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OVERLAPPING ALLIANCES AND THE RISK OF INTERSTATE CONFLICT

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ABSTRACT

Why do some alliance portfolios reassure adversaries while others appear to invite challenge? I theorize that the answer lies in the credibility-weighted redundancy of a state's network: the number of node-disjoint defense paths backed by deep, institutionally costly treaties. Anticipated power decline and rising domestic re-armament costs push leaders to seek such credible "back-ups," but when those back-ups cluster inside enduring rivalries they can signal imminent confrontation rather than deterrent resolve. I test the argument on a global, 199-state dyad-year panel (1960-2000) with a two-stage design. First, a Temporal Exponential Random Graph Model shows that expected capability loss, high military-spending burdens, and partner treaty depth jointly predict the creation of redundant defense ties. Second, depth-weighted Alliance-Backup Capacity (ABC), calculated from the model's predicted networks, enters a complementary-log-log hazard of militarized-dispute onset. A one-standard-deviation increase in ABC raises the yearly MID hazard by roughly 23 percent, but only when at least one back-up treaty is deep; redundancy built on shallow pacts leaves risk unchanged. Causal-mediation analysis attributes 88 percent of the ABC effect to entrenched rivalries, and the results survive alternative depth metrics, longer lags, rarer conflict thresholds, and exclusion of major-power dyads. The findings overturn the conventional view that deeper or more numerous alliances are automatically stabilizing. Credible, node-disjoint redundancy is most common where political tensions already run high, and its presence correlates with higher—not lower—conflict onset. The study refines preventive-war and alliance-network theory, introduces the ABC measure for future research, and cautions policymakers that adding ever-deeper security ties may advertise vulnerability as much as strength.

CHAPTER 1

INTRODUCTION

1.1 Puzzle and Motivating Cases

Alliances are commonly viewed as cost-effective substitutes for sustained arming. Yet historical experience reveals a different vulnerability: when a state already locked in an intense rivalry multiplies defense pacts to insure against future crises, the very redundancy can signal weakness rather than strength. France in 1939 vividly illustrates this. Throughout the interwar years, Paris constructed an “eastern cordon” of defense treaties with Belgium (1920), Poland (1921), Czechoslovakia (1924), Romania (1926), and Yugoslavia (1927), embedding these within the League of Nations’ collective-security framework. Although robust on paper, this alliance structure failed dramatically when German troops entered Prague in March 1939. Belgium had declared neutrality in 1936 (Steiner, 2013), Czechoslovakia had surrendered the Sudetenland, and Poland rejected Soviet troop transit due to fears of Soviet territorial ambitions (Michael Jabara Carley, 1999). Rather than deterring Berlin, this patchwork of shallow or conditional pledges confirmed that no ally was both willing and able to intervene, thereby emboldening a long-standing rival and demonstrating that redundancy without credibility can invite the very aggression it is meant to forestall.

This historical case exemplifies a broader theoretical puzzle: how does alliance redundancy influence deterrence? One perspective argues that more allies increase deterrent capabilities by raising the combined costs of aggression (Gibler and Vasquez, 1998; Huth and Russett, 1988). Another highlights the dangers of entanglement, particularly among great powers in multipolar systems, where unconditional defense commitments risk drawing states into unwanted wars because of acute abandonment fears—so-called “chain-ganging” (Christensen and Snyder, 1990; Senese and Vasquez, 2008). Yet neither perspective fully addresses credibility: the degree to which a prospective attacker believes allies will fight. France’s

1939 experience suggests that redundancy bolsters deterrence only when at least one ally is institutionally credible; in the absence of such guarantees, overlapping treaties can embolden long-standing rivals instead of discouraging them.

This puzzle remains relevant today. Middle powers facing anticipated decline—such as Japan, Poland, and Australia—accumulate multiple alliances to hedge against abandonment. Japan supplements its U.S. treaty with informal security arrangements involving Australia and India, and Poland complements NATO membership with bilateral agreements. Yet the payoff from these extra ties still hinges on credibility—and on how adversaries interpret that credibility in the context of an ongoing rivalry. This thesis therefore investigates the conditions under which redundancy reinforces deterrence and the circumstances under which it coincides with greater conflict risk.

1.2 Strategic Logic for Declining Powers

Why do states facing relative decline adopt external balancing through redundant alliances? Defense economics provides an explanation. MacDonald and Parent (2011) demonstrates that the marginal costs and opportunity costs of the alternative balancing option, sustained arming, escalate sharply as economies stagnate. Similarly, Baliga and Sjöström (2002) show, using data from 1949–2019, that sustained military expenditures often inflict greater long-term welfare losses than episodic conflict itself, especially for declining powers. Historical evidence underscores this logic: Habsburg Spain, Napoleonic France, and post-war Britain each faced fiscal crises driven by military overspending (Gilpin, 1981; Kennedy, 1987). Hence, declining states view external alliances as comparatively attractive relative to escalating internal balancing costs (Waltz, 1979).

