrium defense spending choices yields interesting and at times counterintuitive behavior and outcomes.

***Proposition 4: A smaller defense expenditure may increase the expected utility of a Target and her Ally by a greater margin than would a larger defense expenditure.***

Similar to the free-riding result described in *Proposition 1*, a Target's best option may be to make a small defense expenditure rather than a larger one. There are numerous possible investments that meet this criteria. Because it is difficult to generalize any specific military capability as being purely complementary or strictly a substitute outside the context of a specific alliance and conflict, we cannot say that complementary capabilities are necessarily less expensive than substitute capabilities or vice versa. Also, we cannot say that more expensive capabilities necessarily yield greater military advantages than do cheaper ones. An extremely expensive aircraft carrier may yield the greatest advantage in one situation as a complement to an ally's ground forces against a coastal Challenger. Elsewhere, a less expensive squadron of aerial refuelers may provide the greatest advantage by enabling an inland air force with extended ranges and longer loiter times. The same aircraft carrier might instead represent a substitute capability in an alliance with a island-based naval power, or it might even be useless in a confrontation against a different, land-locked Challenger. The specific context of a Target's military investment with regard to both the Ally and the Challenger determines the extent to which defense spending augments fighting capability, and the Target need not pursue the most expensive technologies in the greatest quantities to address her security needs.

In this model, for a Target fighting alone, if the military capability with the lower cost factor yields greater or equal military benefits, or if the difference in cost factors is large enough to offset the difference in military benefits, then the Target does better to make the smaller investment. For a Target fighting with her Ally, any investment in complementary capability is positively weighted, providing military gains greater than the value of the investment alone. Therefore, a Target investing in complementary capability, fighting alongside her ally, has the greatest potential to make gains in military capability at lower cost.

***Proposition 5: A Target may influence an Ally to defect through excess spending on substitute military capability. A Target may influence an Ally to cooperate through sufficient spending on complementary capability.***

Every decision in the game tree requires that players consider their probability of victory in war.

Given that military investments act directly on the probability of victory in war, and in different proportions, the Target's spending decision is decisive in shaping players' subsequent decisions. Additionally, the Ally's decision whether or not to participate looms large in the outcome of conflict, potentially adding sizeable military capability in opposition to the Challenger. A target, in this model, may invest enough to change his Ally's optimal action and earn them both a more favorable payoff.

Consider a Target, who at the start of the game, prior to making an investment, expects that she will fight alongside her Ally, due to the Ally's low cost of fighting or high cost of defection. The Ally's threshold cost for defecting is relative; it is determined from the Ally's understanding of his probability of prevailing in combat. Any Target investment in military capability increases both the Target's and the Ally's chances of victory. A Target investment in substitute capabilities, however, increases the proportion of total fighting capability wielded by the Target alone, making the Ally's participation less valuable in relative terms. The marginal benefit that the Ally expects to receive when fighting alongside the Target is reduced when the Target is made stronger. If the Target is made strong enough, than the additional benefit the Ally expects to earn from participating in a war may no longer be worth the anticipated cost. Therefore the Target, expecting to fight alongside her Ally at the game's start, may induce her Ally to defect by investing too much in substitute capability.

Conversely, a Target investment that can increase the chances of an allied victory by more than it increases the chances of a unilateral Target victory makes defection more costly, which in turn makes cooperation more valuable. Investments in complementary capability not only increase the allies' probability of victory, the weight assigned to complementary capability makes the Ally's participation more valuable. Therefore, a Target expecting to fight alone at the game's start, may invest enough in complementary capability to induce her Ally to cooperate by increasing the value of the Ally's cooperation and increasing the cost of defection in relative terms.

### 1.5 Discussion

With the above results, we can describe optimal behavior for allied states in a variety of circumstances. In many cases, the Target's spending decision will have no effect on her Ally's actions. Consider a small Target, with relatively limited capacity for generating military power, in an asymmetric alliance in which her Ally wields the preponderance of military power. A relatively weak Target does best to prioritize actions that preserve and motivate Ally cooperation. In such an alliance, however, a Target's defense spending will have the least effect on the balance of military power, and thus the rarest opportunity to influence players' expected payoffs at the margins. A particularly weak Target may choose to forego any defense expenditure at all, finding advanced military technologies cost prohibitive and additional conventional, low-technologies negligible in value. When it is in a Target's best interest to spend on defense, she often does best by selecting a low-cost complementary capability that fulfills a vital role for the Ally. If the Ally's cooperation is assured, either by low cost of power projection or the importance of the disputed issue, then the investment in complementary capability yields synergistic benefits to the alliance. If instead the Ally is certain to defect, an investment in complementary capability still yields military advantages commensurate with the value of the investment. If the Ally's expected war cost is close enough to his threshold cost for defecting from his alliance commitment, then the Target's expenditure on complementary capability can influence her Ally to cooperate in conflict. Only when the Ally is sure to defect, and when the cost of redundant, substitute capability is less than the cost of comparable complements, does the Target do best by investing in substitute capability.

Alternatively, as military power and potential are distributed more equitably among alliance members, the Target obtains more agency over the decisions of other players. When the Target's share of the total military force increases, she gains greater ability to affect the expected utility of the other players at the margins. Many of the actions that best serve weak Targets continue to serve stronger Targets well. If a strong Target identifies a low-cost complementary capability that enhances the capabilities of her Ally, then this will often be her best investment. If the Ally's cooperation is assured, then the investment in complementary capability, again, affords disproportionate gains to the allies. A stronger Target, with greater ability to muster resources for investment in complementary capability, has greater ability to motivate his Ally's cooperation in war through spending. Only when the Target can raise greater military capability through investing in cheap substitutes compared to that which he expects to receive from his Ally if alternatively investing in complements does the Target do best by investing in substitute capability. In doing so, she may even motivate her otherwise cooperative Ally to defect.

It is easy to accept that a Target would want to induce the cooperation of an Ally; after all, the allies chances of victory are greater if they fight together. It is perhaps unclear why a Target would motivate an Ally to defect. This option is potentially optimal for stronger Targets who are able to generate greater military capability than they expect to receive from an Ally. Such Targets could be said to favor autonomy over security. Thus, a Target may spend and push an Ally out of participation in a conflict to dissuade him from muddling a post-conflict settlement over political differences. This issue has been studied elsewhere (Morrow 1991), and the conclusions presented here comport with prior results and further our understanding of asymmetric alliance relations. Some may find it unsatisfactory that, in this model, a Challenger is always able to extract some form of concessions from the Target or the alliance. A simple modification might introduce a measure of risk tolerance for the Challenger based upon relative military capability, which, if exceeded, would deter the Challenger from demanding concessions from the Target. Doing so would bound the upper limits of expenditure for the Target and expand the circumstances in which her best option is to spend, but it would not substantively change the results presented above. A fruitful area of future research would be to relax the condition of complete information, following the prevailing trend in crisis bargaining models. Introducing uncertainty about the Ally's war cost and thus his resolve to fight would induce a reinterpretation of the Target's defense spending decision as a signal and undoubtedly make possible a bevy of new equilibrium behaviors, including simultaneous investment in both complementary capability and substitute capability by the Target, miscalculation resulting in sub-optimal demands by the Challenger, and the potential for war in equilibrium. Finally, one might investigate the relationship between defense spending and alliance behavior empirically, drawing upon existing data on defense spending, alliance membership and behavior, and war. This is the topic of the next chapter.

## 1.6 Appendix 1

### 1.6.1 Model Parameters

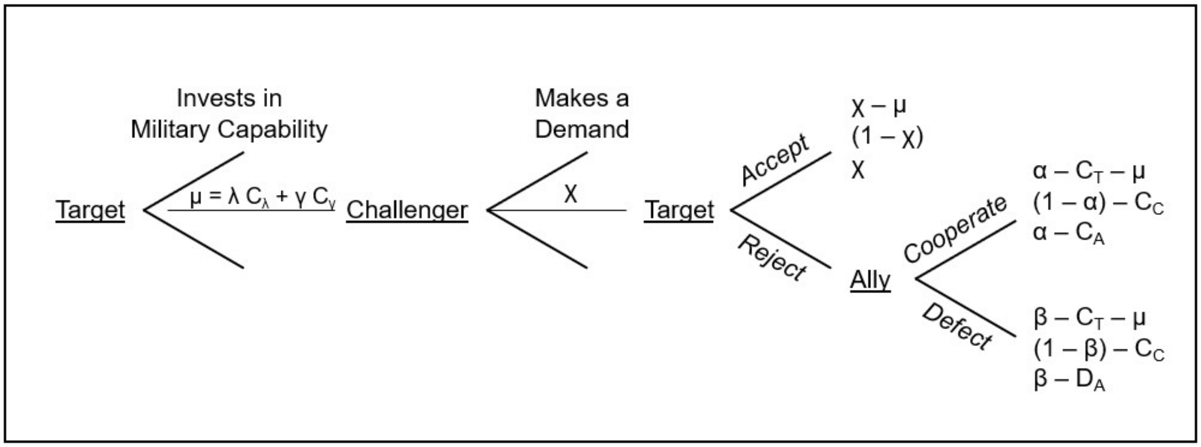



Figure 1.2: Game Tree

$\mu$ is the Target's investment in military capability *(first assume no budget constraint)*,

$\chi$ is the Target's value for the Challenger's demand,

$M_i$ is the military capability of $player_i$, and $C_i$ is the war cost of $player_i$,

$\alpha$ is the probability that the allies prevail in war together,

$\beta$ is the probability that the Target prevails in war alone.

Recall each player's war payoffs are as follows:

$EU_T(CoalitionWar) = \alpha - C_T - \mu$ $\quad$ $EU_T(BilateralWar) = \beta - C_T - \mu$

$EU_C(CoalitionWar) = (1 - \alpha) - C_C$ $\quad$ $EU_C(BilateralWar) = (1 - \beta) - C_C$

$EU_A(CoalitionWar) = \alpha - C_A$ $\quad$ $EU_A(BilateralWar) = \beta - D_A$

$\lambda$ is a quantity of substitute military capability, and $C_\lambda$ is the cost of substitute military capability,

$\gamma$ is a quantity of complementary military capability, and $C_\gamma$ is the cost of complements,

$\omega$ is a weight assigned to complementary capability when the allies fight together.

The Target's probability of victory in war given possible investments are as follows:

Given $\mu = 0$, $\alpha = \frac{M_T+M_A}{M_C+M_T+M_A}$, $\beta = \frac{M_T}{M_C+M_T}$ .

Given $\mu = \lambda C_\lambda$, $\alpha = \frac{M_T+M_A+\lambda}{M_C+M_T+M_A+\lambda}$, $\beta = \frac{M_T+\lambda}{M_C+M_T+\lambda}$.

Given $\mu = \gamma C_\gamma$, $\alpha = \frac{M_T+M_A+\omega\gamma}{M_C+M_T+M_A+\omega\gamma}$, $\beta = \frac{M_T+\gamma}{M_C+M_T+\gamma}$.

Given $\mu = \lambda C_\lambda + \gamma C_\gamma$, $\alpha = \frac{M_T+M_A+\omega\gamma+\lambda}{M_C+M_T+M_A+\omega\gamma+\lambda}$, $\beta = \frac{M_T+\gamma+\lambda}{M_C+M_T+\gamma+\lambda}$.

Ally's Marginal Benefit of Participation in Conflict:

If Target invests nothing in defense: $\mu = 0$

$$\alpha_0 = \frac{M_T+M_A}{M_C+M_T+M_A}, \qquad \beta_0 = \frac{M_T}{M_C+M_T}$$

$$\alpha_0 - \beta_0 = \frac{M_T+M_A}{M_C+M_T+M_A} - \frac{M_T}{M_C+M_T}$$

$$\alpha_0 - \beta_0 = \frac{(M_T+M_A)(M_C+M_T)-M_T(M_C+M_T+M_A)}{(M_C+M_T+M_A)(M_C+M_T)}$$

$$\alpha_0 - \beta_0 = \frac{M_A M_C}{M_C^2+2M_C M_T+M_C M_A+M_T^2+M_T M_A}$$

If Target invests only in **substitute** capability: $\mu' = \lambda C_\lambda$

$$\alpha' = \frac{M_T+M_A+\lambda}{M_C+M_T+M_A+\lambda}, \qquad \beta' = \frac{M_T+\lambda}{M_C+M_T+\lambda}$$

$$\alpha' - \beta' = \frac{M_T+M_A+\lambda}{M_C+M_T+M_A+\lambda} - \frac{M_T+\lambda}{M_C+M_T+\lambda}$$

$$\alpha' - \beta' = \frac{(M_T+M_A+\lambda)(M_C+M_T+\lambda)-(M_T+\lambda)(M_C+M_T+M_A+\lambda)}{(M_C+M_T+M_A+\lambda)(M_C+M_T+\lambda)}$$

$$\alpha' - \beta' = \frac{M_A M_C}{(M_C^2+2M_C M_T+M_C M_A+M_T^2+M_T M_A)+(M_C\lambda+M_T\lambda+M_A\lambda+M_C\lambda+M_T\lambda+\lambda^2)}$$

If Target invests only in **complementary** capability and Ally *defects*: $\mu'' = \gamma C_\gamma$

$$\alpha'' = \frac{M_T+M_A+\gamma}{M_C+M_T+M_A+\gamma}, \qquad \beta'' = \frac{M_T+\gamma}{M_C+M_T+\gamma}$$

$$\alpha'' - \beta'' = \frac{M_T+M_A+\gamma}{M_C+M_T+M_A+\gamma} - \frac{M_T+\gamma}{M_C+M_T+\gamma}$$

$$\alpha'' - \beta'' = \frac{(M_T+M_A+\gamma)(M_C+M_T+\gamma)-(M_T+\gamma)(M_C+M_T+M_A+\gamma)}{(M_C+M_T+M_A+\gamma)(M_C+M_T+\gamma)}$$

$$\alpha'' - \beta'' = \frac{M_A M_C}{(M_C^2+2M_C M_T+M_C M_A+M_T^2+M_T M_A)+(M_C\gamma+M_T\gamma+M_A\gamma+M_C\gamma+M_T\gamma+\gamma^2)}$$

If Target invests only in **complementary** capability and Ally *cooperates*: $\mu'' = \gamma C_\gamma$

$$\alpha'' = \frac{M_T+M_A+\omega\gamma}{M_C+M_T+M_A+\omega\gamma}, \qquad \beta'' = \frac{M_T+\gamma}{M_C+M_T+\gamma}$$

$$\alpha'' - \beta'' = \frac{M_T+M_A+\omega\gamma}{M_C+M_T+M_A+\omega\gamma} - \frac{M_T+\gamma}{M_C+M_T+\gamma}$$

$$\alpha'' - \beta'' = \frac{(M_T+M_A+\omega\gamma)(M_C+M_T+\gamma)-(M_T+\gamma)(M_C+M_T+M_A+\omega\gamma)}{(M_C+M_T+M_A+\omega\gamma)(M_C+M_T+\gamma)}$$

$$\alpha'' - \beta'' = \frac{M_A M_C+\gamma M_C(\omega-1)}{(M_C^2+2M_C M_T+M_C M_A+M_T^2+M_T M_A)+(M_C\gamma+M_T\gamma+M_A\gamma+\omega\gamma M_C+\omega\gamma M_T+\omega\gamma^2)}$$

The Target's optimum investment in military capability maximizes the Target's expected utility. Given Ally *cooperation*, if the Target's optimal investments are as follows:

If Target invests in **complementary** capability:

$$EU_T(\mu=\gamma C_\gamma)=\frac{M_T+M_A+\omega\gamma}{M_C+M_T+M_A+\omega\gamma}-C_T-\gamma C_\gamma,$$
$$\frac{\delta}{\delta\gamma}\left(\frac{M_T+M_A+\omega\gamma}{M_C+M_T+M_A+\omega\gamma}-C_T-\gamma C_\gamma\right)=0,$$
$$\frac{\omega(M_C+M_T+M_A+\omega\gamma)-\omega(M_T+M_A+\omega\gamma)}{(M_C+M_T+M_A+\omega\gamma)^2}-C_\gamma=0,$$
$$\frac{\omega M_C}{(M_C+M_T+M_A+\omega\gamma)^2}-C_\gamma=0,$$
$$\gamma=\frac{\sqrt{\frac{\omega M_C}{C_\gamma}}-M_C-M_T-M_A}{\omega}$$

If Target invests in **substitute** capability:

$$EU_T(\mu=\lambda C_\lambda)=\frac{M_T+M_A+\lambda}{M_C+M_T+M_A+\lambda}-C_T-\lambda C_\lambda,$$
$$\frac{\delta}{\delta\lambda}\left(\frac{M_T+M_A+\lambda}{M_C+M_T+M_A+\lambda}-C_T-\lambda C_\lambda\right)=0,$$
$$\frac{(M_C+M_T+M_A+\lambda)-(M_T+M_A+\lambda)}{(M_C+M_T+M_A+\lambda)^2}-C_\lambda=0,$$
$$\frac{M_C}{(M_C+M_T+M_A+\lambda)^2}-C_\lambda=0,$$
$$\lambda=\sqrt{\frac{M_C}{C_\lambda}}-M_C-M_T-M_A$$

Target's utility if she invests in **complementary** capability ($\mu=\gamma C_\gamma$) and Ally *cooperates*:

$$\frac{\sqrt{\frac{\omega M_C}{C_\gamma}}-M_C}{\sqrt{\frac{\omega M_C}{C_\gamma}}}-C_T-\frac{C_\gamma}{\omega}\left(\sqrt{\frac{\omega M_C}{C_\gamma}}-M_C-M_T-M_A\right)=1-2\sqrt{M_C}\frac{\sqrt{C_\gamma}}{\sqrt{\omega}}-C_T+\frac{C_\gamma}{\omega}M_C+\frac{C_\gamma}{\omega}M_T+\frac{C_\gamma}{\omega}M_A$$

Target's expected utility if she invests in **substitute** capability ($\mu=\lambda C_\lambda$) and Ally *cooperates*:

$$\frac{\sqrt{\frac{M_C}{C_\lambda}}-M_C}{\sqrt{\frac{M_C}{C_\lambda}}}-C_T-C_\lambda\left(\sqrt{\frac{M_C}{C_\lambda}}-M_C-M_T-M_A\right)=1-2\sqrt{M_C}\sqrt{C_\lambda}-C_T+C_\lambda M_C+C_\lambda M_T+C_\lambda M_A$$

Given Ally *defection*, if the Target's optimal investments are as follows:

If Target invests in **complementary** capability:

$$EU_T(\mu=\gamma C_\gamma)=\frac{M_T+\gamma}{M_C+M_T+\gamma}-C_T-\gamma C_\gamma,$$
$$\frac{\delta}{\delta\lambda}\left(\frac{M_T+\gamma}{M_C+M_T+\gamma}-C_T-\gamma C_\gamma\right)=0,$$
$$\frac{(M_C+M_T+\gamma)-(M_T+\gamma)}{(M_C+M_T+\gamma)^2}-C_\gamma=0$$
$$\gamma=\sqrt{\frac{M_C}{C_\gamma}}-M_C-M_T$$

If Target invests in **substitute** capability:

$$EU_T(\mu=\lambda C_\lambda)=\frac{M_T+\lambda}{M_C+M_T+\lambda}-C_T-\lambda C_\lambda$$
$$\frac{\delta}{\delta\lambda}\left(\frac{M_T+\lambda}{M_C+M_T+\lambda}-C_T-\lambda C_\lambda\right)=0,$$
$$\frac{(M_C+M_T+\lambda)-(M_T+\lambda)}{(M_C+M_T+\lambda)^2}-C_\lambda=0,$$
$$\lambda=\sqrt{\frac{M_C}{C_\lambda}}-M_C-M_T$$

Target's utility if she invests in **complementary** capability ($\mu=\gamma C_\gamma$) and Ally *defects*:

$$\frac{\sqrt{\frac{M_C}{C_\gamma}}-M_C}{\sqrt{\frac{M_C}{C_\gamma}}}-C_T-C_\gamma\left(\sqrt{\frac{M_C}{C_\gamma}}-M_C-M_T\right)\quad=\quad1-2\sqrt{M_C}\sqrt{C_\gamma}-C_T+C_\gamma M_C+C_\gamma M_T$$

Target's expected utility if she invests in **substitute** capability ($\mu=\lambda C_\lambda$) and Ally *defects*:

$$\frac{\sqrt{\frac{M_C}{C_\lambda}}-M_C}{\sqrt{\frac{M_C}{C_\lambda}}}-C_T-C_\lambda\left(\sqrt{\frac{M_C}{C_\lambda}}-M_C-M_T\right)\quad=\quad1-2\sqrt{M_C}\sqrt{C_\lambda}-C_T+C_\lambda M_C+C_\lambda M_T$$

### 1.6.2 Formal Theory Proofs

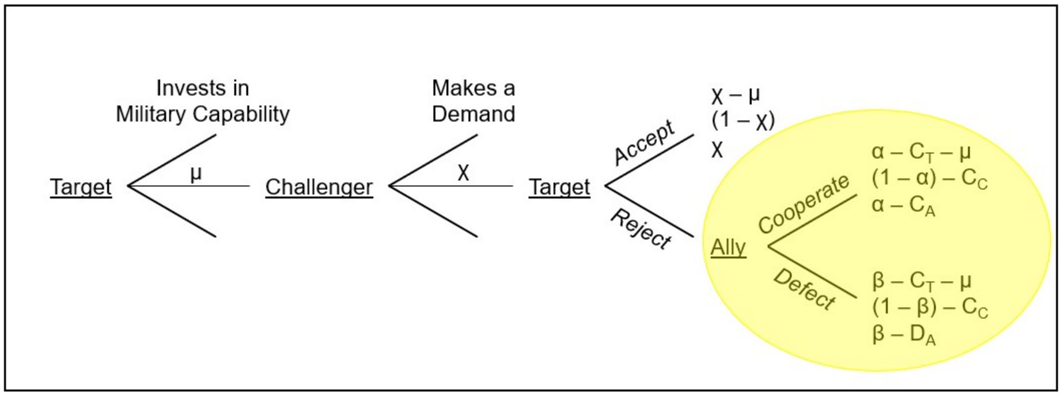



Figure 1.3: Ally's Cooperate/Defect Decision Node

***Lemma 1:*** **It is a best response for the Ally to *cooperate* if and only if $\alpha - \beta \geq C_A - D_A$.**

This complete information model can be solved through backward induction. Beginning with the final decision, the Ally must decide whether to *cooperate* in conflict or *defect* from his alliance commitment. If the Ally chooses to *cooperate*, then he earns payoff equal to the probability of allied victory in war minus his war cost ($\alpha - C_A$). If the Ally chooses to *defect*, then he earns a payoff equal to the probability of unilateral Target victory minus the Ally's cost for failing to honor his commitment ($\beta - D_A$). The Ally, being a rational player, will choose the option that yields the highest payoff. Given that the Target would always prefer that the Ally choose to *cooperate*, holding all else equal, I assume that when the Ally is indifferent, as when the expected payoff for choosing to *cooperate* equals his expected payoff for choosing to *defect*, he chooses to *cooperate*. Taking $\lambda$ and $\gamma$ as given, comparing payoffs yields the following:

Ally will *cooperate* when $\alpha - C_A \geq \beta - D_A$. Ally will *defect* when $\alpha - C_A < \beta - D_A$.

Rearranging terms reveals that the Ally will cooperate when his participation yields an improvement in the probability of victory (Ally's marginal benefit of choosing to *cooperate*) that exceeds the additional cost he will incur by fighting (Ally's marginal cost of *cooperating)*:

Ally will *cooperate* when $\alpha - \beta \geq C_A - D_A$. Ally will *defect* when $\alpha - \beta < C_A - D_A$.

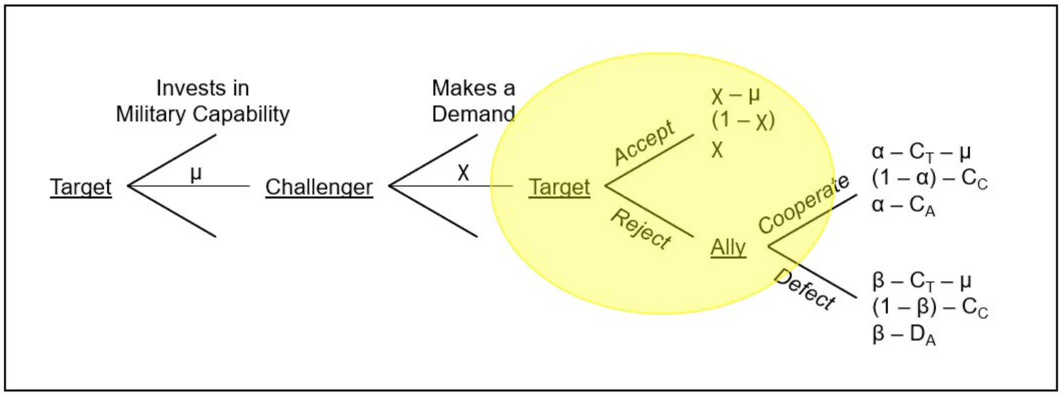



Figure 1.4: Target's Accept/Reject Decision Node

***Lemma 2.1:*** **If the condition for Ally *cooperation* (Lemma 1) is met, the Target will choose to *accept* the Challenger's demands ($\chi$) if and only if $\chi \geq \alpha - C_T$.**

***Lemma 2.2:*** **If the condition for Ally *cooperation* (Lemma 1) is NOT met, the Target will choose to *accept* the Challenger's demands ($\chi$) if and only if $\chi \geq \beta - C_T$.**

In the preceding decision, the Target must choose whether to *accept* or *reject* the Challenger's proposed settlement of terms ($\chi$). If the Target chooses to *accept*, then she earns the portion of the disputed issue offered to her by the Challenger minus the cost of any up front investment in military capability ($\chi - \mu$). If the Target chooses to *reject*, then war results. If the Ally's marginal cost warrants a decision to *cooperate* per the condition specified in Lemma 1.1 above ($\alpha - \beta \geq C_A - D_A$), then the Target's expected payoff for fighting alongside her Ally is equal to the allies' combined probability of victory less the Target's war cost and any upfront cost of investment in military capability ($\alpha - C_T - \mu$). If the Ally's marginal cost warrants a decision to *defect* per the condition specified in Lemma 1.1 above ($\alpha - \beta < C_A - D_A$), then the Target's expected payoff for fighting alongside her Ally is equal to her probability of unilateral victory less her war cost and any upfront cost of investment ($\beta - C_T - \mu$). As above, the Target, being a rational player, will choose the option that yields the highest payoff and avoid war by choosing to *accept* when indifferent.

Taking $\lambda$ and $\gamma$ as given , comparing payoffs yields the following for the Target fighting alongside her Ally:

Target will *accept* all offers $\chi - \mu \geq \alpha - C_T - \mu$.     Ally will *reject* all offers $\chi - \mu < \alpha - C_T - \mu$.

Comparing payoffs yields the following for the Target fighting alone:

Target will *accept* all offers $\chi - \mu \geq \beta - C_T - \mu$.     Ally will *reject* all offers $\chi - \mu < \beta - C_T - \mu$.

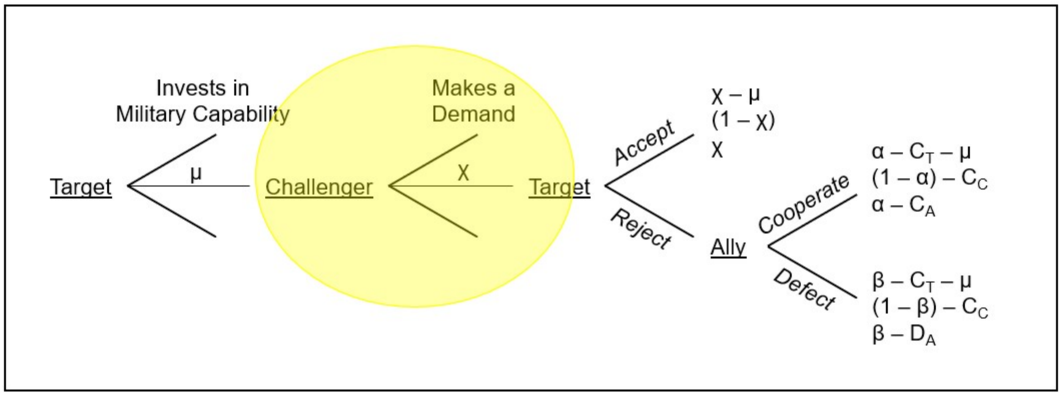



Figure 1.5: Challenger's Demand Decision Node

***Lemma 3.1:*** **If the condition for Ally *cooperation* (Lemma 1) is met, the Challenger's optimal offer is the Target's minimum acceptable offer when fighting with her Ally (Lemma 2.1)** $\chi^* = \alpha - C_T$**.**

***Lemma 3.2:*** **If the condition for Ally *cooperation* (Lemma 1) is NOT met, the Challenger's optimal offer is the Target's minimum acceptable offer when fighting alone (Lemma 2.2)** $\chi^* = \beta - C_T$**.**

The Challenger, acting rationally and with complete information, knows how each player will respond to his demands. He earns the maximum possible payoff from the Target and her Ally by extracting the largest possible concessions while avoiding war. He does this by calibrating his demand to make the Target indifferent between choosing peaceful resolution *accept* and choosing war *reject*.

Comparing payoffs for a Target fighting alongside her Ally, the Target is indifferent when:

$\chi - \mu = \alpha - C_T - \mu$

Comparing payoffs for a Target fighting alone, the Target is indifferent when:

$\chi - \mu = \beta - C_T - \mu$

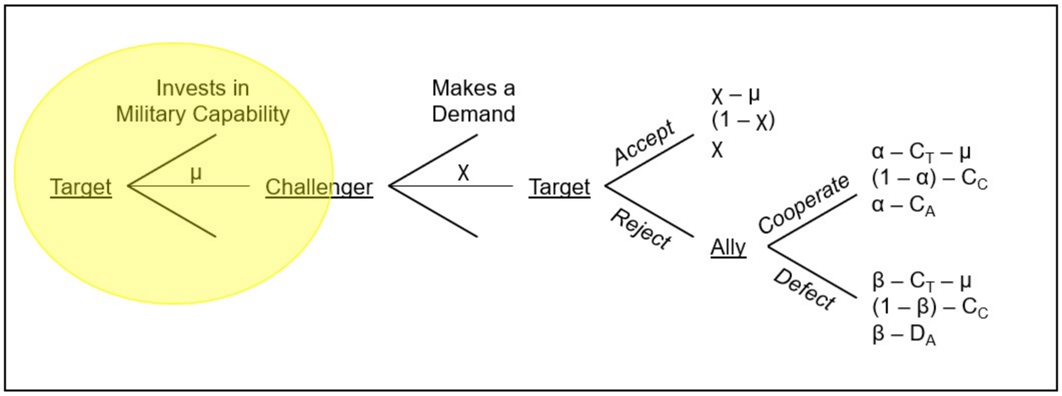



Figure 1.6: Target's Investment Decision Node

***Corollary 1.1:*** **If the condition for Ally *cooperation* (Lemma 1) is met, the Target's best investment ($\mu$) when fighting with her Ally maximizes her value for the allies war payoff ($\alpha - C_T - \mu = \frac{M_T+M_A+\omega\gamma+\lambda}{M_C+M_T+M_A+\omega\gamma+\lambda} - C_T - \lambda C_\lambda - \gamma C_\gamma$).**

***Corollary 1.2:*** **If the condition for Ally *cooperation* (Lemma 1) is NOT met, the Target's best investment ($\mu$) when fighting alone maximizes her value for her unilateral war payoff ($\beta - C_T - \mu = \frac{M_T+\gamma+\lambda}{M_C+M_T+\gamma+\lambda} - C_T - \lambda C_\lambda - \gamma C_\gamma$).**

In the game's first decision, the Target decides what to invest in defense ($\mu = \lambda C_\lambda + \gamma C_\gamma$). She faces a Challenger acting rationally and with complete information who calibrates his demands ($\chi$) to extract the maximum possible concessions by meeting her minimum acceptable offer:

$\chi = \alpha - C_T$ if fighting as allies, or $\chi = \beta - C_T$ if fighting alone

Given that the Target will *accept* such offers in equilibrium, the Target does best by investing ($\mu$) to maximize her expected payoff for choosing to *accept*, (earning $\chi - \mu$)Interestingly, investing in military capability simultaneously improves the terms offered by the Challenger ($\uparrow \chi$) and induces up front costs ($\uparrow \mu$).

***Lemma 4:*** **There is no equilibrium where both $\lambda > 0$ and $\gamma > 0$.**

Suppose the condition for Ally *cooperation* is met ($C_A \leq \alpha - \beta + D_A$). Suppose also this Target invests a positive amount, and splits her investment between both substitute and complementary military capability ($\mu' = \lambda' C_\lambda + \gamma' C_\gamma$). By assumption, complementary capability carries a positive weight ($\omega$) when the allies fight together while substitute capability does not. This investment yields additional military capability ($\lambda' + \omega\gamma'$). In equilibrium, a Challenger with complete information observes this investment and makes an optimal demand ($\chi'$), and the Target accepts, earning payoff ($\chi' - \mu' \quad = \quad \alpha' - C_T - \mu' \quad = \quad \frac{M_T + \lambda' + M_A + \omega\gamma'}{M_C + M_T + \lambda' + M_A + \omega\gamma'} - C_T - \mu'$).

Instead, suppose this Target invests the same positive amount only in complementary military capability ($\mu' = \lambda' C_\lambda + \gamma' C_\gamma = \mu'' = \gamma'' C_\gamma$). This investment thus yields additional military capability ($\omega\gamma''$). Solving this system of equations for the quantity of complementary capability ($\gamma''$) garnered by the investment in only complementary capability ($\mu''$) yields $\gamma'' = \lambda' \frac{C_\lambda}{C_\gamma} + \gamma'$. Comparing the additional military capability yielded by each investment in like terms, investing in both complementary and substitute capabilities yields $\lambda' + \omega\gamma'$ while investing in only complementary capability yields $\omega\lambda' \frac{C_\lambda}{C_\gamma} + \omega\gamma'$. Investing in both complementary and substitute capabilities yields higher payoffs only if the cost of complements relative to substitutes exceeds the weight assigned to complements ($\frac{C_\gamma}{C_\lambda} > \omega$). Otherwise, investing in only complements yields strictly higher payoffs.

Suppose, then, that the relative cost of complements exceeds their weight ($\frac{C_\gamma}{C_\lambda} > \omega$). Now, suppose that the Target invests the same amount, but only in substitute capability ($\mu''' = \lambda''' C_\lambda$). Again, the Target invests the same amount in each case ($\mu' = \mu''' = \lambda' C_\lambda + \gamma' C_\gamma = \lambda''' C_\lambda$). Solving this system of equations for the quantity of substitute capability garnered by the investment in only substitute capability ($\mu'''$) yields $\lambda''' = \lambda' + \gamma' \frac{C_\gamma}{C_\lambda}$. Comparing the additional military capability yielded by each investment in like terms, investing in both complementary and substitute capability yields $\lambda' + \omega\gamma'$ while investing in only substitute capability yields $\lambda' + \gamma'\frac{C_\gamma}{C_\lambda}$. Because we assumed the relative cost of complements exceeds their weight ($\frac{C_\gamma}{C_\lambda} > \omega$), an investment in substitute military capability yields strictly higher payoffs than an equal investment in both complementary and substitute capabilities ($\alpha''' > \alpha'$).

By the definition of best response and the conditions specified above, investing in both complementary and substitute capabilities is not a Target's best response when fighting alongside her Ally.

Now, suppose the condition for Ally *cooperation* is NOT met ($C_A > \alpha - \beta + D_A$). Suppose also this Target invests a positive amount, and splits her investment between both substitute and complementary military capability ($\mu' = \lambda' C_\lambda + \gamma' C_\gamma$). By assumption, neither complementary capability nor substitute capability carries a positive weight when the Target fights alone. This investment thus yields additional military capability ($\lambda' + \gamma'$). In equilibrium, a Challenger with complete information observes this investment and makes an optimal demand ($\chi'$), and the Target *accepts*, earning payoff ($\chi' - \mu' = \beta' - C_T - \mu' = \frac{M_T+\lambda'+\gamma'}{M_C+M_T+\lambda'+\gamma'} - C_T - \mu'$).

Instead, suppose this Target invests the same positive amount only in substitute military capability ($\mu' = \mu'' = \lambda' C_\lambda + \gamma' C_\gamma = \lambda'' C_\lambda$). This investment thus yields additional military capability ($\lambda''$). Solving this system of equations for the quantity of substitute capability garnered by the investment in only complimentary capability ($\mu''$) yields $\lambda'' = \lambda' + \gamma'\frac{C_\gamma}{C_\lambda}$. Comparing the additional military capability yielded by each investment in like terms, investing in both complementary and substitute capabilities yields $\lambda' + \gamma'$ while investing in only substitute capability yields $\lambda' + \gamma'\frac{C_\gamma}{C_\lambda}$. Investing in both complementary and substitute capabilities yields higher payoffs only if the cost of substitutes exceeds the cost of complements ($C_\lambda > C_\gamma$). Otherwise, investing in only substitutes yields strictly higher payoffs.

Suppose, then, that the relative cost of substitutes exceeds the cost of complements ($C_\lambda > C_\gamma$).

Now, suppose that the Target invests the same amount, but only in complementary capability ($\mu' = \mu''' = \lambda' C_\lambda + \gamma' C_\gamma = \gamma''' C_\gamma$). Solving this system of equations for the quantity of substitute capability garnered by the investment in only complementary capability ($\mu'''$) yields $\gamma''' = \lambda' \frac{C_\lambda}{C_\gamma} + \gamma'$. Comparing the additional military capability yielded by each investment in like terms, investing in both complementary and substitute capability yields $\lambda' + \gamma'$ while investing in only complementary capability yields $\lambda' \frac{C_\lambda}{C_\gamma} + \gamma'$. Because we assumed the cost of complements exceeds the cost of substitutes ($C_\lambda > C_\gamma$), an investment in complementary military capability yields strictly higher payoffs than an equal investment in both complementary and substitute capabilities. In the case where cost factors are equal ($C_\lambda = C_\gamma$), the Target is technically indifferent, but may do best to invest in complementary capability to motive her Ally to *cooperate*.

By the definition of best response and the conditions specified above, investing in both complementary and substitute capabilities is not a Target's best response when fighting alone.

***Proposition 1.1:*** **If the condition for Ally *cooperation* is met $\frac{M_A M_C}{(M_C+M_T+M_A)(M_C+M_T)} \geq C_A - D_A$, then there is an equilibrium where both $\lambda = 0$ and $\gamma = 0$ if and only if:**

$$\frac{M_C}{(M_C+M_T+M_A+\lambda)^2} - C_\lambda \leq 0, \quad \text{and}$$
$$\frac{\omega M_C}{(M_C+M_T+M_A+\omega\gamma)^2} - C_\gamma \leq 0.$$

For a direct proof, suppose that the condition for Ally *cooperation* is met in the absence of any Target investment $(\alpha_0 - \beta_0 \geq C_A - D_A)$. Expanding the values of $\alpha_0$ and $\beta$ respectively yields the following: $\frac{M_T+M_A}{M_C+M_T+M_A} - \frac{M_T}{M_C+M_T} \geq C_A - D_A$, or
$$\frac{M_A M_C}{(M_C+M_T+M_A)(M_C+M_T)} \geq C_A - D_A.$$

Consider a Target with complete information who invests nothing in defense ($\mu_0 = 0$). A Challenger with complete information observes this investment and demands the Target's minimum acceptable offer given Ally cooperation ($\chi_0 = \alpha - C_T$), and the Target chooses to *accept*, earning her acceptance payoff, equal to her war payoff given Ally cooperation $(\alpha_0 - C_T - \mu_0 = \frac{M_T+M_A}{M_C+M_T+M_A} - C_T)$. Foregoing investment in military capability is only a best response if the Target cannot do better by deviating and investing a positive amount.

Suppose, instead, the Target invests some positive amount in substitute capability ($\mu' = \lambda C_\lambda$). This decision alters the Target's war payoff given Ally cooperation: ($\alpha' - C_T - \mu' = \frac{M_T+M_A+\lambda}{M_C+M_T+M_A+\lambda} - C_T - \lambda C_\lambda$). This investment decision yields the Target a lower expected utility whenever the first order derivative of the Target's utility function given the investment less than or equal to that given no investment:

$$\frac{\delta}{\delta\lambda}\left(\frac{M_T+M_A+\lambda}{M_C+M_T+M_A+\lambda} - C_T - \lambda C_\lambda\right) \leq 0$$
$$\frac{(M_C+M_T+M_A+\lambda)-(M_T+M_A+\lambda)}{(M_C+M_T+M_A+\lambda)^2} - C_\lambda \leq 0$$
$$\frac{M_C}{(M_C+M_T+M_A+\lambda)^2} - C_\lambda \leq 0.$$

Alternatively, suppose the Target invests in complementary capability ($\mu'' = \gamma C_\gamma$). This decision again alters the Target's war payoff given Ally cooperation:
($\alpha'' - C_T - \mu'' = \frac{M_T+M_A+\omega\gamma}{M_C+M_T+M_A+\omega\gamma} - C_T - \gamma C_\gamma$). As above, this investment decision yields the Target a lower expected utility whenever the first order derivative of the Target's utility function given the investment less than or equal to that given no investment:

$$\begin{aligned}
\frac{\delta}{\delta\gamma}\left(\frac{M_T+M_A+\omega\gamma}{M_C+M_T+M_A+\omega\gamma} - C_T - \gamma C_\gamma\right) &\leq 0\\
\frac{\omega(M_C+M_T+M_A+\omega\gamma)-\omega(M_T+M_A+\omega\gamma)}{(M_C+M_T+M_A+\omega\gamma)^2} - C_\gamma &\leq 0\\
\frac{\omega M_C}{(M_C+M_T+M_A+\omega\gamma)^2} - C_\gamma &\leq 0.
\end{aligned}$$

By the definition of best response and the conditions specified above, it may be a Target's best response to invest nothing in defense. □

***Proposition 1.2:*** **If the condition for Ally *cooperation* is NOT met** $\frac{M_A M_C}{(M_C+M_T+M_A)(M_C+M_T)} < C_A - D_A$**, then there is an equilibrium where both** $\lambda = 0$ **and** $\gamma = 0$ **if and only if:**

$$\frac{M_C}{(M_C+M_T+\lambda)^2} - C_\lambda \leq 0, \quad \text{and}$$
$$\frac{M_C}{(M_C+M_T+\gamma)^2} - C_\gamma \leq 0.$$

For a direct proof, suppose that the condition for Ally *cooperation* is met in the absence of any Target investment ($\alpha_0 - \beta_0 < C_A - D_A$). Expanding the values of $\alpha_0$ and $\beta$ respectively yields the following: $\frac{M_T+M_A}{M_C+M_T+M_A} - \frac{M_T}{M_C+M_T} < C_A - D_A$, or $\frac{M_A M_C}{(M_C+M_T+M_A)(M_C+M_T)} < C_A - D_A$.

Consider a Target with complete information who invests nothing in defense ($\mu_0 = 0$). A Challenger with complete information observes this investment and demands the Target's minimum acceptable offer given Ally defection ($\chi_0 = \beta - C_T$), and the Target chooses to *accept*, earning her acceptance payoff, equal to her war payoff given Ally defection ($\beta - C_T - \mu_0 = \frac{M_T}{M_C+M_T} - C_T$). Foregoing investment in military capability is only a best response if the Target cannot do better by deviating and investing a positive amount.

Suppose, instead, the Target invests some positive amount in substitute capability ($\mu' = \lambda C_\lambda$). This decision alters the Target's war payoff given Ally cooperation: ($\beta' - C_T - \mu' = \frac{M_T+\lambda}{M_C+M_T+\lambda} - C_T - \lambda C_\lambda$). This investment decision yields the Target a lower expected utility whenever the first order derivative of the Target's utility function given the investment less than or equal to that given no investment:

$$\frac{\delta}{\delta\lambda}\left(\frac{M_T+\lambda}{M_C+M_T+\lambda} - C_T - \lambda C_\lambda\right) \leq 0$$
$$\frac{(M_C+M_T+\lambda)-(M_T+\lambda)}{(M_C+M_T+\lambda)^2} - C_\lambda \leq 0$$
$$\frac{M_C}{(M_C+M_T+\lambda)^2} - C_\lambda \leq 0.$$

Alternatively, suppose the Target invests in complementary capability ($\mu'' = \gamma C_\gamma$). This decision again alters the Target's war payoff given Ally cooperation:
($\alpha'' - C_T - \mu'' = \frac{M_T+\gamma}{M_C+M_T+\gamma} - C_T - \gamma C_\gamma$). As above, this investment decision yields the Target a lower expected utility whenever the first order derivative of the Target's utility function given the investment less than or equal to that given no investment:

$$\begin{aligned}
\frac{\delta}{\delta\gamma}\left(\frac{M_T+\gamma}{M_C+M_T+\gamma} - C_T - \gamma C_\gamma\right) &\leq 0 \\
\frac{(M_C+M_T+\gamma)-(M_T+\gamma)}{(M_C+M_T+\gamma)^2} - C_\gamma &\leq 0 \\
\frac{M_C}{(M_C+M_T+\gamma)^2} - C_\gamma &\leq 0.
\end{aligned}$$

By the definition of best response and the conditions specified above, it may be a Target's best response to invest nothing in defense. □

***Proposition 2.1:*** **If the condition for Ally *cooperation* is met $\frac{M_A M_C}{(M_C+M_T+M_A)(M_C+M_T)} \geq C_A - D_A$, then there is an equilibrium where $\gamma > 0$ and $\lambda = 0$ if and only if $\omega \geq \frac{C_\gamma}{C_\lambda}$.** For a direct proof, assume the conditions outlined in Proposition 1 are not met, and a positive investment by the Target is warranted. Equilibrium spending decisions are then determined by identifying the optimal expenditures that maximize the Target's expected utility and then comparing the utility each decision yields.