Yet external balancing carries significant risks. Alliance formation may spur counter-balancing by adversaries, intensifying security dilemmas (Jervis, 1978); when credibility is ambiguous, overlapping pacts can even embolden long-standing rivals. Moral hazard emerges if protégés

leverage alliance assurances to undertake riskier behaviors (Snyder, 2007). Declining states thus face a strategic trade-off: redundant alliances offer cheaper insurance than domestic rearmament, but their effectiveness hinges on ally credibility. To manage this, states prefer partners whose treaties impose high institutional exit costs—automatic-assistance clauses, integrated commands, and no-separate-peace provisions—that increase the political price of defection (Leeds, 2003; Benson and Clinton, 2016).

1.3 Limitations of Existing Scholarship and the Credible-Redundancy Framework

International-relations scholarship has separately advanced knowledge on alliance credibility and network structure but has yet to integrate the two systematically. Leeds (2003) and Benson and Clinton (2016) demonstrate that deep, institutionally robust alliances significantly deter disputes and reduce abandonment. Network analyses (Cranmer et al., 2012a; Maoz et al., 2006; Klein et al., 2006) similarly illustrate how a state’s position within alliance networks shapes conflict outcomes. However, current scholarship does not jointly examine how structural redundancy (node-disjoint defense paths) interacts systematically with treaty depth (institutional credibility).

To bridge this gap, I introduce the Alliance-Backup Capacity (ABC) metric, quantifying how many independent, credible alliance paths connect two states. ABC enumerates node-disjoint defense paths and weights each path by treaty depth—integrating redundancy and credibility into a single measure. Using Temporal Exponential Random Graph Models (TERGMs), I examine whether anticipated power decline and rising domestic military expenditures prompt states to form credible, redundant alliances. Neutrality, consultation, and non-aggression pacts are explicitly excluded due to limited deterrent credibility (Leeds et al., 2000). Subsequently, employing a mixed-effects complementary-log-log hazard model (Beck et al., 1998; Bennett and Stam, 2000a), I evaluate how ABC relates to the likelihood

of militarized interstate disputes (MIDs). The complementary-log-log specification appropriately models the duration-dependent hazard typical of MID occurrences, especially given their rarity.

Empirically, this study covers global defense-pact networks from 1960-2000. Data sources include Bell and Johnson’s anticipated power-shift forecasts (Bell and Johnson, 2015a), Benson and Clinton’s treaty-depth scores, and comprehensive MID data (Gibler, 2009). While previous studies have weighted alliances by reliability alone (Reiter, 2003; Kenwick and Vasquez, 2017), they neglect node-disjointness. The ABC metric directly addresses this critical limitation.

Ultimately, I argue redundancy is not universally stabilizing. Declining states confronting severe anticipated power shifts and high domestic arming costs systematically pursue redundancy, yet its conflict-management value depends on both credibility and rivalry context. Where an enduring rivalry already exists, even high-depth redundancy can be interpreted as preparation for the next clash and may embolden rather than deter challengers; where rivalry is absent, low-credibility pacts provide little insurance.

1.4 Empirical Roadmap and Contributions

This thesis proceeds in three stages. First, I develop the credible-redundancy framework to explain how declining states navigate trade-offs between costly internal arming and risky external alliances. Second, using TERGMs, I estimate the conditions under which states form credible, redundant alliance ties. Third, employing a mixed-effects complementary-log-log hazard model, I evaluate how credible redundancy is associated with MID onset.

This study advances alliance research by building on and linking recent work in treaty design and alliance networks (e.g., Kinne and Kang 2023) and by situating its findings within ongoing debates about Indo-Pacific security entanglement (Hughes, 2009; Reilly, 2017). It introduces a new Alliance-Backup Capacity (ABC) metric that combines redundancy and

credibility—something previous credibility-weighted indices have not captured (Chiba et al., 2015). Using this metric, the analysis shows empirically how overlapping alliances deter in some dyads and, especially among entrenched rivals, how they can coincide with higher conflict risk, thereby refining classic expectations about alliance effectiveness (Christensen and Snyder, 1990; Kenwick and Vasquez, 2017).

Practically, these findings caution policymakers against reflexively multiplying shallow alliances and against assuming that even deep, overlapping pacts will always reassure opponents. Genuine security depends not only on credible guarantors but also on how adversaries interpret those guarantees in light of ongoing rivalry dynamics. Debates surrounding NATO enlargement and recent Indo-Pacific security alignments underscore the contemporary relevance of careful alliance layering—rather than mere numerical expansion—as key to effective deterrence.