Given Ally *cooperation*, if the Target invests in **substitute** capability ($\mu = \lambda C_\lambda$), then the Target's optimal expenditure and expected utility are as follows:

$$EU_T = \alpha - C_T - \mu = \frac{M_T+M_A+\lambda}{M_C+M_T+M_A+\lambda} - C_T - \lambda C_\lambda$$

$$\frac{\delta}{\delta\lambda}\left(\frac{M_T+M_A+\lambda}{M_C+M_T+M_A+\lambda} - C_T - \lambda C_\lambda\right) = 0, \qquad \frac{(M_C+M_T+M_A+\lambda)-(M_T+M_A+\lambda)}{(M_C+M_T+M_A+\lambda)^2} - C_\lambda = 0$$

$$\lambda = \sqrt{\frac{M_C}{C_\lambda}} - M_C - M_T - M_A$$

$$EU_T = \frac{M_T+M_A+\lambda}{M_C+M_T+M_A+\lambda} - C_T - \lambda C_\lambda$$

$$= \frac{M_T+M_A+\sqrt{\frac{M_C}{C_\lambda}}-M_C-M_T-M_A}{M_C+M_T+M_A+\sqrt{\frac{M_C}{C_\lambda}}-M_C-M_T-M_A} - C_T - C_\lambda\left(\sqrt{\frac{M_C}{C_\lambda}} - M_C - M_T - M_A\right)$$

$$= 1 - 2\sqrt{M_C}\sqrt{C_\lambda} - C_T + C_\lambda M_C + C_\lambda M_T + C_\lambda M_A$$

Given Ally *cooperation*, if the Target invests in **complementary** capability ($\mu = \gamma C_\gamma$), then the Target's optimal expenditure and expected utility are as follows:

$$EU_T = \alpha - C_T - \mu = \frac{M_T+M_A+\omega\gamma}{M_C+M_T+M_A+\omega\gamma} - C_T - \gamma C_\gamma$$

$$\frac{\delta}{\delta\gamma}\left(\frac{M_T+M_A+\omega\gamma}{M_C+M_T+M_A+\omega\gamma} - C_T - \gamma C_\gamma\right) = 0, \qquad \frac{(M_C+M_T+M_A+\omega\gamma)-(M_T+M_A+\omega\gamma)}{(M_C+M_T+M_A+\omega\gamma)^2} - C_\gamma = 0$$

$$\gamma = \frac{\sqrt{\frac{\omega M_C}{C_\gamma}}-M_C-M_T-M_A}{\omega}$$

$$EU_T = \frac{M_T+M_A+\omega\gamma}{M_C+M_T+M_A+\omega\gamma} - C_T - \gamma C_\gamma$$

$$= \frac{M_T+M_A+\sqrt{\frac{\omega M_C}{C_\gamma}}-M_C-M_T-M_A}{M_C+M_T+M_A+\sqrt{\frac{\omega M_C}{C_\gamma}}-M_C-M_T-M_A} - C_T - C_\gamma\left(\frac{\sqrt{\frac{\omega M_C}{C_\gamma}}-M_C-M_T-M_A}{\omega}\right)$$

$$= 1 - 2\sqrt{M_C}\sqrt{\frac{C_\gamma}{\omega}} - C_T + \frac{C_\gamma}{\omega}M_C + \frac{C_\gamma}{\omega}M_T + \frac{C_\gamma}{\omega}M_A$$

Comparing expected utilities, investing in complementary capability ($\mu = \gamma C_\gamma$) yields equal or greater utility whenever the weight assigned to complementary capability meets or exceeds the ratio of the cost of complements to the cost of substitutes ($\omega \geq \frac{C_\gamma}{C_\lambda}$). □

***Proposition 2.2:*** **If the condition for Ally *cooperation* is NOT met** $\frac{M_A M_C}{(M_C+M_T+M_A)(M_C+M_T)} < C_A - D_A$**, then there is an equilibrium where** $\gamma > 0$ **and** $\lambda = 0$ **if and only if** $C_\gamma \leq C_\lambda$**.**

Given Ally *defection*, if the Target invests in **substitute** capability ($\mu = \lambda C_\lambda$), then the Target's optimal expenditure and expected utility are as follows:

$$EU_T = \beta - C_T - \mu = \frac{M_T+\lambda}{M_C+M_T+\lambda} - C_T - \lambda C_\lambda$$

$$\frac{\delta}{\delta\lambda}\left(\frac{M_T\lambda}{M_C+M_T+\lambda} - C_T - \lambda C_\lambda\right) = 0, \qquad \frac{(M_C+M_T+\lambda)-(M_T+\lambda)}{(M_C+M_T+\lambda)^2} - C_\lambda = 0$$

$$\lambda = \sqrt{\frac{M_C}{C_\lambda}} - M_C - M_T$$

$$EU_T = \frac{M_T+\lambda}{M_C+M_T+\lambda} - C_T - \lambda C_\lambda$$

$$= \frac{M_T+\sqrt{\frac{M_C}{C_\lambda}}-M_C-M_T}{M_C+M_T+\sqrt{\frac{M_C}{C_\lambda}}-M_C-M_T} - C_T - C_\lambda\left(\sqrt{\frac{M_C}{C_\lambda}} - M_C - M_T\right)$$

$$= 1 - 2\sqrt{M_C}\sqrt{C_\lambda} - C_T + C_\lambda M_C + C_\lambda M_T$$

Given Ally *defection*, if the Target invests in **complementary** capability ($\mu = \gamma C_\gamma$), then the Target's optimal expenditure and expected utility are as follows:

$$EU_T = \beta - C_T - \mu = \frac{M_T+\gamma}{M_C+M_T+\gamma} - C_T - \gamma C_\gamma$$

$$\frac{\delta}{\delta\gamma}\left(\frac{M_T\gamma}{M_C+M_T+\gamma} - C_T - \gamma C_\gamma\right) = 0, \qquad \frac{(M_C+M_T+\gamma)-(M_T+\gamma)}{(M_C+M_T+\gamma)^2} - C_\gamma = 0$$

$$\gamma = \sqrt{\frac{M_C}{C_\gamma}} - M_C - M_T$$

$$EU_T = \frac{M_T+\gamma}{M_C+M_T+\gamma} - C_T - \gamma C_\gamma$$

$$= \frac{M_T+\sqrt{\frac{M_C}{C_\gamma}}-M_C-M_T}{M_C+M_T+\sqrt{\frac{M_C}{C_\gamma}}-M_C-M_T} - C_T - C_\gamma\left(\sqrt{\frac{M_C}{C_\gamma}} - M_C - M_T\right)$$

$$= 1 - 2\sqrt{M_C}\sqrt{C_\gamma} - C_T + C_\gamma M_C + C_\gamma M_T$$

Comparing expected utilities, investing in complementary capability ($\mu = \gamma C_\gamma$) yields equal or greater utility whenever the cost of the optimal investment in substitute capability meets or exceeds the cost of the optimal investment in complementary capability ($C_\gamma \leq C_\lambda$). □

***Proposition 3.1:*** **If the condition for Ally *cooperation* is met** $\frac{M_A M_C}{(M_C+M_T+M_A)(M_C+M_T)} \geq C_A - D_A$**, then there is an equilibrium where** $\lambda > 0$ **and** $\gamma = 0$ **if and only if** $\omega \leq \frac{C_\gamma}{C_\lambda}$**.**

For a direct proof, assume the conditions outlined in Proposition 1 are not met, and a positive investment by the Target is warranted. Equilibrium spending decisions are then determined by identifying the optimal expenditures that maximize the Target's expected utility and then comparing the utility each decision yields.

Given Ally *cooperation*, if the Target invests in **substitute** capability ($\mu = \lambda C_\lambda$), then the Target's optimal expenditure and expected utility are as follows:

$$EU_T = \alpha - C_T - \mu = \frac{M_T+M_A+\lambda}{M_C+M_T+M_A+\lambda} - C_T - \lambda C_\lambda$$

$$\frac{\delta}{\delta\lambda}\left(\frac{M_T+M_A+\lambda}{M_C+M_T+M_A+\lambda} - C_T - \lambda C_\lambda\right) = 0, \qquad \frac{(M_C+M_T+M_A+\lambda)-(M_T+M_A+\lambda)}{(M_C+M_T+M_A+\lambda)^2} - C_\lambda = 0$$

$$\lambda = \sqrt{\frac{M_C}{C_\lambda}} - M_C - M_T - M_A$$

$$EU_T = \frac{M_T+M_A+\lambda}{M_C+M_T+M_A+\lambda} - C_T - \lambda C_\lambda$$

$$= \frac{M_T+M_A+\sqrt{\frac{M_C}{C_\lambda}}-M_C-M_T-M_A}{M_C+M_T+M_A+\sqrt{\frac{M_C}{C_\lambda}}-M_C-M_T-M_A} - C_T - C_\lambda\left(\sqrt{\frac{M_C}{C_\lambda}} - M_C - M_T - M_A\right)$$

$$= 1 - 2\sqrt{M_C}\sqrt{C_\lambda} - C_T + C_\lambda M_C + C_\lambda M_T + C_\lambda M_A$$

Given Ally *cooperation*, if the Target invests in **complementary** capability ($\mu = \gamma C_\gamma$), then the Target's optimal expenditure and expected utility are as follows:

$$EU_T = \alpha - C_T - \mu = \frac{M_T+M_A+\omega\gamma}{M_C+M_T+M_A+\omega\gamma} - C_T - \gamma C_\gamma$$

$$\frac{\delta}{\delta\gamma}\left(\frac{M_T+M_A+\omega\gamma}{M_C+M_T+M_A+\omega\gamma} - C_T - \gamma C_\gamma\right) = 0, \qquad \frac{(M_C+M_T+M_A+\omega\gamma)-(M_T+M_A+\omega\gamma)}{(M_C+M_T+M_A+\omega\gamma)^2} - C_\gamma = 0$$

$$\gamma = \frac{\sqrt{\frac{\omega M_C}{C_\gamma}}-M_C-M_T-M_A}{\omega}$$

$$EU_T = \frac{M_T+M_A+\omega\gamma}{M_C+M_T+M_A+\omega\gamma} - C_T - \gamma C_\gamma$$

$$= \frac{M_T+M_A+\sqrt{\frac{\omega M_C}{C_\gamma}}-M_C-M_T-M_A}{M_C+M_T+M_A+\sqrt{\frac{\omega M_C}{C_\gamma}}-M_C-M_T-M_A} - C_T - C_\gamma\left(\frac{\sqrt{\frac{\omega M_C}{C_\gamma}}-M_C-M_T-M_A}{\omega}\right)$$

$$= 1 - 2\sqrt{M_C}\sqrt{\frac{C_\gamma}{\omega}} - C_T + \frac{C_\gamma}{\omega}M_C + \frac{C_\gamma}{\omega}M_T + \frac{C_\gamma}{\omega}M_A$$

Comparing expected utilities, investing in substitute capability ($\mu = \lambda C_\lambda$) yields equal or greater utility whenever the weight assigned to complementary capability is less than or equal to the ratio of the cost of complements to the cost of substitutes ($\omega \leq \frac{C_\gamma}{C_\lambda}$). □

***Proposition 3.2:*** **If the condition for Ally *cooperation* is NOT met** $\frac{M_A M_C}{(M_C+M_T+M_A)(M_C+M_T)} < C_A - D_A$**, then there is an equilibrium where** $\lambda > 0$ **and** $\gamma = 0$ **if and only if** $C_\lambda \leq C_\gamma$**.**

Given Ally *defection*, if the Target invests in **substitute** capability ($\mu = \lambda C_\lambda$), then the Target's optimal expenditure and expected utility are as follows:

$$EU_T = \beta - C_T - \mu = \frac{M_T+\lambda}{M_C+M_T+\lambda} - C_T - \lambda C_\lambda$$

$$\frac{\delta}{\delta\lambda}\left(\frac{M_T\lambda}{M_C+M_T+\lambda} - C_T - \lambda C_\lambda\right) = 0, \qquad \frac{(M_C+M_T+\lambda)-(M_T+\lambda)}{(M_C+M_T+\lambda)^2} - C_\lambda = 0$$

$$\lambda = \sqrt{\frac{M_C}{C_\lambda}} - M_C - M_T$$

$$EU_T = \frac{M_T+\lambda}{M_C+M_T+\lambda} - C_T - \lambda C_\lambda$$

$$= \frac{M_T+\sqrt{\frac{M_C}{C_\lambda}}-M_C-M_T}{M_C+M_T+\sqrt{\frac{M_C}{C_\lambda}}-M_C-M_T} - C_T - C_\lambda\left(\sqrt{\frac{M_C}{C_\lambda}} - M_C - M_T\right)$$

$$= 1 - 2\sqrt{M_C}\sqrt{C_\lambda} - C_T + C_\lambda M_C + C_\lambda M_T$$

Given Ally *defection*, if the Target invests in **complementary** capability ($\mu = \gamma C_\gamma$), then the Target's optimal expenditure and expected utility are as follows:

$$EU_T = \beta - C_T - \mu = \frac{M_T+\gamma}{M_C+M_T+\gamma} - C_T - \gamma C_\gamma$$

$$\frac{\delta}{\delta\gamma}\left(\frac{M_T\gamma}{M_C+M_T+\gamma} - C_T - \gamma C_\gamma\right) = 0, \qquad \frac{(M_C+M_T+\gamma)-(M_T+\gamma)}{(M_C+M_T+\gamma)^2} - C_\gamma = 0$$

$$\gamma = \sqrt{\frac{M_C}{C_\gamma}} - M_C - M_T$$

$$EU_T = \frac{M_T+\gamma}{M_C+M_T+\gamma} - C_T - \gamma C_\gamma$$

$$= \frac{M_T+\sqrt{\frac{M_C}{C_\gamma}}-M_C-M_T}{M_C+M_T+\sqrt{\frac{M_C}{C_\gamma}}-M_C-M_T} - C_T - C_\gamma\left(\sqrt{\frac{M_C}{C_\gamma}} - M_C - M_T\right)$$

$$= 1 - 2\sqrt{M_C}\sqrt{C_\gamma} - C_T + C_\gamma M_C + C_\gamma M_T$$

Comparing expected utilities, investing in complementary capability ($\mu = \gamma C_\gamma$) yields equal or greater utility whenever the cost of the optimal investment in complementary capability meets or exceeds the cost of the optimal investment in substitute capability ($C_\lambda \leq C_\gamma$). $\square$

**Comparative Statics**

***Proposition 4:* If the condition for Ally *cooperation* is met $\frac{M_A M_C}{(M_C+M_T+M_A)(M_C+M_T)} \geq C_A - D_A$, then there is an equilibrium where the Target invests some amount in complementary capability that yields greater expected utility than would an equal or greater relative investment in substitute capability if and only if $\omega \geq \frac{C_\gamma}{C_\lambda}$.**

For a direct proof, assume the conditions outlined in Proposition 1 are not met, and a positive investment by the Target is warranted. To start, assume that the Target recognizes no possible investment in complementary capability.

Given Ally *cooperation*, if the Target invests in **substitute** capability ($\mu = \lambda C_\lambda$), in equilibrium the Target's optimal investment and resulting expected utility are as follows:

$$\lambda = \sqrt{\frac{M_C}{C_\lambda}} - M_C - M_T - M_A$$

$$EU_T = \alpha - C_T - \mu = \frac{M_T+M_A+\lambda}{M_C+M_T+M_A+\lambda} - C_T - \lambda C_\lambda$$

$$= 1 - 2\sqrt{M_C}\sqrt{C_\lambda} - C_T + C_\lambda M_C + C_\lambda M_T + C_\lambda M_A$$

Alternatively, suppose instead that an opportunity for investment in **complementary** capability does exist. Given Ally *cooperation*, if the Target now invests in **complementary** capability ($\mu = \gamma C_\gamma$), then in equilibrium the Target's optimal investment and resulting expected utility are as follows:

$$\gamma = \frac{\sqrt{\frac{\omega M_C}{C_\gamma}} - M_C - M_T - M_A}{\omega}$$

$$EU'_T = \alpha' - C_T - \mu = \frac{M_T+M_A+\omega\gamma}{M_C+M_T+M_A+\omega\gamma} - C_T - \gamma C_\gamma$$

$$= 1 - 2\sqrt{M_C}\sqrt{\frac{C_\gamma}{\omega}} - C_T + \frac{C_\gamma}{\omega}M_C + \frac{C_\gamma}{\omega}M_T + \frac{C_\gamma}{\omega}M_A$$

Comparing costs and expected utilities, Target investment in complementary capability yields an equal or larger payoff than would a larger investment in substitute capability whenever the investment in complementary capability yields a greater probability of victory ($\frac{M_T+M_A+\omega\gamma}{M_C+M_T+M_A+\omega\gamma} > \frac{M_T+M_A+\lambda}{M_C+M_T+M_A+\lambda}$ at equal or lesser cost ($\gamma C_\gamma \leq \lambda C_\lambda$) compared to an investment in substitute capability. These conditions may be met when the weight assigned to complementary capability exceeds the cost ratio of complements to substitutes ($\omega > \frac{C_\gamma}{C_\lambda}$). □

***Proposition 5a:*** **A Target's defense expenditure may induce an Ally to defect.**

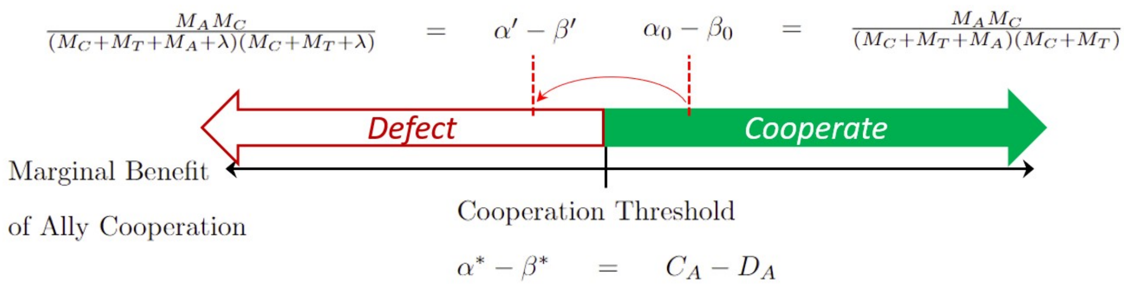



Figure 1.7: Target Investment in **substitute** military capability induces Ally *defection*

For a direct proof, suppose first that a Target invests nothing in defense ($\mu = 0$). Recall from Lemma 1, it is a best response for the Ally to choose to *cooperate* if and only if $\alpha - \beta \geq C_A - D_A$. Therefore, in the absence of any Target investment in military capability, the Ally will *cooperate* whenever:

$$\alpha_0 - \beta_0 \geq C_A - D_A,$$

$$\frac{M_T+M_A}{M_C+M_T+M_A} - \frac{M_T}{M_C+M_T} \geq C_A - D_A,$$

$$\frac{M_A M_C}{(M_C+M_T+M_A)(M_C+M_T)} \geq C_A - D_A.$$

Suppose the Ally's marginal benefit of participating in conflict barely exceeds the threshold for *cooperation*. Now, suppose instead the Target invests some positive amount in **substitute** military capability ($\mu' = \lambda C_\lambda$). This investment increases both the allies probability of victory in war ($\alpha'$) and the Target's unilateral probability of victory in war ($\beta'$) and alters the Ally's decision to *cooperate* whenever:

$$\alpha' - \beta' \geq C_A - D_A,$$

$$\frac{M_T+M_A+\lambda}{M_C+M_T+M_A+\lambda} - \frac{M_T+\lambda}{M_C+M_T+\lambda} \geq C_A - D_A,$$

$$\frac{M_A M_C}{(M_C+M_T+M_A+\lambda)(M_C+M_T+\lambda)} \geq C_A - D_A.$$

From above, the marginal benefit of Ally *cooperation* given an investment in **substitute** capability ($\alpha' - \beta'$) is less than the marginal benefit of Ally *cooperation* absent any investment whenever $\lambda > 0$.

If the reduction in the marginal benefit of Ally participation wrought by the investment in **substitute** military capability is sufficiently large (exceeds the margin by which the benefits of Ally participation outweigh the costs absent any investment), then choosing to *cooperate* is no longer an Ally's best response: $(\alpha_0 - \beta_0) - (\alpha' - \beta') > (\alpha_0 - \beta_0) - (\alpha^* - \beta^*)$. □

***Proposition 5b:*** **A Target's defense expenditure may induce an Ally to cooperate.**

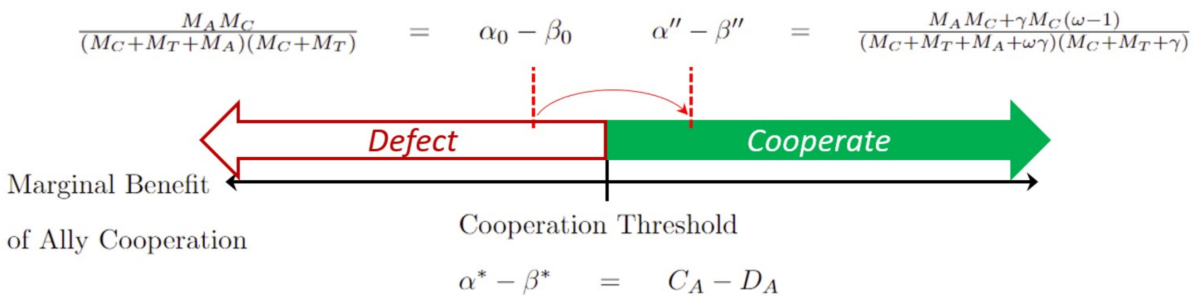



Figure 1.8: Target Investment in **complementary** military capability induces Ally *cooperation*

For a direct proof, suppose first that a Target invests nothing in defense ($\mu = 0$). Recall from Lemma 1, it is a best response for the Ally to choose to *cooperate* if and only if $\alpha - \beta \geq C_A - D_A$. Therefore, in the absence of any Target investment in military capability, the Ally will *cooperate* whenever:

$$\alpha_0 - \beta_0 \geq C_A - D_A,$$

$$\frac{M_T+M_A}{M_C+M_T+M_A} - \frac{M_T}{M_C+M_T} \geq C_A - D_A,$$

$$\frac{M_A M_C}{(M_C+M_T+M_A)(M_C+M_T)} \geq C_A - D_A.$$

Suppose the Ally's marginal benefit of participating in conflict falls just below the threshold for *cooperation*. Now, suppose instead the Target invests some positive amount in **complementary** military capability ($\mu'' = \gamma C_\gamma$). This investment increases both the allies probability of victory in war ($\alpha''$) and the Target's unilateral probability of victory in war ($\beta''$) and alters the Ally's decision to *cooperate* whenever:

$$\alpha'' - \beta'' \geq C_A - D_A,$$

$$\frac{M_T+M_A+\omega\gamma}{M_C+M_T+M_A+\omega\gamma} - \frac{M_T+\gamma}{M_C+M_T+\gamma} \geq C_A - D_A,$$

$$\frac{M_A M_C+\gamma M_C(\omega-1)}{(M_C+M_T+M_A+\omega\gamma)(M_C+M_T+\gamma)} \geq C_A - D_A.$$

From above, the marginal benefit of Ally *cooperation* given an investment in **complementary** capability ($\alpha'' - \beta''$) is greater than the marginal benefit of Ally *cooperation* absent any investment whenever: ($\alpha'' - \beta'' > \alpha_0 - \beta_0$),

$$\frac{M_A M_C+\gamma M_C(\omega-1)}{(M_C+M_T+M_A+\omega\gamma)(M_C+M_T+\gamma)} > \frac{M_A M_C}{(M_C+M_T+M_A)(M_C+M_T)}.$$

If the increase in the marginal benefit of Ally participation wrought by the investment in **complementary** military capability is sufficiently large (exceeds the margin by which the costs of Ally participation outweigh the benefits absent any investment), then choosing to *cooperate* becomes an Ally's best response: $(\alpha'' - \beta'') - (\alpha_0 - \beta_0) > (\alpha^* - \beta^*) - (\alpha_0 - \beta_0)$. $\square$

# CHAPTER 2

## Defense Spending and Alliance Reliability in Times of War and Peace

### 2.1 Introduction

The results of the model presented in the first chapter suggest that defense spending may have a profound influence on the reliability of one's alliance commitments. The amount a state spends on defense and the specific capabilities that it acquires can alter an ally's behavior in the event of war. By investing in redundant substitute capabilities, those that the alliance already possesses in strength, a targeted state reinforces her ally's incentive to defect, and may indeed induce a defection by an ally who would have otherwise come to her aide. Conversely, an investment in complementary capabilities, those that improve the efficiency and interoperability of the alliance, makes one's alliances more reliable, potentially motivating cooperation by an otherwise reluctant partner.

This chapter presents an empirical investigation of the relationship between defense spending and alliance reliability. The purpose is twofold. First, the subsequent analysis endeavors to establish a general understanding of the relationship between defense spending and alliance reliability, drawing upon recent scholarship and the most current and complete sources of military spending and alliance membership data. Second, this research effort seeks to address the results of the model presented in the previous chapter by evaluating the effects of states' defense spending decisions on their alliance commitments in the run up to war. The results indicate that increases in defense spending reduce the reliability of one's alliance commitments, as evidenced by an increase in the incidence of early termination of one's defense pact agreements following periods in increased military spending. This result is consistent across both short term increases in defense spending and longer term trends of increased spending. Conversely, similar increases in defense spending by states targeted for war yield fewer incidents of defection by allies who are obligated to defend them. Together, these results support two interesting conclusions. Alliance relationships are adversely affected by the relative power shifts implied by defense spending; however, when war is on the horizon, the desire for greater allied military force overrides these negative effects.

A direct examination of the results of the formal model presented in the previous chapter requires granular data on the specific content of each state's defense expenditures over time. Each state's military capability would need to be assessed against that of its allies and adversaries to determine if each new investment constitutes a substitute capability or a complementary capability. As described in the previous chapter, such a determination is dependent upon the specific context of each alliance partnership and principal threat. Recently, scholars have made promising progress toward producing more detailed defense spending data, but for current decades (Gannon 2021). The research described below employs the most current defense spending data, but the figures used are aggregate annual measures for each state rather than itemized defense spending budgets. Even a compilation of many available sources that report defense spending data are missing approximately 14% of such annual observations.

In the subsequent sections, I first review relevant scholarship that helped to inform and shape this analysis, identifying prevailing theory in need of update and revision. Next, I describe the research design and data selection and collection decisions made to enable hypothesis testing. I then report the results of the analysis, including checks for the robustness of my findings and extensions to the main analysis. I conclude with a brief discussion of the implication of the results.

### 2.1.1 Arms versus Allies

Most studies addressing both arms and allies together examine the purported trade-off between the two. Waltz (1979) considers the polarity of the international system to be an important determinant of alliance and defense spending behavior, with multipolar systems favoring alliances while bipolar systems favor arming. Christensen and Snyder (1990) contend that a comparison of offensive and defensive advantages better explains the choices states make. Alliances offer a quicker redress of power imbalances, which is more necessary if offensive advantages dominate, whereas defensive advantages afford the opportunity to rebalance more slowly through arming. Altfeld (1984) established that analysis of economic factors reveals optimal choices are made at the margins, with states doing best to pursue whichever capability, arms or allies, produces the greatest marginal benefit at the lowest marginal cost. Morrow (1993) furthers this position, offering that the decision is dynamic. When states exhaust the marginal benefits of the cheapest option, then they do best by switching to another. Collectively, these studies fail to examine how armament and alliance decisions are made simultaneously. We know however, that states continue to allocate resources toward defense while also entering into and maintaining alliance agreements. This study examines how the arms versus allies trade-off functions within alliances after they are formed.

### 2.1.2 Defense Spending in Military Alliances

The study of defense spending within the context of military alliances often addresses the way in which alliance members approach sharing the burdens of collective defense. Scholars have paid particular attention to the causes and consequences of free riding, whereby certain alliance members bear disproportionately large responsibility for the overall security of the alliance while others make little or no contribution to allied defense. Olson and Zeckhauser (1966) wondered why so many of the NATO Alliance's smaller European members contributed comparably less to alliance security than their larger, more distant counterparts when these smaller European Allies in fact faced greater peril due to their proximity to the expected European front. They determined that the public nature of the collective security good and the unequal marginal benefits that accrue to alliance members explain why larger states, who stand to gain and lose more from conflict in absolute terms, make greater relative contributions to collective defense. While many scholars have updated Olson and Zeckhauser's theory since its publication, its main finding continues to hold. Subsequent research has shown that relative state size alone inadequately explains free riding behavior (Plümper & Neumayer 2015), declining hegemony upends burden sharing arrangements (Oneal & Elrod 1989), and private interests and the specific military strategies pursued by states better define member contributions (Murdoch & Sandler 1991). These studies examine the influence of alliance member characteristics on defense spending, whereas this study takes defense spending as its principal independent variable and considers the effects of defense spending on ally behavior.

When research has taken defense spending as a treatment variable, the focus has primarily been on the utility of investing in specialized capabilities. Some argue that the specialization opportunity that alliances provide and the efficiencies it yields are a main driver in the formation of alliance agreements (Lake 1999). Similarly, Gonzales & Mehay (1991) examined defense spending by NATO states over a decade and argued that the specific capabilities that each ally brought to bear motivated cooperation among member states. More recently, Horowitz et al (2017) used data on military conscription to deduce that the effectiveness of certain military capabilities influences states' motivation to form alliances as well as their ability to serve alliance interests. These efforts have produced only narrow examinations with limited results. While I believe that future research should further expand our understanding of how the character of specific investments in military capability influence alliance behavior, more work is needed to provide a more comprehensive accounting of states' military spending. Researchers attempting to examine any state's military spending over time face numerous challenges in compiling and coding data because states have incentives to conceal or misrepresent their military capabilities (Fearon 1995) and because reporting defense spending is inherently complex. The availability of defense spending data is often sparse and the reliability of the data is sometimes questionable. Researchers must make numerous decisions to produce consistent estimates, as state military and bureaucratic roles, structures, and processes vary widely. As such, this work draws from several available military spending data sources and employs aggregate military spending as a treatment variable as opposed to military specialization.

### 2.1.3 Alliance Reliability in War and Peace

Several studies have examined violations of alliance commitments in times of war, and the results vary widely. An early effort by Sabrosky (1980) provided a pessimistic view of the utility of formal alliance agreements, reporting that only approximately one-quarter (27%) of allies fought alongside their partners when called upon in 50 conflicts from 1816 to 1965. Conversely, while examining a similar period, Leeds et al (2000) contended that three-quarters of alliance agreements were upheld in 52 conflicts from 1816 to 1944 after adjusting Sabrosky's methods to account for the specific requirements laid out in the provisions of each alliance agreement. More recently, Berkemeier and Fuhrmann (2018) identified a temporal disparity in the fulfillment of alliance obligations, asserting that, prior to WWII, alliances were upheld in two-thirds of all opportunities (66%) while, in the post-WWII period, allies honored less than one-quarter (22%) of their agreements, yielding a combined cooperation rate of 50% in 70 wars from 1816 to 2003. This study endeavors to inform this debate by reporting states' fulfillment of their alliance obligations using the most updated data and methods.

An important related study by Johnson (2016) investigated the role of alliance obligations in states' decisions to intervene in conflict. Johnson found that states' intervention decisions comported closely with their alliance commitments - states party to defense pacts demonstrate greater propensity to intervene on behalf of targets while those with offensive obligations are more apt to join challengers. Johnson's work provided a useful update to earlier work on the fulfillment of alliance agreements in wartime, examining war intervention opportunities and alliance commitments from 1816 - 2003. A notable earlier work by Leeds (2003) more closely scrutinized alliance violations in wartime, aiming to identify specific factors contributing to allied defection, namely relative power and relative democracy. Leeds identified a significant positive link between alliance violations and major power status as well as changes in relative power. She also found a significant negative relationship between the probability of defection and a state's measured democracy score.

Alternatively, researchers have chosen to examine alliance reliability in peacetime, studying the conditions under which states prematurely terminate alliance agreements. Morrow (1991) examined whether a trade-off exists between states' autonomy and their security, considering, among several hypotheses, whether changes in military capabilities yield changes in the probability that alliances break up. Reporting similar results to Leeds (2003), Morrow found that there is indeed a positive relationship between changes in relative power and early alliance termination. Gartzke &

Gleditsch (2004) examined the link between political institutions and alliance reliability, concluding that the political volatility inherent to democracies makes them unreliable allies. Conversely, Leeds et al (2009) find that democratic institutions mitigate the negative effects of political volatility on international cooperation.

Much of the empirical research regarding the reliability of military alliances considers persistent characteristics of member states, such as their history of belligerence (LeVeck & Narang 2016), method of governance (Leeds et al 2009), and enduring interests (Gibler & Rider 2004). Largely overlooked are the specific decisions that states make in the time prior to war's onset. Due to challenges in collecting sufficient data, such work often narrowly focuses on specific regions (Sorokin 1994) or covers limited time periods long past (Morrow 1991; Leeds 2000). Studies that consider the dynamic factors influencing ally behavior are in need of updating.

### 2.2 Theory and Design

In this work, I examine the empirical record of states' war intervention behavior to test theory using current war onset, alliance membership, and defense spending data. I primarily consider defense pacts to comport with the theory presented in the previous chapter. I endeavor to elucidate a more nuanced understanding of the factors that influence alliance reliability. The principal concern of this study is the direct influence of military spending on ally behavior. I consider both the durability of alliance commitments both in peacetime and in the run-up to war.

Just as the arms versus allies trade-off functions in alliance formation decisions, I expect that it functions to some degree within military alliances as well. In determining whether to pursue arms or allies to redress security imbalances, states make optimal choices by considering the marginal benefits of each option. As the conditions under which an alliance was formed change, the relevance of that alliance may be called into question (Leeds & Savun 2007). Defense spending, if it portends a shift in the military balance of power, may lead to a reappraisal of defensive obligations among one's allies. In peacetime, this may be exhibited by more instances of early abrogation of alliance commitments following periods of increased defense spending by one or more alliance members. Recall that allies face defection costs when they renege on their defensive obligations once invoked; they may be deemed less desirable partners in the future, or they may engender dissension at home for losing face. Allies face similar costs when they abrogate an alliance agreement early; however, these costs are arguably less than those incurred when abandoning a partner under attack. More importantly, increases in defense spending by one alliance partner often reduce the marginal benefit of participation in conflict for the others as the spending state becomes more able to achieve favorable unilateral outcomes in both bargaining and war. The reduction in these states' marginal benefits of fighting a potential war coupled with costs of maintaining their alliance commitments makes early abrogation a desirable action whenever the relatively lesser cost of early abrogation is exceeded. The urgency to address specific alliance vulnerabilities is reduced absent an imminent threat, and the impetus to gain battlefield efficiencies through complementary military spending may be overridden by more general security concerns. This drives more redundant substitute military spending, which increases the likelihood of defection.

*Hypothesis 1: An increase in a state's defense spending results in an increase in the likelihood that its alliance partners will terminate their defensive obligations early.*

Similarly, states deciding whether to intervene or remain neutral in conflict must consider the marginal benefits of joining that conflict. An ally's marginal benefit of participating in war could be increased by a partner's military investment if it specifically addresses the ally's war costs or augments his existing capabilities. Conversely, an investment could reduce an ally's marginal benefit of cooperating in conflict if it primarily serves the security needs of the targeted state. In wartime, however, the exigencies of battle weigh heavily on state's decisions and may even sway leaders from rational decision-making processes. If unilateral concerns dominate, then state's may be more likely to augment their own security, investing in substitute capabilities that reduce the reliability of their alliance commitments. Alternatively, if cooperative concerns prevail, then states will procure complementary capabilities that both enhance their ability to fight together and strengthen their alliance bonds.

*Hypothesis 2a: (Unilateralism dominates) An increase in defense spending results in an in-*

*crease in the likelihood that one's ally's defect from their defensive obligations in wartime.*

*Hypothesis 2b: (Multilateralism dominates) An increase in defense spending results in a decrease in the likelihood that one's ally's defect from their defensive obligations in wartime.*

### 2.2.1 Alliance Membership

In order to evaluate any hypotheses pertaining to upholding alliance commitments, one must determine a state's alliance relationships. For this information, the work of Leeds et al (2002), the Alliance Treaty Obligations and Provisions Project (ATOP), provides the most comprehensive data. The data report alliance membership, start and end dates, applicable provisions, and the circumstances of termination as well many other parameters. Because the theory first pertains to targeted states, alliance treaties binding one state to provide military aide to another in the event of attack are of particular importance. The ATOP directed dyad-year dataset codes 137,660 instances of such defensive obligations from 1815 to 2018.[1] Combining the alliance data with the war participation data identifies 256 defensive obligations that were invoked during wartime. [2]

### 2.2.2 War Participation and Roles

To identify the incidence of war as well as each war's participants and their roles, this study draws upon data prevalent in contemporary literature maintained by Sarkees and Wayman (2010), the Correlates of War Project (COW). The COW project identifies 337 participating states in 95 interstate wars from 1816 to 2007 that meet selection criteria of 1,000 annual battle deaths. Importantly, the data identifies a side (1 or 2) for every participating state in each conflict. In bilateral war, identification of the target and her challenger are simple - they are simply the states identified

[1]Due to some similarity in theoretical logic, upholding offensive obligations may also be relevant. ATOP codes 263 additional instances of states' obligations to join conflict on the side of the initiator (6,059 instances in which states' simultaneously bare offensive and defensive obligations to their partners). Such offensive obligations are considered in an extension to the model.

[2]To more accurately code relevant alliance obligations, one must assess whether a conflict met the specific provisions of an alliance agreement, as some alliance agreements pertain only to specific threats and circumstances. Recent work by Johnson (2016) recorded 120 instances in which the circumstances met obligation provisions from 1816 - 2007. For robustness, I test the results against both the broader sample of 256 defensive obligations and the smaller sample of 120 invoked alliances. I argue that it is reasonable to assume that states targeted for war would reach out to all alliance partners for support regardless of the specific provisions of their defensive alliance agreements.

as opposing participants in the conflict. When more than two states are party to a conflict, then the target and the challenger are identified by the earliest conflict initiation dates by participants on opposing sides. As in Johnson (2016), when states have identical conflict initiation dates, I determine targets and challengers by referencing corresponding militarized international disputes (MIDs) that preceded the conflict according to COW data and applicable literature resulting in a target and a challenger for each conflict.[3] Of the remaining participants, 89 joined targets in battle and another 58 states joined initiators.[4]

### 2.2.3 Dependent Variables - Early Alliance Termination and Wartime Alliance Defection

I use the early termination of defense pact obligations to proxy for alliance reliability. The ATOP project again provides useful data. The member-level dataset reports termination dates for every recorded alliance as well as the circumstances under which each alliance ended (Leeds et al 2002). For years in which a defense pact terminated prior to the date specified in the alliance provisions (if any) due to a violation of terms by one or more of its members, I code member states as having experienced an early alliance termination ($early\_term = 1$). All other state-years are coded as zero. The ATOP data report 189 incidences of early termination of defense pacts among 8,877 state-year observations since 1816.

Combining alliance membership data with war participation data yields an indicator variable which captures the outcome of alliance cooperation decisions. Directed dyad-years in which state pairs represent parties to a defense pact and the allied state either remains neutral or joins the challenger are coded as defections from defensive alliance obligations (*defect* = 1). State pairs representing parties to a defense pact in which the joining state enters the war on the side of the target are coded as honoring an alliance obligation (*defect* = 0). Of the 120 defense pacts invoked in wartime from 1816 to 2007, states intervened on behalf of the challenger twice, on behalf of the target 29 times, and remained neutral 89 times, resulting in 91 instances of defection from defensive obligations (74%). This finding much more pessimistic than recent accounts, likely ow-

[3]As in Johnson (2016), I include both Poland and the UK as targets of Germany in WWII increasing the dataset to 96 pairs of challengers and targets.

[4]A list of wars, participants, and roles is included in the appendix.

ing to this work's analysis of directed dyads compared to previous studies' alliance-level analysis (Sabrosky 1980; Leeds 2003; Gibler 2004; Burkemeier & Fuhrmann 2018). In several instances, numerous states simultaneously defected from defensive commitments to a single target. For example, nineteen Middle Eastern and North African states defected from their obligations to defend Iraq by remaining neutral after the United States invaded in 2003. I code these each as separate alliance defections, while others would code them as a single alliance defection. [5]

### 2.2.4 Independent Variable - Defense Spending

Beckley (2018) notes that measuring state power is a difficult task, and doing so accurately may indeed be impossible, as it entails knowing and measuring the multitude of each states interests and influences. Scholars have employed numerous measures to capture state power, including GDP, defense spending, and composite indices, each subject to their own critiques. In this study, I use defense spending data, as it arguably offers the clearest, most direct link between security decision making and wartime outcomes.

Fortunately, several notable endeavors compile defense spending data and explain the collection efforts. I again rely upon the Correlates of War Project using the most recent version of data originally compiled by Singer (1987). The National Military Capabilities dataset reports a measure of defense spending for each state over a 200-year period from 1816 to 2016, recording 15,951 state-year observations with values ranging from $0 to over $690 billion (current USD). Despite, or perhaps in light of this large collection effort, defense spending data is missing for 13.9% of total observations, most often in earlier periods, and is missing in the years leading up to an instance of defection in 41 of 91 defection cases (45%).

To provide the most precise description of the relationship between a state's defense spending and the behavior of its allies, I measure growth over several time periods. I first calculate acute growth, comparing defense spending in the year prior to war onset (t-1) against a rolling average of each state's defense spending. I also compare spending in the three-year period prior to war onset

[5] Early research on alliance defection counted alliance cooperation opportunities for any pair of states party to a defense pact and did not account for the specific provisions of alliance agreements. As a robustness check, I employ this conception of alliances, which more than doubles the sample size. The results remain consistent.

to each state's rolling average. Figures 2.1 and 2.2 plot the relationship between defense spending growth and early alliance termination. Figures 2.3 and 2.4 plot the relationship between defense spending and wartime alliance defection.

Figure 2.1: Acute Increase in Defense Spending and Early Alliance Termination

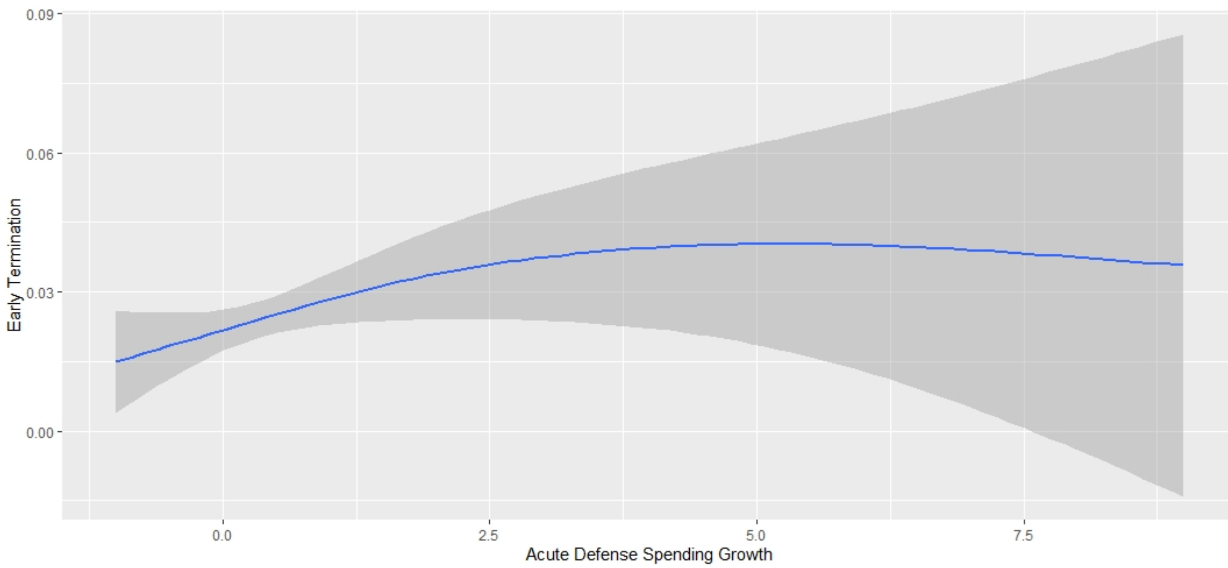



Figure 2.2: Trend of Increased Defense Spending and Early Alliance Termination

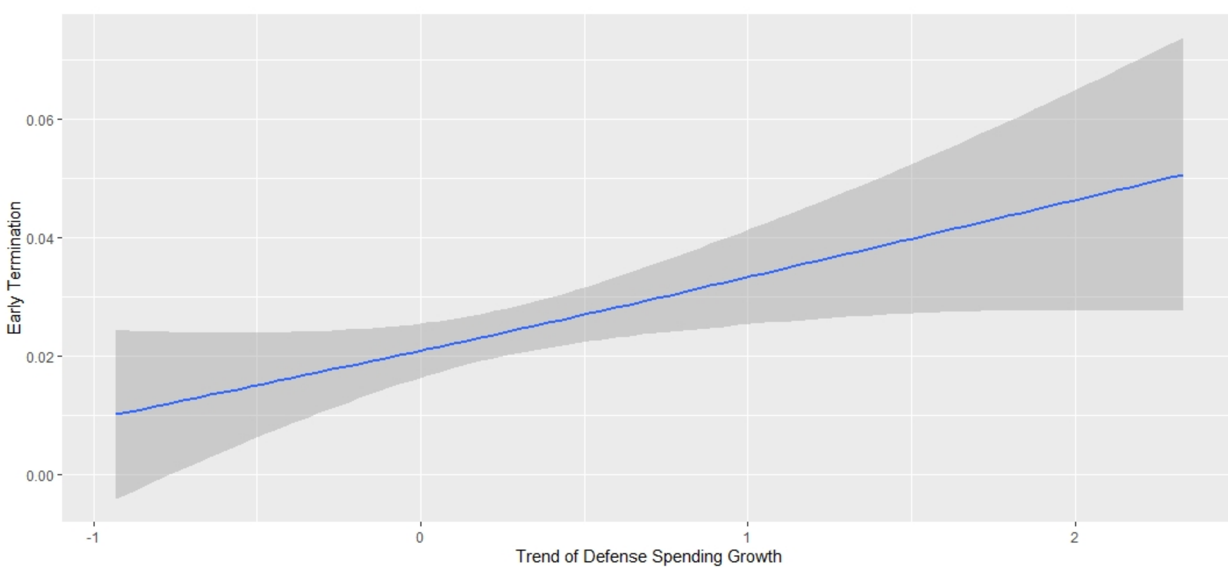


Figure 2.3: Acute Increase in Defense Spending and Alliance Defection

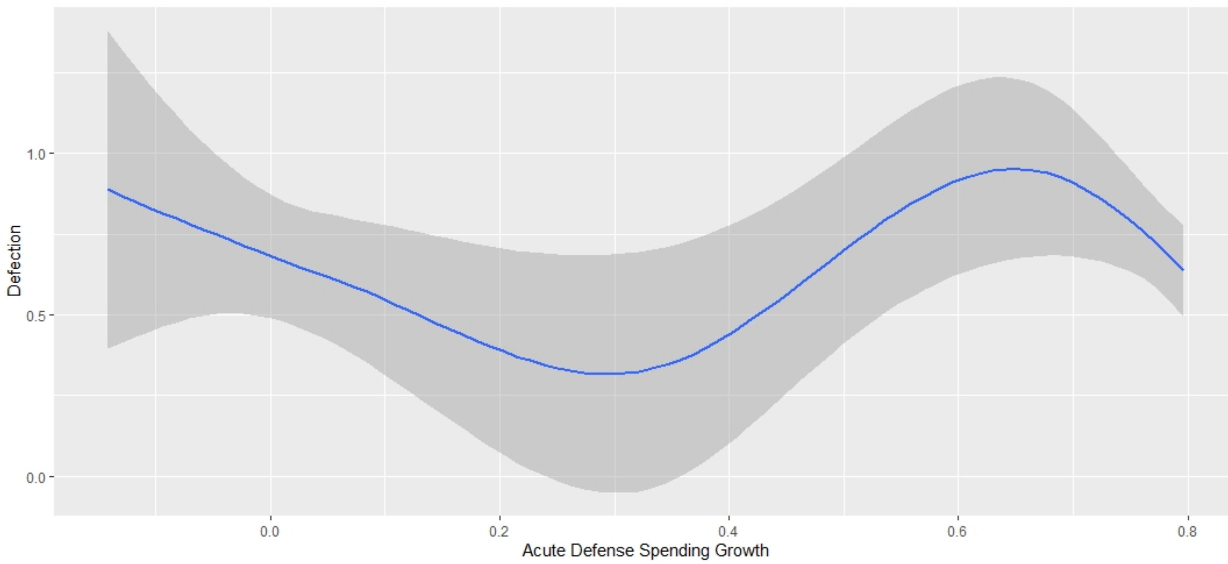
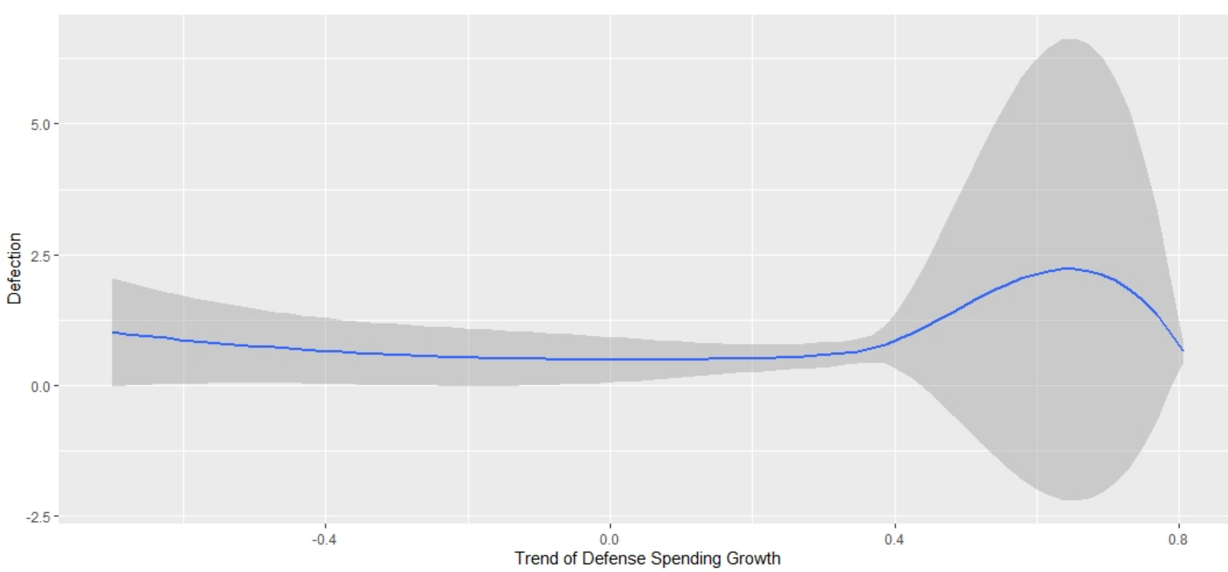



Figure 2.4: Trend of Increased Defense Spending and Alliance Defection



### 2.2.5 Control Variables

To identify appropriate control variables, one must examine a factor's potential to affect both a target state's defense spending and an ally's decision to enter a conflict. Certainly, the implications of relative power imbalances and changes in relative power among allies and adversaries are well studied. The relative size of states determines their propensity to spend on defense, varying in relation to both the size of their adversaries and their partners, with larger states being more apt to favorably influence their relative security through defense spending (Palmer 1994). Also, major powers are more likely to defect because they are better able to bear the costs of defection than smaller states (Leeds 2003). Here, I consider an ally's power relative to his adversary rather than inter-alliance power dynamics. I hypothesize an inverse relationship between an ally's propensity to defect and his power relative to his adversary because more powerful states enjoy a greater marginal benefit of participation in conflict than do smaller partners.

The COW project again provides an apt measure, the Composite Index of National Capabilities (CINC) score, to proxy for states' military capability, reporting a relative power score for each state from 1816 to 2016 (Singer, 1987). I calculate the ally's power relative to the challenger at the time of his intervention decision as a control variable with the following expression:

$$ALLYPOWER = \frac{CINC_{Ally,t}}{CINC_{Ally,t} + CINC_{Challenger,t}}$$

This expression yields a value between 0 and 1 and grows with the relative power of the ally.

Also, the threat environment of the ally influences his decision whether to abrogate an existing alliance and whether to participate in conflict. If an state lives in a hostile neighborhood, he may want to preserve the deterrent value of his alliance agreements (Morrow 1994; Smith 1995; Walt 1987, 1997, Leeds & Savun 2007). Conversely, if an ally deems his partner to be under constant threat, that partnership represents a security liability. If he has numerous adversaries to consider, he may be less willing to commit military forces in defense of a partner. More specifically, if an ally faces threats in addition to the challenger against whom they are called to defense, then he will be less likely to disperse his own military capability. Alternatively, a history of conflict with that challenger may make an ally more likely to join the in defense of the target. Thus, I include a measure of the ally's relative threat environment as a control variable. To calculate this variable, I draw from the COW project's dyadic Militarized Interstate Dispute (MID) dataset, which captures threats, demonstrations of military force, and minor military clashes that fall short of the criteria to be counted as interstate war. (Maoz, 2018) I count the number of MIDs in which a state was identified as a principle target during the five and ten year periods preceding the onset of war. For targeted states, I subtract the MIDs in which the wartime challenger was a participant.

$$MIDCOUNT = \sum_{t-1}^{t-5} MID_{i,k} - \sum_{t-1}^{t-5} MID_{i,Challenger}$$

By similar logic, the size of a state's alliance portfolio influences the reliability one's alliance commitments. As the size of one's alliance portfolio increases, the value of any particular alliance decreases in proportion to the relative power of the joining state. Conversely, if a state loses an alliance partner, the value of its remaining alliance obligations increases. Using ATOP state-level data, I create an indicator variable recording whether a state gained any alliance partners in the period prior to alliance termination.

Domestic political factors have been proven pivotal in assessing alliance reliability. Alliances between politically similar states should be more durable to shocks and last longer (Bennett 1997). Material support is more likely to be provided in disputes pursuing similar interests by states with aligned policies. (Morrow 1994, Smith 1995) Also, alliance dissolution is directly linked to changes in domestic political structure. (Walt 1997) I employ two variables common in the literature to capture these concepts. First, I measure political differences between allies. The Center for Systemic Peace's Polity 5 dataset (Marshall 2018) reports a measure of authoritarianism versus democracy across a sliding scale, from which I take the absolute value of the difference between each ally's score. Also, as democratic states have been demonstrated to make more reliable alliance commitments (McGillivray & Smith 2000, Leeds et al 2009), I code an indicator variable for democracy for any state-year with a regime score higher than 6.

Additionally, as the distance between a target and her ally increases, the ally's cost of participating in the target's defense also increases, reducing the likelihood of cooperation. Also, closer allies mean lesser costs of cooperation, which may obviate the need for large expenditures by the target in preparation for war. In keeping with trends in contemporary scholarship, distance is measured between the capital cities of the target and her allies. As in Johnson (2016), I take the natural logarithm of the linear distance between capitals to reduce its effect as distances become greater. I do not employ this as a control variable to predict early termination because states have already considered distance at alliance formation; however, in wartime, distance bears real cost.

### 2.2.6 Model Estimation

First, I examine the spending behavior of states targeted for war to determine if their defense spending patterns differ in any consistent and significant way from those not targeted for war. I compare these ninety-six states' spending to all states party to defense pacts as well as the total population of states for which there is recorded spending data. I create an indicator variable recording whether or not a state was targeted for war in a given year ($is.target = 1$) and conduct ordinary least squares regression analysis of this dependent variable on the defense spending treatment variables described above. For this and the analysis of early alliance termination, the state-level data and the large population size (5,640) warrants the inclusion of fixed effects (Hausman, 1978, Liang  Zeger, 1986; Arellano, 1987, Cameron  Miller, 2015).

To test the hypotheses, I estimate two ordinary least squares models for each scenario. First, I examine the relationship between defense spending and early alliance termination. I consider an acute spending increase to be a growth in defense spending in any year relative to the state's rolling average. I regress the incidence of early termination on this measure of acute spending growth. For the second model, I consider a trend of increased defense spending to be a three-year spending period that exceeds the state's rolling average. I regress the incidence of early termination on this growth trend measure. I report the results of the base OLS estimation, the OLS estimation with state and year fixed effects, and the complete OLS estimation with fixed effects and controls with cluster robust standard errors in Table 2.1. I follow the same procedure and regress wartime alliance defection on the spending variables described above. I report the results of the base OLS estimation and the OLS estimation with controls and robust standard errors in Table 2.2. I forego fixed effects here due to the relatively small number of relevant observations (72).

### 2.3 Results

First, there is no statistically significant relationship between a state's defense spending and its being targeted for war nor its membership in a defense pact. This perhaps reflects competing forces. The likelihood of a challenge motivates states to spend on defense while states that spend more on defense deter potential challengers. This result addresses potential bias and enhances the validity of the subsequent findings.

Next, if the first hypothesis is correct, then an increase in defense spending will lead to an increase in the likelihood that a defensive alliance terminates early in violation of its provisions. This is indeed what we observe. Drawing from the full population of states party to defense pacts, the model reports a positive and statistically significant relationship between increases in defense spending and the termination of defensive alliances early in violation of their terms. This result applies whether one considers short-term, acute increases in defense spending or longer-term trends of increased defense spending across all model specifications. The substantive effects are quite small, whereby a near-term increase in defense spending of one standard deviation above the ten-year average is an increase in the incidence of early alliance termination by 0.000028 (0.002%). The substantive effect of a sustained increase in defense spending over a three-year period is nearly five times larger than an acute increase, increasing the incidence of early termination by 0.00013 (0.01%). Also, in accordance with theory, an increased threat environment and a domestic political shift show a positive and significant relationship with early alliance termination, while a high democracy score reduces one's risk of early alliance termination. The recent gain of an ally shows no statistically significant relationship here with subsequent alliance reliability.

Table 2.1: OLS regressions of defense spending on early alliance termination (no data imputation)

| Model 1 | Base OLS Estimation | OLS with Fixed Effects | OLS with FE & Controls |
|---|---|---|---|
| Acute Increase in Defense Spending | **0.0061 *** **(0.0029)** | **0.0056 .** **(0.0033)** | **0.0069 .** **(0.0041)** |
| Threat Environment (# MIDs last 5 years) | | | **0.0136 *** **(0.0053)** |
| Political Change (+/-2 Polity) | | | **0.0189 .** **(0.0113)** |
| Democratic State (Polity Score >5) | | | **-0.0149 *** **(0.0059)** |
| Gain of Ally | | | 0.0036 (0.0079) |
| **Model 2** | **Base OLS Estimation** | **OLS with Fixed Effects** | **OLS with FE & Controls** |
| Trend of Increased Defense Spending | **0.0143 **** **(0.0051)** | **0.0165 *** **(0.0065)** | **0.0179 *** **(0.0076)** |
| Threat Environment (# MIDs last 5 years) | | | **0.0097 *** **(0.0039)** |
| Political Change (+/-2 Polity) | | | **0.0188 .** **(0.0111)** |
| Democratic State (Polity Score >5) | | | **-0.0153*** **(0.0059)** |
| Gain of Ally | | | 0.0036 (0.0080) |
| Observations | 5,640 | | |

Notes:
Standard errors in parentheses.
.p <0.1, *p <0.05, **p <0.01, ***p <0.001.
Acute increase calculated by comparing defense spending in year t-1 to 10-year average.
Increasing trend calculated by comparing 3-year average defense spending to 10-year average.

Table 2.2: OLS regressions of defense spending on wartime alliance defection (no data imputation)

| Model 1 | Base OLS Estimation | OLS with Controls |
|---|---|---|
| Acute Increase in Defense Spending | -0.0267<br>(0.1549) | **-0.3597 .**<br>**(0.1960)** |
| Ally Relative Power (CINC Ratio) | | **0.6881 ***<br>**(0.3136)** |
| Ally Threat Measure (# MIDs in last 5 years) | | **-0.0519 .**<br>**(0.0269)** |
| Distance between Ally and Target | | **0.0660**<br>**(0.0515)** |
| Political Difference | | **0.0228 ***<br>**(0.0098)** |
| **Model 2** | **Base OLS Estimation** | **OLS with Controls** |
| Trend of Increased Defense Spending | -0.0672<br>(0.4934) | **-1.2032 .**<br>**(0.6255)** |
| Ally Relative Power (CINC Ratio) | | 0.3917<br>(0.3038) |
| Ally Threat Measure (# MIDs in last 5 years) | | -0.0306<br>(0.0188) |
| Distance between Ally and Target | | **0.1288 ***<br>**(0.0519)** |
| Political Difference | | **0.0245 ***<br>**(0.0095)** |
| Observations | 72 | |

Notes:
Standard errors in parentheses.
.p <0.1, *p <0.05, **p <0.01, ***p <0.001.
Acute increase calculated by comparing defense spending in year t-1 to 5-year average.
Increasing trend calculated by comparing 3-year average defense spending to 5-year average.

After accounting for the ally's relative incentive for participating in the conflict, the ally's threat environment, and political and physical distance between allies, the fully specified model reports a negative and statistically significant relationship between defense spending and wartime defection from defensive alliance obligations. Again, this relationship is consistent whether one considers immediate increases in defense spending or trends of increased defense spending over time. The substantive effect of a one-standard deviation increase in defense spending above the five-year average is a decrease in the incidence of defection by over 7%. The substantive effect of a sustained increase over a five-year period is an decrease in the incidence of defection by over 75%. Physical distance, political differences, and the ally's power relative to the adversary all bear positive relationships with ally defection, all conforming with prevailing theories of alliance reliability. Interestingly, the ally's threat environment, even when removing the challenger from consideration, bears a negative relationship with alliance defection.

### 2.3.1 Robustness Checks

To test the robustness of these results, I consider numerous conceptions of defense spending growth, comparing defense spending in the year prior to conflict to the previous year (t-2) and the three, five, and ten-year averages, as well as comparing each periodic average to one another. I also test the results against dummy variables indicating whether defense spending growth met a threshold level of one standard deviation above the five-year and ten-year means. In nearly all cases, the results remain consistent. Comparing defense spending in the year prior to conflict (t-1) to spending two-years prior to conflict (t-2) yields inconsistent results. In some instances, comparing growth to the ten-year mean reduced the statistical significance of the results, but did not alter the substantive relationships. Additionally, whether analyzing a larger sample of over 250 defense pact intervention opportunities or the stricter 120 opportunities that consider each the specific provisions of each agreement, the results remain consistent. I also include ally intervention opportunities for parties to offensive obligations. I test this to determine whether the effect of increased defense spending by one's allies functions similarly across all states called to fight on behalf of another, whether it be to aid aggression or to bolster defense. Again the results demonstrate a negative and significant, though slightly attenuated relationship. Finally, I impute the missing values for military expenditure using each state's rolling ten-year mean value. Here, I observe a change in statistical significance, but no change in the substantive results.

### 2.4 Discussion

The disparity between these findings in interesting. On the one hand, we observe the general trend of alliance agreements becoming less reliable as member states increase their defense spending. This result aligns with prevailing scholarship which reports that relative power shifts reduce the reliability of alliance agreements. Military capability appears, then, to be a good proxy measure for a state's relative power. On the other, we observe states cooperating with their allies on the battlefield more frequently when their partners increase defense spending in the years prior to the onset of war. This suggests that when war is imminent, multilateralism and cooperative motives dominate. War is indeed a costly and unpredictable affair. As the formal analysis in the previous chapter establishes, states achieve better war outcomes when they cooperate. If winning the conflict is the principal concern, then states should be expected to take actions that improve their probability of victory, perhaps even if it means cutting into their relative gains. After all, a loss on the battlefield could mean a total loss on the disputed issue.

Also interesting is the relationship between states' threat environments and the reliability of their alliance agreements. States facing greater threats, exhibited by a higher frequency of international disputes over a five-year period, are more likely to lose alliance partners when they alter the balance of power through defense spending; however, allies who face more threats are more likely to cooperate in war with partners who increase their defense spending. There appear to be competing impulses for states to avoid risky partnerships with threatened states, but also to reinforce partnerships when they themselves are at higher risk of conflict. Leaders may wish to present themselves as loyal to motivate cooperation from partners in the event that they too are attacked. This claim warrants further analysis.

The effects of longer trends of increased spending are slightly more robust to alternative measures of defense spending growth than are acute increases. The opposite is true of wartime alliance defections. This suggests that the imminent demands of war may motivate leaders to shorten their relevant time horizons when making important national security decisions. Again, future research should investigate this issue.

The reliability of these reported results suffers from the current state of defense spending data, particularly with regard to its specificity. Also, spending data is missing in cases of wartime alliance defection in nearly half of all cases. This research uncovered no discernible reason for the correlation between the missingness of defense spending data states' decisions to abandon their alliance commitments in wartime. The next chapter examines specific cases of alliance decision making in context in an effort to better understand the results of the formal theoretic and empirical models.

## 2.5 Appendix 2

### 2.5.1 Diagnostic Plots & Robustness Check Results

Figure 2.5: Four Diagnostic Plots from Regression of Early Alliance Termination on Defense Spending Growth - ACUTE

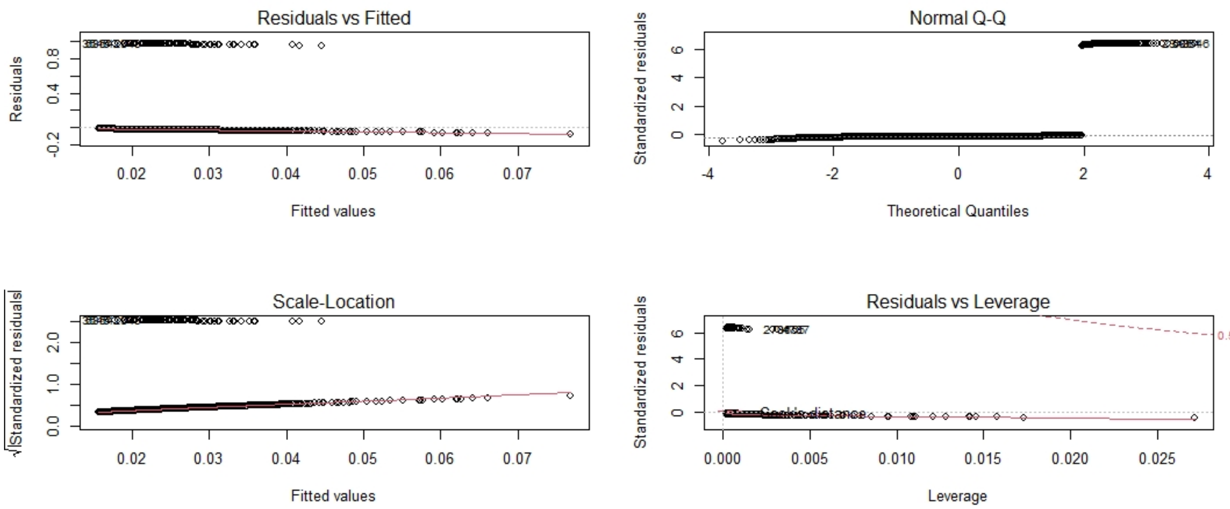



Figure 2.6: Four Diagnostic Plots from Regression of Early Alliance Termination on Defense Spending Growth - TREND

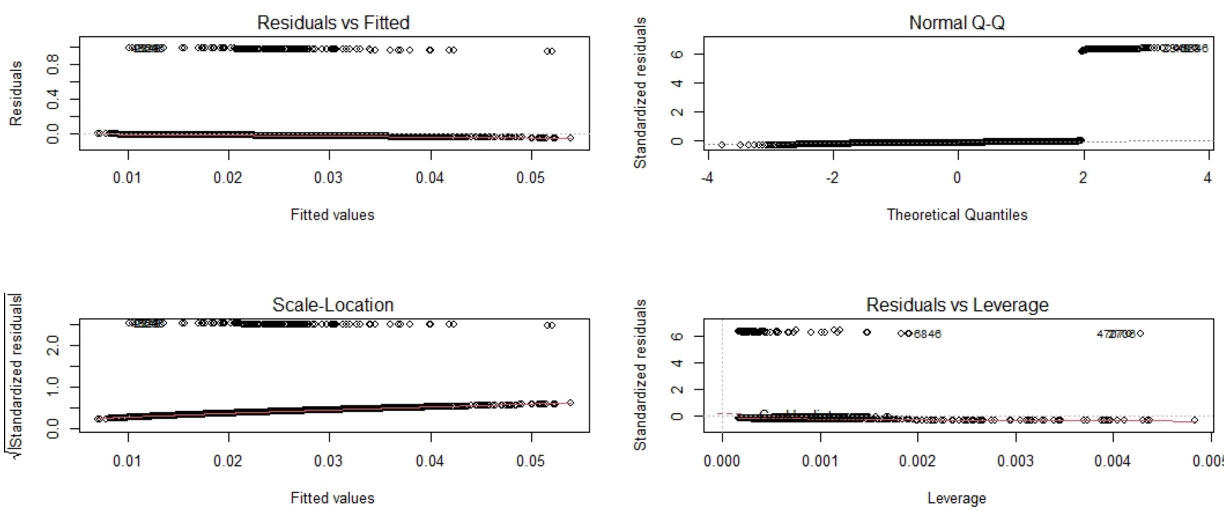


Figure 2.7: Four Diagnostic Plots from Regression of Wartime Alliance Defection on Defense Spending Growth - ACUTE

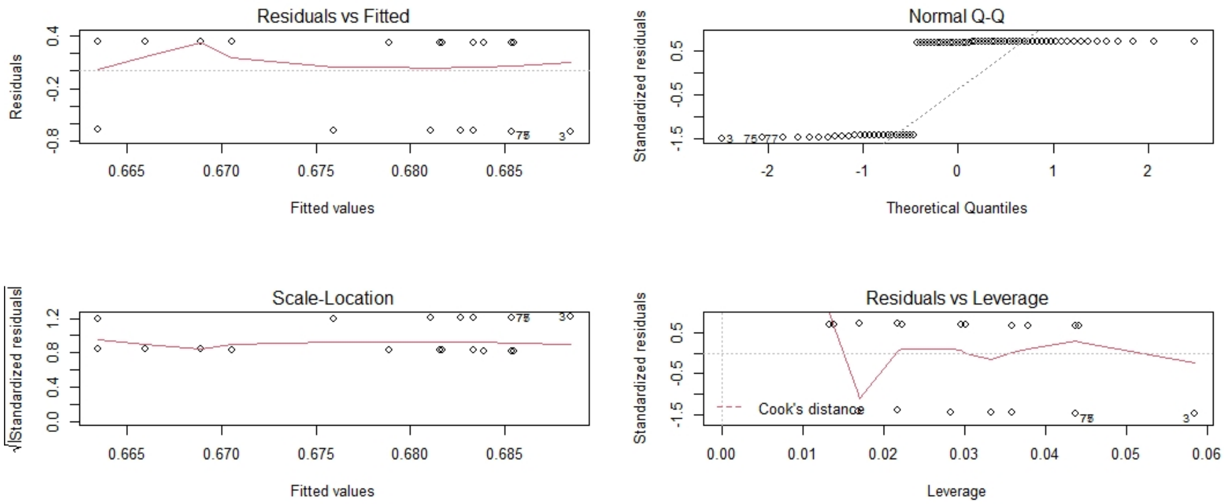



Figure 2.8: Four Diagnostic Plots from Regression of Wartime Alliance Defection on Defense Spending Growth - TREND

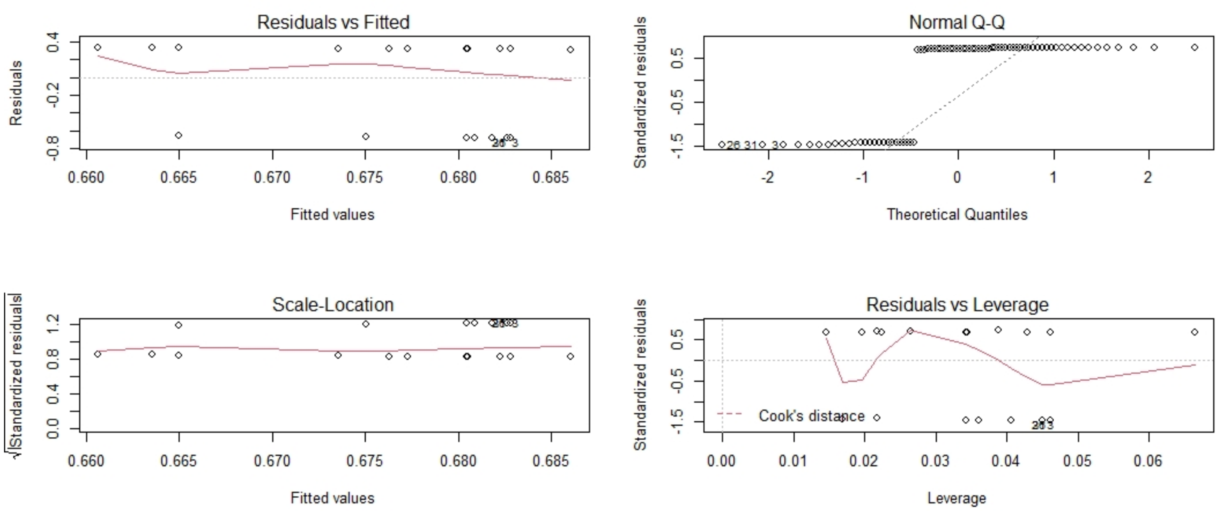


Table 2.3: OLS regressions of defense spending on alliance defection (no data imputation)

| Model 1 | Base OLS Estimation | OLS with Controls |
|---|---|---|
| Acute Increase in Defense Spending | -0.0123 (0.0897) | **-0.2054 . (0.1158)** |
| Ally Relative Power CINC Ratio | | 0.3995 (0.3195) |
| Ally Threat Measure (# MIDs in last 5 years) | | **-0.0459 . (0.0265)** |
| Distance between Ally and Target | | **0.1063 . (0.0552)** |
| Political Difference | | **0.0259 * (0.0098)** |

| Model 2 | Base OLS Estimation | OLS with Controls |
|---|---|---|
| Trend of Increased Defense Spending | -0.0219 (0.1885) | -0.3690 (0.2324) |
| Ally Relative Power CINC Ratio | | 0.4518 (0.3140) |
| Ally Threat Measure (# MIDs in last 5 years) | | **-0.0456 . (0.0266)** |
| Distance between Ally and Target | | **0.1027 . (0.0555)** |
| Political Difference | | **0.0249 * (0.0098)** |
| Observations | 72 | |

Notes:
Standard errors in parentheses.
.p <0.1, *p <0.05, **p <0.01, ***p <0.001.
Acute increase calculated by comparing defense spending in year t-1 to 10-year average.
Increasing trend calculated by comparing 3-year average defense spending to 10-year average.

Table 2.4: OLS regressions of defense spending on defection (missing data imputed with mean)

| Model 1 | Base OLS Estimation | OLS with Controls |
|---|---|---|
| Acute Increase in Defense Spending | **-0.2463 * (0.0997)** | **-0.5411 *** (0.1266)** |
| Ally Relative Power CINC Ratio | | -0.0765 (0.1700) |
| Ally Threat Measure (# MIDs in last 5 years) | | -0.0142 (0.0138) |
| Distance between Ally and Target | | **0.1201 ** (0.0388)** |
| Political Difference | | **0.0184* (0.0075)** |
| **Model 2** | **Base OLS Estimation** | **OLS with Controls** |
| Trend of Increased Defense Spending | -0.2340 (0.3241) | **-0.9757 ** (0.3691)** |
| Ally Relative Power CINC Ratio | | **0.3703 * (0.1612)** |
| Ally Threat Measure (# MIDs in last 5 years) | | **-0.0249. (0.0145)** |
| Distance between Ally and Target | | **0.1226 ** (0.0431)** |
| Political Difference | | **0.0143 . (0.0077)** |
| Observations | 113 | |

Notes:
Standard errors in parentheses.
.p <0.1, *p <0.05, **p <0.01, ***p <0.001.
Acute increase calculated by comparing defense spending in year t-1 to 5-year average.
Increasing trend calculated by comparing 3-year average defense spending to 5-year average.

Table 2.5: OLS regressions of defense spending on defection (missing data imputed with mean)

| Model 1 | Base OLS Estimation | OLS with Controls |
|---|---|---|
| Acute Increase in Defense Spending | **-0.1496 **** **(0.0555)** | **-0.2949***** **(0.0671)** |
| Ally Relative Power CINC Ratio | | -0.0645 (0.1580) |
| Ally Threat Measure (# MIDs in last 5 years) | | -0.0203 (0.0193) |
| Distance between Ally and Target | | **0.1192 **** **(0.0402)** |
| Political Difference | | **0.0186 *** **(0.0077)** |
| **Model 2** | **Base OLS Estimation** | **OLS with Controls** |
| Trend of Increased Defense Spending | **-0.2164 .** **(0.1123)** | **-0.4572 ***** **(0.1229)** |
| Ally Relative Power CINC Ratio | | **0.3585 *** **(0.1540)** |
| Ally Threat Measure (# MIDs in last 5 years) | | -0.0234 (0.0197) |
| Distance between Ally and Target | | **0.1240 **** **(0.0419)** |
| Political Difference | | **0.0159 *** **(0.0077)** |
| Observations | 113 | |

Notes:
Standard errors in parentheses.
.p <0.1, *p <0.05, **p <0.01, ***p <0.001.
Acute increase calculated by comparing defense spending in year t-1 to 10-year average.
Increasing trend calculated by comparing 3-year average defense spending to 10-year average.

# CHAPTER 3

## Defense Spending and Alliance Reliability - Case Analysis

### 3.1 Introduction

The formal analysis in the first chapter describes how alliance members with perfect knowledge of military capabilities and intentions will behave if acting rationally under threat of war. The empirical results reported in the second chapter relate general trends of ally behavior to periods of increased spending by one or more alliance partners in both peacetime and wartime conditions. This third and final chapter investigates specific cases of defensive alliances in an effort to evaluate how states' spending actions contributed to ally decision making, extrapolating the results of the formal model to consider both the context of peacetime alliance abrogation and wartime alliance cooperation. Certainly, defense spending played a significant role in shaping ally behavior. This chapter assesses whether states' defense spending influenced their allies actions in accordance with the previously described theory, in particular whether defense spending motivated allies to behave contrary to expectations based on factors previously demonstrated to predict allied behavior. The case analysis that follows adds nuanced understanding to the myriad factors that interacted with defense spending to influence states decisions with regard to their alliance commitments.

Case analysis infuses necessary details into the study of a topic that can be lost with large sample empirical analysis. Table 3.1 below lists all defensive alliances that were invoked since 1816 as well as the states who cooperated and those that defected from their alliance agreements. Only 22 of the 95 wars that occurred over a 200 year period invoked defensive alliance agreements. Four conflicts involved ten or more states making alliance decisions, and one, WWII, involved dozens. Quick analysis reveals that many states who defected from their defensive obligations to Britain in WWII were small Latin American states with limited ability to lend direct military support to allies in Europe. Additionally, regional biases are evident. Middle Eastern and North African states cooperated in only two instances among sixty opportunities. Case analysis prevents us from making sweeping generalizations about entire regions based on pooled data. Missing from the analysis is whether states held competing alliance agreements with both warring parties, having obligations to defend one while remaining neutral to against the other. Also, in many instances, what is coded as cooperation actually represents a simultaneous declaration of war or a large scale attack such as in the Seven Weeks War in 1866 and the War of the Pacific in 1879. Domestic political factors intervene as well. For example, popular support for the decision to ally with another state may vary widely from support for participation in war (Gartzke & Gleditsch 2004). Diplomacy also matters, as alliance agreements accompanied by signals of support tend to be more durable. (LeVeck & Narang 2017). Also, the specific terms of an alliance agreement are important. States may form alliances with others who have a history of defection, but they may attempt to address abandonment risks through alliance provisions (Leeds and Anac 2005). A simple coding of allied defection or cooperation based upon participating troop levels provides a useful level of analysis, while investigating individual cases uncovers details that may be difficult to incorporate into models.

### 3.2 Early Alliance Termination

The empirical analysis in the previous chapter confirms several prevailing theories regarding the factors that influence the durability of defensive alliance obligations. As the conditions under which alliances form undergo change, alliances may become less desirable. States undergoing significant domestic political or ideological change, facing greater relative threat, or gaining additional allies in previous periods are all more likely to experience the early termination of an alliance agreement by one or more partners. Democratic states appear better able to sustain their partnerships. This section considers these factors and examines alliance partnerships that diverge from expectations. I evaluate the influence of alliance member state's defense spending decisions on the longevity of defensive alliance agreements, and present the results of two such cases below. When alliances were expected to endure but they end in early abrogation, theory suggests that increases in a state's defense spending, particularly on unilateral or substitute capabilities, undermine the

Table 3.1: Conflicts Featuring Invocation of a Defense Pact 1816-2003

| Conflict Name | Onset Year | Challenger | Target | Allies who Cooperated | Allies who Defected |
|---|---|---|---|---|---|
| Austro-Sardinian | 1848 | Italy | Austria-Hungary | None | Modena, Tuscany |
| Italian Unification | 1859 | Austria-Hungary | Italy | France | None |
| Lopez War | 1864 | Paraguay | Brazil | Argentina | None |
| Naval War | 1865 | Spain | Chile | Peru | Ecuador, Bolivia |
| Franco-Prussian | 1870 | France | Prussia | Bavaria, Baden, Wuerttemburg | None |
| War of the Pacific | 1879 | Chile | Bolivia | Peru | None |
| Second Balkan | 1913 | Bulgaria | Serbia | Greece | None |
| World War I | 1914 | Austria-Hungary | Serbia | Greece | None |
| Changkufeng | 1938 | Japan | Russia | None | Mongolia |
| World War II | 1939 | Germany | Poland | UK, France | Romania |
| World War II | 1939 | Germany | UK | USA, Canada, Brazil, Netherlands, Belgium, France, Poland, Yugoslavia, Greece, Russia, Norway, South Africa, China, Australia, New Zealand | Cuba, Haiti, Dominican Republic, Mexico, Guatemala, Honduras, El Salvador, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, Ecuador, Peru, Bolivia, Paraguay, Chile, Uruguay, Luxembourg, Czechoslovakia, Liberia, Iran, Turkey, Iraq, Egypt, Saudi Arabia |
| Nononhan | 1939 | Japan | Mongolia | Russia | None |
| Offshore Islands | 1954 | China | Taiwan | None | USA |
| Invasion of Hungary | 1956 | Russia | Hungary | None | Romania |
| Sinai War | 1956 | Israel | Egypt | None | Iraq, Syria, Lebanon, Jordan, Saudi Arabia, Yemen |
| Taiwan Straits | 1958 | China | Taiwan | None | USA |
| Six Day War | 1967 | Israel | Egypt | Syria, Jordan | Morocco, Algeria, Tunisia, Libya, Sudan, Iraq, Lebanon, Saudi Arabia, Yemen, Kuwait |
| Second Ogaden War | 1977 | Somalia | Ethiopia | None | Kenya |
| Aouzou Strip | 1986 | Chad | Libya | None | Somalia, Djibouti, Morocco, Algeria, Tunisia, Sudan, Iraq, Syria, Lebanon, Jordan, Saudi Arabia, Yemen, Kuwait, Bahrain, Qatar, UAE, Oman |
| Azeri-Armenian | 1993 | Armenia | Azerbaijan | None | Turkey |
| Badme Border | 1998 | Eritrea | Ethiopia | None | Kenya |
| Invasion of Iraq | 2003 | USA | Iraq | None | Somalia, Djibouti, Comoros, Morocco, Algeria, Tunisia, Sudan, Egypt, Syria, Lebanon, Jordan, Saudi Arabia, Yemen, Kuwait, Bahrain, Qatar, UAE, Oman |
| Observations | 22 wars | | | 29 Cooperating States | 91 Defecting States |

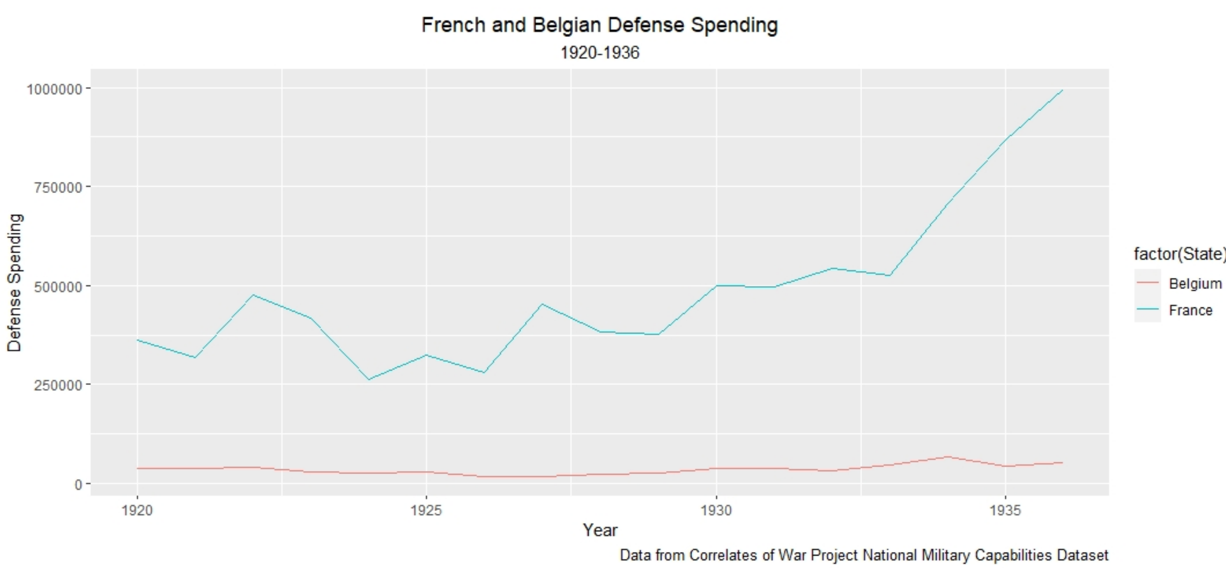
Notes:
Data compiled from the Correlates of War Project and the Alliance Treaty Obligations and Provisions Data Project.

propensity of its partners to uphold their alliance agreements. Conversely, when evidence suggests that alliance longevity is in question but the partnership endures, we should observe defense spending that strengthens the alliance through complementary capability.

### 3.2.1 The Franco-Belgian Alliance: 1920-1936

After WWI, France and Belgium forged a secretive military pact that committed each state to cooperate in defense against a repeat of westward German aggression in Europe. The alliance met numerous criteria for a stable partnership; it was a limited agreement involving reliably democratic neighboring states with a recent history of cooperative victory in major conflict. Yet, it was abrogated by the weaker side on the eve of the deadliest conflict in world history. Evidence suggests that France's defense spending growth in the early 1930's and its insular military strategy contributed to the expiration of the agreement.

Figure 3.1: French and Belgian Defense Spending, 1920-1936




Alliance agreements that contain specific provisions for cooperation are often more reliable than general alliance agreements (Leeds et al 2000). The Franco-Belgian defense pact was certainly limited in scope. It specified a cooperative agreement for Rhineland defense, overall force sizes to be maintained, and committed each state to go to war only in the event of an unprovoked attack against both states simultaneously. Furthermore, each party was free to judge events independently and abrogate the agreement within 5 years of Rhineland cessation to Germany (Helmreich 1964, 372). Though the agreement did not specify it, military planners on both sides quickly began preparing for a cooperative defense of each country's frontier lands.

Defense planning proved to be a point of contention between the allies in the 1930s. The Belgians confronted domestic political dissent. The Flemish advisers favored a strategy of layered defense, gradually ceding territory if confronted by a superior invading force, while the Walloon's advocated a vigorous defense of the Belgian frontier. The French preferred the frontier defense strategy, hoping to keep the fighting as far from French territory as possible. Meanwhile, French military doctrine, drawn from experiences at the close of WWI, called for organized, detailed war plans creating conditions for decisive battles on favorable terms. As such, the French sought to bolster their own frontier defenses, creating the famed Maginot Line along the French eastern border. Simultaneously, France endeavored to modernize its own armed forces, developing not only a land Army to rival any in Europe, but also a leading Air Force and Navy. French defense spending grew 35% in 1934, 23% in 1935, and another 15% in 1936. See figure 3.1 for a comparison of French and Belgian defense spending over the tenure of the Franco-Belgian alliance. The French did not collaborate closely with the Belgians on the construction or maintenance of Belgian defenses nor the interoperability of their armed forces. France's defensive improvements and strategy left Belgium isolated to the east, between France and Germany. France's foreign policy focused more on addressing the potential for German expansion eastward given Germany's economic and potential military advantages there (Helmreich 1964, Thomas 1998). As such, French investments in military capability in the 1930s largely favored unilateral French interests over cooperative Franco-Belgian interests.

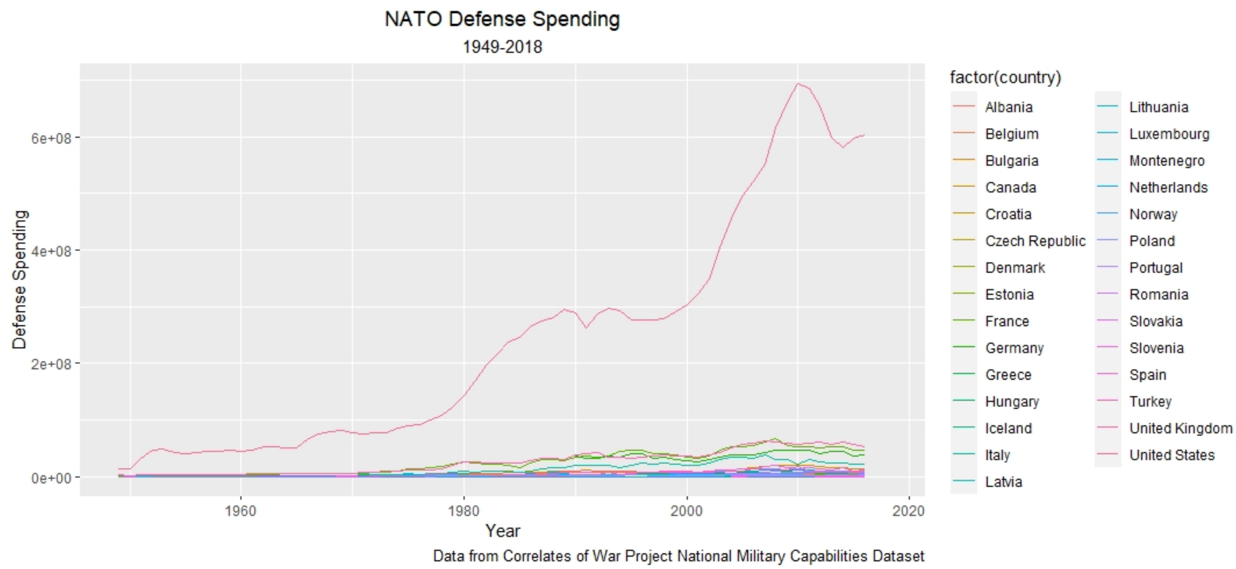
Thus, France's defense spending and military strategy in the 1930s altered the conditions under which the Franco-Belgian alliance was formed. The growth in French military power and its decidedly French military and foreign policy diminished Belgian confidence in the the French commitment to the alliance. Confronted with the specter of recent European conflict and impending German rearmament, Belgium opted to abandon its fifteen-year military alliance with France in favor of a policy of neutrality in the hopes of avoiding any involvement in another European conflict.

### 3.2.2 The Durability of American Support to NATO

One of the most interesting and oft studied alliance cases is the North Atlantic Treaty Organization (NATO). The Alliance was formed with the signing of the Atlantic Charter in 1949 in the wake of the Second World War with the goal of promoting peace and cooperation in Europe. It is the largest alliance that the world has ever known, with its membership reaching thirty states at the time of writing, and it has never dropped a member. NATO's longevity is indeed remarkable. Lord Hastings Ismay, NATO's first Secretary General, famously quipped that the Alliance's purpose with regard to Europe was to "keep the Russians out, the Americans in, and the Germans down." Less than a decade after the founding of the Alliance, the Federal Republic of Germany was admitted as a member. Over 30 years ago, the Soviet Union disintegrated, leaving many to wonder whether the Alliance continued to serve a purpose (Yost, 2014). Not only did NATO persevere, it nearly doubled in size with even more European states seeking admittance. Much has been written about NATO's continuing international political relevance and its bureaucratic inertia to explain its surviving past 70 years. This paper offers a more practical explanation. Perhaps it is the lack of spending by so many of NATO's European members that enables the alliance to survive.

American President's since Eisenhower have lamented what they have perceived as paltry defense contributions by the majority of NATO's European members. Upon assuming command of NATO, then General Eisenhower speculated that American military forces would return from Europe within ten years. He later championed numerous failed initiatives, including an integrated European Defense community and even a Multilateral Nuclear Force under NATO control. President Eisenhower ruminated that America's European Allies were "making a sucker out of Uncle Sam" by refusing to provide for their own defense (Leffler 2010, 298). Currently, the United States

Figure 3.2: NATO Defense Spending, 1949-2018




defense budget represents two-thirds of all NATO military spending while France, Germany, and the United Kingdom together make up more than half of the remaining military capability. Over fifteen years ago, all NATO members agreed to a policy of spending a minimum of 2% of their respective GDPs on defense; less than ten states have hit that mark. Nightly news was made of former President Donald Trump's speculation about NATO's importance and the Allies reluctance to bolster their defenses. Even President Joseph Biden, speaking at a 2015 NATO summit then as Vice President, referenced Americans' discontent with the apparently unequal burden of European defense. The evidence presented in the previous two chapters suggests that these leaders perhaps failed to consider best strategies from the point of view of their European allies. The theory contends that pleadings to increase allied defense contributions to meet blanket thresholds coupled with simultaneous threats to withdraw from alliance commitments may work at cross-purposes.

When the conditions under which an alliance formed change significantly, then that Alliance has a heightened probability of ending prematurely (Leeds & Savun 2007). The European security environment in which NATO was formed has undergone numerous shifts since the inception of the Alliance. Germany was admitted and later unified, removing a principle source of European belligerency. The threat of both conventional and nuclear war against the Soviet Union in Europe waxed and waned over several decades while limited proxy wars were waged all over the globe. Persistent unrest in the Balkans continued to threaten European security after the fall of the Soviet Union. Transnational violent extremist organizations carried out and inspired attacks all over the West in the years after the Al Qaeda's 2001 terrorist attacks in the United States. An ever evolving migration and refugee crisis saw the European Union reexamining its border policies. All the while, the European Union and NATO's membership grew, indicating a more politically unified European continent.

Despite ever changing threats to European security and disparate conceptions of the principal threat to the Alliance, NATO has perennially sought not only to increase its members' individual contributions to defense but also to steer member states' defense expenditures toward critical Alliance capability shortfalls. The smaller, newer Allies favor shoring up their defenses against neighboring adversaries while the largest, most established western members prefer building a deployable, interoperable expeditionary force capable of responding to global contingencies. Indeed, NATO's Defense and Planning Process (NDPP) markets a "shopping list" that prioritizes filling Alliance capability gaps over bolstering the unilateral security of member states (Schroeder 2019, 10-11), This menu includes worldwide deployable networks, aerial electronic attack, anti-submarine warfare, and joint intelligence capabilities at the top of the catalog of options. Two other important things remained constant. American security remained inexorably tied to European security, and European states remained collectively unable or unwilling to address security threats in a way that met the expectations of American leaders. As long as American interest in European security remains high and European contributions to Allied defense address alliance needs while remaining low, then American support to NATO should endure.

### 3.3 Wartime Defection

If allies have disparate political ideologies, are separated by great physical distance, or possess military capabilities of markedly greater power, then they are more likely to defect in the event of war. Conversely, allies that experience greater levels of relative threat are more likely to uphold their alliance commitments. In the next section I examine the wartime defection dataset developed in the previous chapter to identify cases where defection was either highly likely or highly unlikely given the above criteria.[1] I then search for instances of defection and cooperation that do not conform with expectations, and I examine the defense spending decisions of states within these alliances to determine the effect of spending on state behavior. In instances where cooperation is deemed likely given the above factors but defection occurred, theory suggests that we should observe the targeted state increasing spending on substitute military capability, augmenting their unilateral defenses. In instances where defection is deemed likely, but cooperation occurred, we should observe the targeted state increasing spending on complementary capability bolstering the alliance.

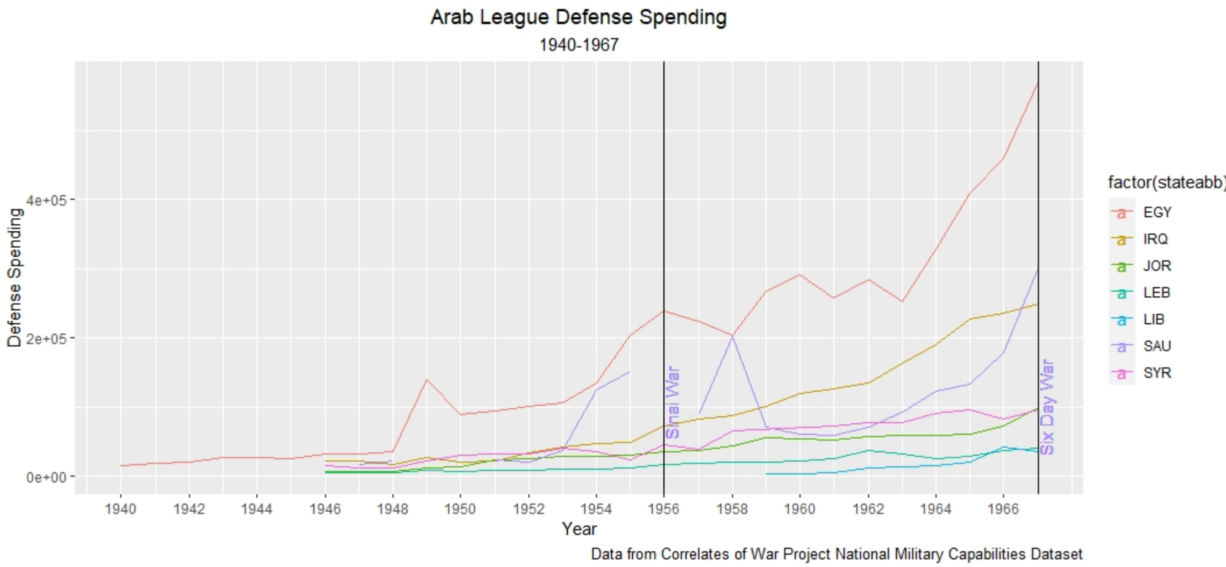
### 3.3.1 Egypt and the Arab League in the 1956 Sinai War and 1967 Suez Crisis

The Arab League provides several wartime cases of alliance decision making for analysis. Here I consider Egypt's role in the early years of the Arab League and its performance in conflict against Israel. In the early 1950s, Egypt sought to assert its leadership in the Arab world and began investing more heavily in its military defenses. Coupled with intra-alliance political dissension and inter-alliance conflict, Egypt's rise in power undermined the unity of the League and motivated its members to defect from their defensive obligations. These allies were geographically proximate and similar in power and authoritarian political ideology. Their shared history of European colonization belied disparate enduring influences, however, and Egypt's defense spending in support of regional dominance outpaced that of its partners, leaving Egypt to fight alone.

The Arab League was formed in 1945, concordant with the United Nations, on the principles of rebuilding and reintegrating the Arab community. At the end of the Second World War, Arab leaders grew concerned about the fates of their territories and the threat of enduring European colonial ambitions in the Middle East and Africa along the lines of the Sykes-Picot Agreement. The

[1] To determine likelihood, I filter the results by quartile as well as by variations greater than one standard deviation from the mean.

Figure 3.3: Egypt's Defense Spending Before and After Suez Crisis, 1940-1967




League's seven founding members, Egypt, Iraq, Lebanon, Saudi Arabia, Syria, and Transjordan, agreed to collaborate on a wide range of issues, including military matters, and added a mutual defense pact to the chartered agreement in 1950 after joining in combat to oppose the independence of Israel in 1948, and its membership has since grown to include 22 member states. Though unsuccessful in its initial opposition of Israeli independence, conflict between Israelis and Palestinians would continue to be a principle issue for the Arab League in the decades to come.

The Arab League was headquartered in Cairo, Egypt, and the Egyptian President, Gamel Abdel Nasser, became its defacto leader and champion of the pan-Arab movement in the 1950s. Still, the league never achieved the level of cooperation and integration necessary to reap any military efficiencies. Political strife and internal dissension among allies plagued the Arab League from its outset. Ancient rivalries persisted and the "binds" of the alliance became mere "links" and its intent became "stabilization" in lieu of "consolidation" of the Arab world (Little 1965, 140). Furthermore, post-war European influences endured, with the United Kingdom, France, Italy, the Soviet Union, and the United States all competing for influence among the League members. Military cooperation and specialization requires faith that one's ally will come to their aide if called upon, and that faith was not present in the early Arab League.

President Nasser announced the nationalization of the Suez Canal, a strategic waterway connecting the Mediterranean Sea to the Red Sea, dividing Africa and Asia, in July 1956. The waterway was until then owned by the British and French Suez Canal Company, and the nationalization of the canal marked a culmination of Egyptian efforts to expel colonial influence from its territory and establish itself firmly as the leader of the Arab world. The British and French responded by cooperating with Israel to invade Egypt and seize the canal zone. The fighting lasted only a week, and ended in a multilateral negotiation and the withdrawal of British, French, and Israeli troops after Soviet threats of nuclear attack and American threats of economic sanctions.

Of note, none of the Arab League member states mobilized their forces to contribute to Egypt's defense. For their part, Libya refused the United Kingdom use of bases on its territory for staging military forces (Worrall 2007). Saudi Arabia participated in "Five-Power" negotiations and lobbied on Egypt's behalf. Jordan had recently expelled British military leadership, but remained party to a defense pact with the United Kingdom. Iraq remained Egypt's chief rival for Arab hegemony and offered no military support. They too were negotiating a separate alliance with Britain the year prior, the Baghdad Pact. Iraq did, however, at the behest of Britain, begin the transfer of military forces to Jordan in the event the conflict spread (Raad 2007). Lebanon, too, sided with the west, even expelling government officials who advocated support for Nasser and Egypt, foreshadowing internal strife which was to come (Little 1996, 34). In the lone example of Arab League cooperation, Egypt and Syria formed a joint military command in 1955 and together acquired arms from the Soviet Union, but Syrian military support for the conflict was not forthcoming amidst domestic turmoil. Egypt and Syria did briefly merge, forming the United Arab Republic in 1958, but Syria ended the collaboration in 1961 as Egypt continued its efforts to control Arab politics.

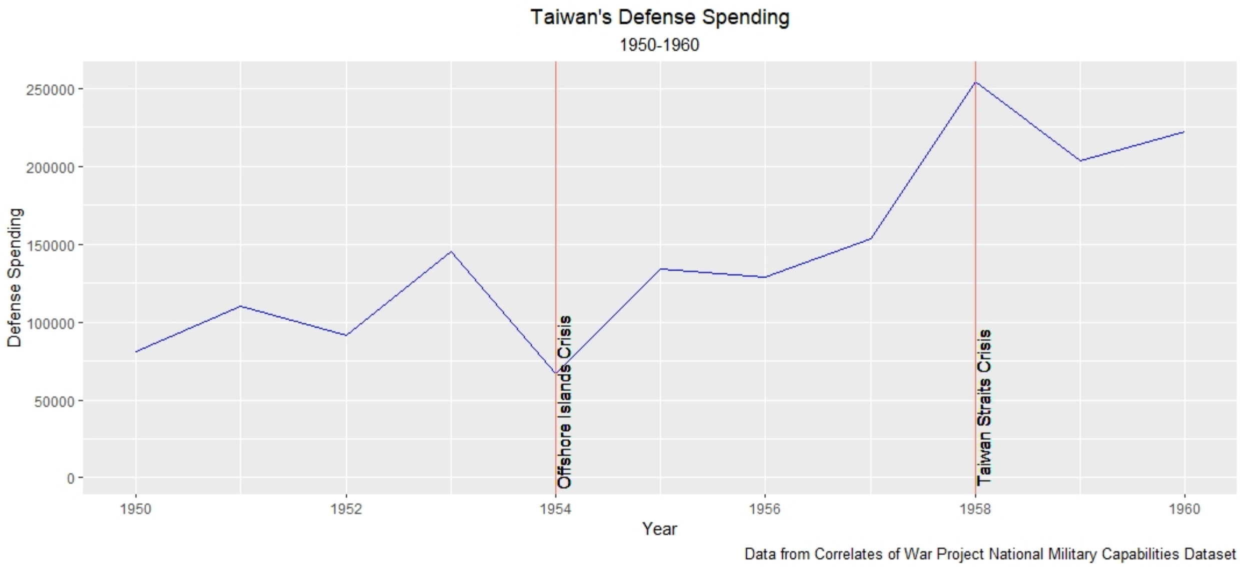
Egyptian defense spending increased each year from 1950 through 1956 and continued to rise throughout the 1960s, outpacing those of the rest of the Arab League except for sporadic bursts in spending by Saudi Arabia. See figure 3.3 for a comparison Egypt's defense spending to its partner states in the Arab League. In the years preceding the Suez Crisis, Egypt purchased large amounts of arms from Czechoslovakia, then a client state of the Soviet Union, while also receiving aide from the United States. Egypt's growing military power and its political assertiveness wrought rivalry within the Arab League rather than cooperation. Nasser's perceived victory in the Suez Crisis elevated his standing and perpetuated competition over Arab leadership within the League. Over a decade later, the trend persisted and the Arab League again failed to organize a collective defense against its longtime foe. Three Arab League members are listed as participants in this conflict (Egypt, Syria, and Jordan); however, they were essentially simultaneously attacked by Israel and can hardly be said to have coordinated their participation in support of one another, resulting in the loss of Arab territory from the Dead Sea in the East to the Suez in the west. Egypt's increased defense spending coupled with its contentious motives of Arab leadership and regional dominance contributed to the failure of the Arab League to coalesce and oppose Israel together.

### 3.3.2 Taiwan and the U.S. in the 1954 Offshore Islands and 1958 Taiwan Straits Crises

Theory suggests that the United States ought to have abandoned Taiwan when crisis in the straits resumed in 1958. Taiwan's defense spending tripled in the four years between the two crisis peaks. The formal alliance was young and contentious, having been enacted in 1955 and exacerbating hostility between the U.S. and China. The two capitals, Taipei and Washington D.C., were separated by over 6,000 miles. The allies were led by disparate political regimes, with a difference of 17 points on the Polity2 scale in the 1950s. The U.S. had the preponderance of military power, with a relative power CINC score more than three times larger than its adversary and 50 times larger than its ally. The U.S. also had numerous global security responsibilities in carrying out its policy of containing the spread of communism, experiencing dozens of militarized international disputes in the 1950s. Indeed, the incident is coded as a defection by the criteria employed in most empirical studies. After all, the United States did not commit its military forces to fighting. Closer examination of events reveals critical American involvement throughout the crisis, including military intervention.

In 1949, Chinese Communist forces drove the Chinese Nationalist forces from the mainland. The nationalists, calling themselves the Republic of China, took up residence on the islands off

Figure 3.4: Taiwan's Defense Spending During the Offshore Islands and Taiwan Straits Crises, 1950-60




China's southeastern coast, principally on the island of Formosa, today called Taiwan. Tensions between the Communists and Nationalists remained high and often manifested themselves over control of these disputed offshore islands. Nationalist control of several small islands threatened Chinese port facilities and shipping in the area, and the islands were integral to any communist strategy to retake Taiwan. (Elleman 2021).

Upon reaching an armistice in the Korean conflict in 1953, the People's Republic of China (PRC) turned their attentions to these offshore islands, proclaiming the need to liberate Taiwan. In September 1954, they launched an artillery strike against the islands, striking Quemoy and Matsu and later invaded Yijiangshan in January 1955. Taiwan vacated the Dachen Island chain, ceding control to the PRC and tensions quickly cooled by April. The Nationalists continued their blockade of the PRC, who in turn augmented their coastal defense forces. The Communists grew tired of interruptions to their growing trade relations, particularly with the British. Hostilities flared once more in 1958, and the PRC again attacked the island of Quemoy with a reported 40,000 shells. The Nationalists invoked their alliance and requested the full might of the U.S. military. The United Stated declined to participate in the fighting, however, and restricted their forces from operating within three miles of PRC territory. The second phase of the conflict ended when the Nationalists agreed to reduce their military footprint on the offshore islands. The Nationalists suffered a reported 3,000 military casualties along with almost 150 civilians dead and thousands of buildings destroyed.

Although the U.S. did not engage directly in the fighting, American and Taiwanese forces were acting in concert, with the United States 7th Fleet projecting American naval power in the region and the Kuomintang Army of Chiang Kai-shek providing the local ground forces. American naval forces had taken up permanent presence in the region. Though American forces were not involved in the shooting war, the matter in which they contributed to the conflict is ambiguous. One could argue that the presence of the U.S. 7th fleet limited the scope of the conflict, deterring an all out invasion of Taiwan. The Seventh Fleet positioned numerous ships in the vicinity of Taiwan, effectively assuming its tactical defense while the Chinese Nationalists defended the offshore islands (Elleman 2021, 94). Also, U.S. naval forces helped to evacuate tens of thousands of nationalist military and civilians from the embattled islands. The United States was the principal arms supplier to Taiwan and provided critical military equipment to support the Nationalists throughout the conflict. Furthermore, the threat of nuclear war combined with the presence of the U.S. fleet limited the scope of the PRCs aggression.

The crisis in the Taiwan Straits became a symbol of America's steadfast opposition to the spread of communism. The United States quickly turned to the United Nations to mediate a cease-fire, which the PRC opposed. The U.S. Congress approved a resolution authorizing President Eisenhower the use of force in defending Taiwan from PRC aggression. In an effort to de-escalate the early conflict, the U.S. lobbied Chiang Kai-shek to evacuate and turn over the Dachen Islands. The U.S. State Department continuously led diplomatic efforts to stave off further violence, ending the second flare up by negotiating to reduce Nationalist military presence on the offshore islands, reducing the threat to the mainland and effectively ending the decade-long blockade. Thus, U.S. involvement, both military and political, was instrumental throughout the protracted crisis despite prevailing circumstances suggesting that the U.S. would likely defect. The interoperability of U.S.

and Chinese Nationalist military forces, the former providing the preponderance of naval power and the latter providing the land forces, helped to keep the partnership intact.

## 3.4 Conclusion

The complete information bargaining game presented in the first chapter describes a set of alliance members' equilibrium behaviors when a targeted state is presented with an opportunity to make a contribution to defense in anticipation of a challenge and her ally has an opportunity to cooperate in conflict or defect from his defensive obligations. A wide range of behaviors are possible in equilibrium. A target may invest in complementary capability and induce an ally to cooperate. Conversely, a target may invest in substitute capability and motivate an ally to defect. Interestingly a smaller defense expenditure may be preferable to a larger one for all allied parties, and the best course for the target may be to spend nothing at all on defense.

The second chapter reported the effects of defense spending on alliance behavior using real world data on states' military spending, alliance membership, and the incidence of war over a 200-year period, as well as several covariates. The results indicate that when members of defense pacts increase their defense spending, they experience a higher incidence of their alliance agreements ending early in violation of their specified terms. This supports the theory that defense spending may alter the conditions under which an alliance was formed and motivate states to violate or terminate their alliance agreements. In wartime, however, states are more likely to uphold their defensive obligations after their partners increase their defense spending. Paired with the results of the formal model, this suggests that parties to defense pacts more often invest in complementary capabilities that reinforce alliance commitments rather than substitute capabilities that undermine alliance reliability.

The case evidence presented in this final chapter lends descriptive analysis of individual events, facilitating a deeper understanding of the relationship between defense spending and alliance defection. Indeed, the theorized relationships are borne out by the historical record, and defense spending has influenced the behavior of allies in accordance with the relationships theorized in the previous two chapters; however, the case analysis illustrates that a variety of additional factors intervene to influence ally behavior. Regional disparities are evident and may warrant a closer examination of the empirical record. Competing alliance agreements may keep an otherwise cooperative ally out of a fight. Competition within an alliance can inspire opportunism among members and motivate defection from defensive obligations. Sometimes cooperation is a product of a challenger's broadly applied aggression rather than a conscious effort among allies to work together in defense. In other instances, any ally who did not participate with troops in accordance with its obligations did cooperate in other ways to help bring about a satisfactory conclusion to hostilities.

Together these results suggest several important implications for alliance policy and behavior. First, states that encourage their allies to increase their defense spending to meet an arbitrary threshold may do so at their own peril. In NATO's case, a 2% spending threshold is unlikely to interrupt the intra-alliance power dynamics sufficiently to warrant a U.S. abrogation of its defensive obligations to Europe. In a more symmetrical alliance, it may. If states anticipate conflict, then the negative effects of increased in defense spending may be mitigated, particularly if states acquire capabilities that fulfill alliance security needs. Therefore, states desiring to both increase spending among allies and preserve the reliability of their alliance agreements do best to emphasize the imminent threat of conflict with joint adversaries. Also, smaller defense contributions may indeed be the best option for smaller alliance members, and states must consider the strategic calculus of their partners when judging their defense budgets. Exacerbating tensions within alliances by criticizing security decisions or competing for regional dominance undermines alliance reliability. Reinforcing commitments to smaller states and allowing them to specialize their military forces can create battlefield efficiencies that yield the best results for all allies fighting together.

## References


Allen, M. A., Digiuseppe, M. (2013). Tightening the Belt: Sovereign Debt and Alliance Formation. International Studies Quarterly, 57(4), 647–659. https://doi.org/10.1111/isqu.12010

Altfeld, M. F. (1984). The Decision to Ally: A Theory and Test. The Western Political Quarterly, 37(4), 523–544. https://doi.org/10.2307/448471

Altfeld, M. F., de Mesquita, B. B. (1979). Choosing Sides in Wars. International Studies Quarterly, 23(1), 87–112. https://doi.org/10.2307/2600275

Appathurai, J. (2002, September 1). NATO Review - Closing the Capabilities Gap. NATO Review. https://www.nato.int/docu/review/articles/2002/09/01/closing-the-capabilities-gap/index.html

Barnett, M. N., Levy, J. S. (1991). Domestic Sources of Alliances and Alignments: The Case of Egypt, 1962-73. International Organization, 45(3), 369–395.

Bas, M., Schub, R. (2016). Mutual Optimism as a Cause of Conflict: Secret Alliances and Conflict Onset. International Studies Quarterly, 60(3), 552–564. https://doi.org/10.1093/isq/sqw002

Beckley, M. (2012). China's Century? Why America's Edge Will Endure. International Security, 36(3), 41–78. https://doi.org/10.1162/ISEC_a_00066

Beckley, M. (2015). The Myth of Entangling Alliances: Reassessing the Security Risks of U.S. Defense Pacts. International Security, 39(4), 7–48. https://doi.org/10.1162/ISEC_a_00197

Beckley, M. (2018). The Power of Nations: Measuring What Matters. International Security, 43(2), 7–44. https://doi.org/10.1162/isec_a_00328

Benson, B. V. (2011). Unpacking Alliances: Deterrent and Compellent Alliances and Their Relationship with Conflict, 1816–2000. The Journal of Politics, 73(4), 1111–1127. https://doi.org/10.1017/S0022381611000867

Benson, B. V., Clinton, J. D. (2016). Assessing the Variation of Formal Military Alliances. Journal of Conflict Resolution, 60(5), 866–898. https://doi.org/10.1177/0022002714560348

Benson, B. V., Meirowitz, A., Ramsay, K. W. (2014). Inducing Deterrence through Moral Hazard in Alliance Contracts. Journal of Conflict Resolution, 58(2), 307–335. https://doi.org/10.1177/0022002712467936

Berkemeier, M., Fuhrmann, M. (2018). Reassessing the fulfillment of alliance commitments in war. Research Politics, 5(2), 2053168018779697. https://doi.org/10.1177/2053168018779697

Betts, R. K. (1992). Systems for Peace or Causes of War? Collective Security, Arms Control, and the New Europe. International Security, 17(1), 5–43. https://doi.org/10.2307/2539157

Blankenship, B., Lin-Greenberg, E. (2022). Replication Data for: Trivial Tripwires? Military Capabilities and Alliance Reassurance [Data set]. Harvard Dataverse. https://doi.org/10.7910/DVN/ZXCXNV

Boutton, A. (2019). Coup-Proofing in the Shadow of Intervention: Alliances, Moral Hazard, and Violence in Authoritarian Regimes. International Studies Quarterly, 63(1), 43–57. https://doi.org/10.1093/isq/sqy056

Carroll, R. J., Kenkel, B. (2019). Prediction, Proxies, and Power. American Journal of Political Science, 63(3), 577–593. https://doi.org/10.1111/ajps.12442

Chiba, D., Johnson, J. C., Leeds, B. A. (2015). Careful Commitments: Democratic States and Alliance Design. The Journal of Politics, 77(4), 968–982. https://doi.org/10.1086/682074

Clare, J. (2013). The Deterrent Value of Democratic Allies. International Studies Quarterly, 57(3), 545–555. https://doi.org/10.1111/isqu.12012

Colaresi, M. P., Thompson, W. R. (2005). Alliances, Arms Buildups and Recurrent Conflict: Testing a Steps-to-War Model. The Journal of Politics, 67(2), 345–364. https://doi.org/10.1111/j.1468-2508.2005.00320.x

Conybeare, J. A. C. (1992). A Portfolio Diversification Model of Alliances: The Triple Alliance and Triple Entente, 1879-1914. Journal of Conflict Resolution, 36(1), 53–85. https://doi.org/10.1177/0022002792036001003

Conybeare, J. A. C. (1994a). The Portfolio Benefits of Free Riding in Military Alliances. International Studies Quarterly, 38(3), 405–419. https://doi.org/10.2307/2600739

Conybeare, J. A. C. (1994b). Arms Versus Alliances: The Capital Structure of Military Enterprise. Journal of Conflict Resolution, 38(2), 215–235. https://doi.org/10.1177/0022002794038002003

Crescenzi, M. J. C., Enterline, A. J. (2001). Time Remembered: A Dynamic Model of Interstate Interaction. International Studies Quarterly, 45(3), 409–431.

Crescenzi, M. J. C., Enterline, A. J., Long, S. B. (2008). Bringing Cooperation Back In: A Dynamic Model of Interstate Interaction. Conflict Management and Peace Science, 25(3), 264–280. https://doi.org/10.1080/07388940802219059

Crescenzi, M. J. C., Kathman, J. D., Kleinberg, K. B., Wood, R. M. (2012). Reliability, Reputation, and Alliance Formation1: Reliability, Reputation, and Alliance Formation. International Studies Quarterly, 56(2), 259–274. https://doi.org/10.1111/j.1468-2478.2011.00711.x

Crowcroft, B. (2016). Egypt's Other Nationalists and the Suez Crisis of 1956. The Historical

Journal, 59(1), 253–285. https://doi.org/10.1017/S0018246X15000060

De Mesquita, B. B. (1980). An Expected Utility Theory of International Conflict. The American Political Science Review, 74(4), 917–931. https://doi.org/10.2307/1954313

De Mesquita, B. B. (1981). Risk, Power Distributions, and the Likelihood of War. International Studies Quarterly, 25(4), 541–568. https://doi.org/10.2307/2600512

De Mesquita, B. B. (1985). The War Trap Revisited: A Revised Expected Utility Model. The American Political Science Review, 79(1), 156–177. https://doi.org/10.2307/1956125

Digiuseppe, M., Poast, P. (2018). Arms versus Democratic Allies. British Journal of Political Science, 48(4), 981–1003. https://doi.org/10.1017/S0007123416000247

DiGiuseppe, M., Shea, P. (2020). Alliances, Signals of Support, and Military Effort. SocArXiv. https://doi.org/10.31235/osf.io/acrpb

Downs, G. W., Rocke, D. M., Siverson, R. M. (1985). Arms Races and Cooperation. World Politics, 38(1), 118–146. https://doi.org/10.2307/2010353

Eden, A. (1968). The Suez Crisis of 1956. Beacon Press.

Elleman, B. A. (2021). Taiwan Straits Standoff: 70 Years of PRC–Taiwan Cross-Strait Tensions. Anthem Press. https://doi.org/10.2307/j.ctv1zvcccg

Fang, S., Johnson, J. C., Leeds, B. A. (2014). To Concede or to Resist? The Restraining Effect of Military Alliances. International Organization, 68(4), 775–809.

Fariss, C. J., Anders, T., Markowitz, J. N., Barnum, M. (2022). New Estimates of Over 500 Years of Historic GDP and Population Data. Journal of Conflict Resolution, 66(3), 553–591. https://doi.org/10.1177/00220027211054432

Fearon, J. D. (1995). Rationalist Explanations for War. International Organization, 49(3), 379–414.

Fearon, J. D. (1997). Signaling Foreign Policy Interests: Tying Hands versus Sinking Costs. The Journal of Conflict Resolution, 41(1), 68–90.

Fearon, J. D. (1998). Bargaining, Enforcement, and International Cooperation. International Organization, 52(2), 269–305. https://doi.org/10.1162/002081898753162820

Fordham, B., Poast, P. (2016). All Alliances Are Multilateral: Rethinking Alliance Formation. Journal of Conflict Resolution, 60(5), 840–865. https://doi.org/10.1177/0022002714553108

Fuhrmann, M., Sechser, T. S. (2014). Signaling Alliance Commitments: Hand-Tying and Sunk Costs in Extended Nuclear Deterrence. American Journal of Political Science, 58(4), 919–935. https://doi.org/10.1111/ajps.12082

Gartzke, E., Gleditsch, K. S. (2004). Why Democracies May Actually Be Less Reliable Allies. American Journal of Political Science, 48(4), 775-795. https://doi-org.proxy.library.vanderbilt.edu/10.2307/1519933

Gibler, D. M. (2008). The Costs of Reneging: Reputation and Alliance Formation. Journal of Conflict Resolution, 52(3), 426–454. https://doi.org/10.1177/0022002707310003

Gibler, D. M., Sarkees, M. R. (2004). Measuring Alliances: The Correlates of War Formal Interstate Alliance Dataset, 1816–2000. Journal of Peace Research, 41(2), 211–222. https://doi.org/10.1177/0022343304041061

Gibler, D. M., Vasquez, J. A. (1998). Uncovering the Dangerous Alliances, 1495-1980. International Studies Quarterly, 42(4), 785–807.

Gibler, D., Rider, T. (2004). Prior Commitments: Compatible Interests versus Capabilities in Alliance Behavior. International Interactions, 30(4), 309–329. https://doi.org/10.1080/03050620490883985\
Glaser, C. L. (1997). The Security Dilemma Revisited. World Politics, 50(1), 171–201. https://doi.org/10.1017/S0043887100014763

Golani, M. (2000). Shall we go to war? And if we do, when? The genesis of the internal debate in Israel on the road to the Sinai war. Israel Affairs, 6(3–4), 22–42. https://doi.org/10.1080/13537120008719570

Gonzalez, R. A., Mehay, S. L. (1991). Burden Sharing in the NATO Alliance: An Empirical Test of Alternative Views. Public Choice, 68(1), 107–116. https://doi.org/10.1007/BF00173822

Grant, K. A. (2013). Outsourcing Security: Alliance Portfolio Size, Capability, and Reliability 1: Alliance Portfolio Size, Capability, and Reliability. International Studies Quarterly, 57(2), 418–429. https://doi.org/10.1111/isqu.12021

Hartley, K., Sandler, T. (1999). NATO Burden-Sharing: Past and Future. Journal of Peace Research, 36(6), 665–680. https://doi.org/10.1177/0022343399036006004

Hasou, Tawfig Y. (2019). The Struggle for the Arab World: Egypt's Nasser and the Arab League. Routledge. https://doi.org/10.4324/9781315829074

Helmreich, J. (1964). The Negotiation of the Franco-Belgian Military Accord of 1920. French Historical Studies, 3(3), 360–378. https://doi.org/10.2307/285948

Henke, M. E. (2017). The Politics of Diplomacy: How the United States Builds Multilateral

Military Coalitions. International Studies Quarterly, 61(2), 410–424. https://doi.org/10.1093/isq/sqx017

Horowitz, M. C., Poast, P., Stam, A. C. (2017). Domestic Signaling of Commitment Credibility: Military Recruitment and Alliance Formation. Journal of Conflict Resolution, 61(8), 1682–1710. https://doi.org/10.1177/0022002715612576

Hourani, C. A. (1947). The Arab League in Perspective. Middle East Journal, 1(2), 125–136.

Jervis, R. (1978). Cooperation Under the Security Dilemma. World Politics, 30(2), 167–214. https://doi.org/10.2307/2009958

Johnson, J. C. (2016). Alliance treaty obligations and war intervention. Conflict Management and Peace Science, 33(5), 451–468.

Johnson, J. C. (2017). External Threat and Alliance Formation. International Studies Quarterly, 61(3), 736–745. https://doi.org/10.1093/isq/sqw054

Johnson, J. C., Joiner, S. (2021). Power changes, alliance credibility, and extended deterrence. Conflict Management and Peace Science, 38(2), 178–199. https://doi.org/10.1177/0738894218824735

Johnson, J. C., Leeds, B. A. (2011). Defense Pacts: A Prescription for Peace?1: Defense Pacts and Peace. Foreign Policy Analysis, 7(1), 45–65. https://doi.org/10.1111/j.1743-8594.2010.00122.x

Kaiser, D. E. (1980). Economic Diplomacy and the Origins of the Second World War: Germany, Britain, France, and Eastern Europe, 1930-1939. Princeton University Press. http://www.jstor.org/stable/j.ctt183q12g

Kang, C.-N. (2017). Capability revisited: Ally's capability and dispute initiation. Conflict Management and Peace Science, 34(5), 546–571. https://doi.org/10.1177/0738894215604966

Kenkel, B. (2019). The Efficacy of CheapTalk in Collective Action Problems. Journal of Theoretical Politics, 31(3), 370–402. https://doi.org/10.1177/0951629819850625

Kenkel, B., Ramsay, K. W. (n.d.). The Effective Power of Military Coalitions: A Unified Theoretical and Empirical Model. 57.

Kenwick, M. R., Vasquez, J. A. (2017). Defense Pacts and Deterrence: Caveat Emptor. The Journal of Politics, 79(1), 329–334. https://doi.org/10.1086/686700

Kenwick, M. R., Vasquez, J. A., Powers, M. A. (2015). Do Alliances Really Deter? The Journal of Politics, 77(4), 943–954. https://doi.org/10.1086/681958

Kimball, A. L. (2006). Alliance Formation and Conflict Initiation: The Missing Link. Journal of Peace Research, 43(4), 371–389. https://doi.org/10.1177/0022343306064816

Kinsella, D. (1995). Nested rivalries: Superpower competition, arms transfers, and regional conflict, 1950–1990. International Interactions, 21(2), 109–125. https://doi.org/10.1080/03050629508434862

Kirkbride, A. S., Huda, T. A., Mulki, F. E. (1948). Treaty of Alliance between His Majesty in Respect of the United Kingdom of Great Britain and Northern Ireland and His Majesty the King of the Hashimite Kingdom of Transjordan, 15th March, 1948. Middle East Journal, 2(4), 469–473.

Krause, K. (1992). Arms and the state: Patterns of military production and trade. Cambridge University Press.

Krause, V. (2004). Hazardous Weapons? Effects of Arms Transfers and Defense Pacts on Militarized Disputes, 1950-1995. International Interactions, 30(4), 349–371. https://doi.org/10.1080/03050620490884038

Krause, V., Sprecher, C. (2004). Causes and Consequences of Military Alliances: Concepts, Theory, Evidence. International Interactions, 30(4), 281–283. https://doi.org/10.1080/03050620490883949

Kuo, R. (2020). Secrecy among Friends: Covert Military Alliances and Portfolio Consistency. Journal of Conflict Resolution, 64(1), 63–89. https://doi.org/10.1177/0022002719849676

Leeds, B. (2015). Capability, Credibility, and Extended General Deterrence [Data set]. Harvard Dataverse. https://doi.org/10.7910/DVN/29531

Leeds, B. A. (2003). Alliance Reliability in Times of War: Explaining State Decisions to Violate Treaties. International Organization, 57(4), 801–827.

Leeds, B. A. (2015). Why Do States Sign Alliances? In Emerging Trends in the Social and Behavioral Sciences (pp. 1–14). American Cancer Society. https://doi.org/10.1002/9781118900772.etrds0387

Leeds, B. A., Johnson, J. C. (2017). Theory, Data, and Deterrence: A Response to Kenwick, Vasquez, and Powers. The Journal of Politics, 79(1), 335–340. https://doi.org/10.1086/687285

Leeds, B. A., Long, A. G., Mitchell, S. M. (2000). Reevaluating Alliance Reliability: Specific Threats, Specific Promises. The Journal of Conflict Resolution, 44(5), 686–699.

Leeds, B. A., Mattes, M., Vogel, J. S. (2009). Interests, Institutions, and the Reliability of International Commitments. American Journal of Political Science, 53(2), 461–476. https://doi.org/10.1111/j.1540-5907.2009.00381.x

Leeds, B. A., Morgan, T. C. (2010). The Quest for Security: Alliances and Arms. Oxford Research Encyclopedia of International Studies. https://doi.org/10.1093/acrefore/9780190846626.013.345

Leeds, B. A., Savun, B. (2007). Terminating Alliances: Why Do States Abrogate Agreements? The Journal of Politics, 69(4), 1118–1132. https://doi.org/10.1111/j.1468-2508.2007.00612.x

Leeds, B., Ritter, J., Mitchell, S., Long, A. (2002). Alliance Treaty Obligations and Provisions, 1815-1944. International Interactions, 28(3), 237–260. https://doi.org/10.1080/03050620213653

Leffler, M. P., Westad, O. A. (2012). The Cambridge History of the Cold War: Volume 1, Origins. Cambridge University Press.

LeVeck, B. L., Narang, N. (2017). How International Reputation Matters: Revisiting Alliance Violations in Context. International Interactions, 43(5), 797–821. https://doi.org/10.1080/03050629.2017.1237818

Levy, J. S. (1981). Alliance Formation and War Behavior: An Analysis of the Great Powers, 1495-1975. The Journal of Conflict Resolution, 25(4), 581–613.

Levy, J. S., Gochal, J. R. (2001). Democracy and Preventive War: Israel and the 1956 Sinai Campaign. Security Studies, 11(2), 1–49. https://doi.org/10.1080/714005332

Little, D. (1996). His Finest Hour? Eisenhower, Lebanon, and the 1958 Middle East Crisis. Diplomatic History, 20(1), 27–54.

Little, T. R. (1956). The Arab League: A Reassessment. Middle East Journal, 10(2), 138–150.

Lute, D., Burns, N. (2019). NATO at Seventy: An Alliance in Crisis (Project on Europe and the Transatlantic Relationship). Belfer Center for Science and International Affairs. https://www.atlanticcouncil.org/wp-content/uploads/2019/04

Mattes, M. (2012a). Democratic Reliability, Precommitment of Successor Governments, and the Choice of Alliance Commitment. International Organization, 66(1), 153–172. https://doi.org/10.1017/S0020818311000336

Mattes, M. (2012b). Reputation, Symmetry, and Alliance Design. International Organization, 66(4), 679–707. https://doi.org/10.1017/S002081831200029X

McGillivray, F., Smith, A. (2000). Trust and Cooperation Through Agent-specific Punishments. International Organization, 54(4), 809–824. https://doi.org/10.1162/002081800551370

McGinnis, M. D. (1990). A Rational Model of Regional Rivalry. International Studies Quarterly, 34(1), 111–135. https://doi.org/10.2307/2600407

Milner, H. (1992). International Theories of Cooperation Among Nations: Strengths and Weaknesses. World Politics, 44(3), 466–496. https://doi.org/10.2307/2010546

Morgan, T. C., Palmer, G. (2000). A Model of Foreign Policy Substitutability: Selecting the Right Tools for the Job(s). The Journal of Conflict Resolution, 44(1), 11–32.

Morrow, J. D. (1991). Alliances and Asymmetry: An Alternative to the Capability Aggregation Model of Alliances. American Journal of Political Science, 35(4), 904–933. https://doi.org/10.2307/2111499

Morrow, J. D. (1993). Arms Versus Allies: Trade-Offs in the Search for Security. International Organization, 47(2), 207–233.

Morrow, J. D. (1994). Alliances, Credibility, and Peacetime Costs. Journal of Conflict Resolution, 38(2), 270–297. https://doi.org/10.1177/0022002794038002005

Morrow, J., D. (2000). Alliances: Why Write Them Down? Annual Review of Political Science, 3, 63–83.

Morrow, J. D. (2017). When Do Defensive Alliances Provoke Rather than Deter? The Journal of Politics, 79(1), 341–345. https://doi.org/10.1086/686973

Murdoch, J. C., Sandler, T. (1991). NATO Burden Sharing and the Forces of Change: Further Observations. International Studies Quarterly, 35(1), 109–114. https://doi.org/10.2307/2600391

Narang, N., LeVeck, B. L. (2019). International Reputation and Alliance Portfolios: How Unreliability Affects the Structure and Composition of Alliance Treaties. Journal of Peace Research, 56(3), 379–394. https://doi.org/10.1177/0022343318808844

Niou, E. M. S., Zeigler, S. M. (2019). External Threat, Internal Rivalry, and Alliance Formation — The Journal of Politics: Vol 81, No 2. The Journal of Politics, 81(2), 571–584.

Olson, M. (1971). The Logic of Collective Action: Public Goods and the Theory of Groups. Harvard Economic Studies. https://www.hup.harvard.edu/catalog.php?isbn=9780674537514

Olson, M., Zeckhauser, R. (1966). An Economic Theory of Alliances. The Review of Economics and Statistics, 48(3), 266–279. https://doi.org/10.2307/1927082

Oneal, J. R. (1991). Rejoinder to Murdoch and Sandler. International Studies Quarterly, 35(1), 115–117. https://doi.org/10.2307/2600392

Oren, M. B. (1990). A Winter of Discontent: Britain's Crisis in Jordan, December 1955-March 1956. International Journal of Middle East Studies, 22(2), 171–184.

Palmer, G. (1990). Alliance Politics and Issue Areas: Determinants of Defense Spending. American Journal of Political Science, 34(1), 190–211. https://doi.org/10.2307/2111515

Palmer, G., Bhandari, A. (2000). The Investigation of Substitutability in Foreign Policy. The

Journal of Conflict Resolution, 44(1), 3–10.

Paul Poast. (2019). Arguing about Alliances: The Art of Agreement in Military-Pact Negotiations. Cornell University Press. https://doi.org/10.7591/j.ctvfc52c5

Plümper, T., Neumayer, E. (2015). Free-riding in alliances: Testing an old theory with a new method. Conflict Management and Peace Science, 32(3), 247–268. https://doi.org/10.1177/0738894214522916

Podeh, E. (1993). The Struggle over Arab Hegemony after the Suez Crisis. Middle Eastern Studies, 29(1), 91–110.

Powell, R. (1991). Absolute and Relative Gains in International Relations Theory. American Political Science Review, 85(4), 1303–1320. https://doi.org/10.2307/1963947

Powell, R. (2002). Bargaining Theory and International Conflict. Annual Review of Political Science, 5, 1–30. https://doi.org/10.1146/annurev.polisci.5.092601.141138

Powell, R. (2007). Allocating Defensive Resources with Private Information about Vulnerability. American Political Science Review, 101(4), 799–809. https://doi.org/10.1017/S0003055407070530

Powers, K. (2004). Regional Trade Agreements as Military Alliances. International Interactions, 30(4), 373–395. https://doi.org/10.1080/03050620490884065

Raad, Z. (1994). A Nightmare Avoided: Jordan and Suez 1956. Israel Affairs, 1(2), 288–308. https://doi.org/10.1080/13537129408719328

Reiter, D. (2003). Exploring the Bargaining Model of War. Perspectives on Politics, 1(1), 27–43.

Reiter, D., Stam, A. C., Horowitz, M. C. (2016a). A Revised Look at Interstate Wars, 1816–2007. Journal of Conflict Resolution, 60(5), 956–976. https://doi.org/10.1177/0022002714553107

Reiter, D., Stam, A. C., Horowitz, M. C. (2016b). A Deeper Look at Interstate War Data: Interstate War Data Version 1.1. Research Politics, 3(4), 2053168016683840. https://doi.org/10.1177/2053168016683840

Saperstein, A. M. (1992). Alliance Building versus Independent Action: A Nonlinear Modeling Approach to Comparative International Stability. Journal of Conflict Resolution, 36(3), 518–545. https://doi.org/10.1177/0022002792036003005

Schelling, T. C. (1995). Arms and Influence. Yale University Press. http://ebookcentral.proquest.com/lib/vand/detail.action?docID=3421294

Signorino, C. S., Ritter, J. M. (1999). Tau-b or Not Tau-b: Measuring the Similarity of Foreign

Policy Positions. International Studies Quarterly, 43(1), 115–144.

Singer, J. D., Small, M. (1966). Formal Alliances, 1815—1939: A Quantitative Description. Journal of Peace Research, 3(1), 1–31. https://doi.org/10.1177/002234336600300101

Slantchev, B. L. (2005). Military Coercion in Interstate Crises. American Political Science Review, 99(4), 533–547. https://doi.org/10.1017/S0003055405051865

Small, M., Singer, J. D. (1969). Formal Alliances, 1816-1965: An Extension of the Basic Data. Journal of Peace Research, 6(3), 257–282. https://doi.org/10.1177/002234336900600305

Smith, A. (1998). Extended Deterrence and Alliance Formation. International Interactions, 24(4), 315-343. https://doi-org.proxy.library.vanderbilt.edu/10.1080/03050629808434934

Smith, A. (1995). Alliance Formation and War. International Studies Quarterly, 39(4), 405–425. https://doi.org/10.2307/2600800

Snyder, G. H. (1984). The Security Dilemma in Alliance Politics. World Politics, 36(4), 461–495. https://doi.org/10.2307/2010183

Snyder, G. H. (1990). Alliance Theory: A Neorealist First Cut. Journal of International Affairs, 44(1), 103–123.

Snyder, G. H. (1997). Alliance Politics. NY: Cornell University Press.

Sorokin, G. L. (1994). Arms, Alliances, and Security Tradeoffs in Enduring Rivalries. International Studies Quarterly, 38(3), 421–446. https://doi.org/10.2307/2600740

Sprecher, C. (2004). Alliance Formation and the Timing of War Involvement. International Interactions, 30(4), 331–347. https://doi.org/10.1080/03050620490884010

Sprecher, C., Krause, V. (2006). Alliances, Armed Conflict, and Cooperation: Theoretical Approaches and Empirical Evidence. Journal of Peace Research, 43(4), 363–369. https://doi.org/10.1177/0022343306065881

Thies, W. J. (2015). Friendly Rivals: Bargaining and Burden-Shifting in NATO. Routledge. https://doi.org/10.4324/9781315704197

Thomas, M. (1998). At the Heart of Things? French Imperial Defense Planning in the Late 1930s. French Historical Studies, 21(2), 325–361. https://doi.org/10.2307/286632

Toffolo, C. E. (2008). The Arab League. Infobase Publishing.

Wagner, R. H. (2004). Bargaining, War, and Alliances. Conflict Management and Peace Science, 21(3), 215–231.

Wallace, G. P. R. (2008). Alliances, Institutional Design, and the Determinants of Military Strategy. Conflict Management and Peace Science, 25(3), 224–243. https://doi.org/10.1080/07388940802218978

Walt, S. M. (1987). The Origins of Alliance. Cornell University Press. http://www.jstor.org/stable/10.7591/j.ctt32b5fc

Weede, E. (1983). Extended Deterrence by Superpower Alliance. Journal of Conflict Resolution, 27(2), 231–253. https://doi.org/10.1177/0022002783027002002

Weisiger, A. (2016). Exiting the Coalition: When Do States Abandon Coalition Partners during War? International Studies Quarterly, 60(4), 753–765. https://doi.org/10.1093/isq/sqw029

Weitsman, P. A. (1997). Intimate Enemies: The Politics of Peacetime Alliances. Security Studies, 7(1), 156–193. https://doi.org/10.1080/09636419708429337

Wolford, S. (2020). War and Diplomacy on the World Stage: Crisis Bargaining Before Third Parties. Journal of Theoretical Politics, 32(2), 235–261. https://doi.org/10.1177/0951629819893025

Wolford, S., Kim, M. (2017). Alliances and the High Politics of International Trade. Political Science Research and Methods, 5(4), 587–611. https://doi.org/10.1017/psrm.2015.19

Yarhi-Milo, K., Lanoszka, A., Cooper, Z. (2016). To Arm or to Ally? The Patron's Dilemma and the Strategic Logic of Arms Transfers and Alliances. International Security, 41(2), 90–139. https://doi.org/10.1162/ISEC$_{a0}0250$

Zagare, F. C., Marc Kilgour, D. (2003). Alignment Patterns, Crisis Bargaining, and Extended Deterrence: A Game-Theoretic Analysis. International Studies Quarterly, 47(4), 587–615. https://doi.org/10.1046/j.0020-8833.2003.00280.x

Zeigler, S. M. (2016). Competitive Alliances and Civil War Recurrence. International Studies Quarterly, 60(1), 24–37. https://doi.org/10.1093/isq/sqv002