In sum, alliances are neither inherently stabilizing nor destabilizing. Their effectiveness hinges on the interaction between redundancy, credibility, and rivalry context. By clarifying precisely when alliances succeed or fail in deterrence, this thesis offers clear theoretical, empirical, and policy-relevant insights into contemporary alliance politics.

CHAPTER 2

THEORY & HYPOTHESES

2.1 Deterrence Failures in Dense Alliance Webs

Deterrence theory assumes that a publicly declared security guarantee alters a challenger’s cost–benefit calculus: the higher the probability and expected efficacy of allied intervention, the lower the appeal of attack (Schelling, 1966; Huth and Russett, 1988). Large- N tests typically reduce that guarantee to a dichotomous indicator—alliance present = 1, absent = 0—and treat each dyad as insulated from the rest of the alliance network (Morrow, 1994; Leeds et al., 2000). Three crises expose the limits of that binary, dyad-isolated lens and foreground the puzzle at the heart of this dissertation: why does war still erupt around states embedded in dense—or apparently dense—webs of defense pacts?

Inter-war France sat at the center of what contemporaries called a *système des alliances*: the Franco-Polish Mutual Assistance Pact (1921), the Petite Entente with Czechoslovakia and Romania, and an Anglo-French guarantee hurriedly signed in March 1939. Standard datasets therefore code the France–Poland dyad as “allied.” Yet when Hitler issued his ultimatum, Paris delayed general mobilization, fearing another Somme, while London’s obligations were contingent on House of Commons approval and limited to economic assistance until full mobilization could be completed (Steiner, 2013, 164–70). Warsaw possessed no node-disjoint back-up that could intervene if France stalled. The deterrent failed—not because alliances were absent, but because redundancy and credibility were missing. Binary coding masks that strategic fragility (Press, 2005).

By 1982 the United Kingdom was a charter member of NATO, enjoyed ANZUS ties, and maintained extensive basing rights from Gibraltar to Diego Garcia. A naïve count of treaties depicts London as one of the most “hedged” powers on earth. In practice, every plausible rescuer in the South Atlantic—most critically the United States—was constrained: NATO’s

Article 5 stops at the Tropic of Cancer, ANZUS imposes no obligation regarding colonial territories, and Washington’s regional priorities lay in courting anti-communist regimes, including Buenos Aires (Freedman, 1988, 199–206). Britain’s alliances formed a hub-and-spoke centered on itself or on the United States; none constituted an independent deterrent channel. Argentina’s junta correctly concluded that London lacked a credible substitute guarantor and gambled on invasion.

Czechoslovakia, a founding member of the Warsaw Pact, ostensibly enjoyed the collective defense of every other Pact member. Yet when Prague’s liberalization threatened Soviet interests, the alliance mechanism was inverted: Warsaw-Pact partners became the invasion force. Because Poland, Hungary, and East Germany relied on Moscow for both security and economic aid, they could not credibly oppose Soviet coercion (Mastny et al., 2005). **The resulting security–autonomy dependence meant that no node-disjoint defender outside Moscow’s orbit existed, so the formal treaty offered no independent deterrent against the very patron that underwrote it**—a textbook case of Snyder’s “abandonment–entrapment” dilemma in reverse (Snyder, 1984).

Across these episodes, the aggressor did not simply observe whether a defense pact existed; it assessed the network’s redundancy (Are alternative patrons available if the pivotally demurs?) and credibility, a combination of reputation (each patron’s historical propensity to honor its pledges) and the observable design features that would raise the future cost of defection. Extant quantitative work has begun to parse credibility—showing, for instance, that deeper, institutionalized treaties deter more reliably (Benson and Clinton, 2016)—and network scholars highlight how alliance topology shapes conflict propensity (Maoz et al., 2006; Cranmer et al., 2012a). Yet the two strands remain largely unconnected: we still lack a measure that fuses structural redundancy with treaty depth in a single empirical design.

The gap matters. Binary dummies over-predict deterrence where alliances cluster around a single hub (France 1939; UK 1982) and under-predict conflict where a small set of credible,

independent back-ups signals a hardened rivalry. To resolve this disconnect, the dissertation introduces Alliance-Backup Capacity—a credibility-weighted count of node-disjoint, two-step defense paths—and theorizes how strategic demand, domestic fiscal pressures, and partner reliability jointly generate or undermine that capacity. The following sections formalize these mechanisms, specify testable hypotheses, and situate them within the broader literature on alliance reliability, rivalry dynamics, and networked deterrence.

2.2 Strategic Trade-off for Declining States

When leaders foresee a relative decline in national power, they confront an acute allocation problem: should scarce resources be poured into internal balancing—the rapid expansion of military capabilities at home—or diverted toward external redundancy, that is, securing additional allies who can offset the looming gap? The decision is not trivial. Internal rearmament promises autonomous deterrence but imposes a steep, convex cost curve; external hedging economizes on defense outlays yet exposes the state to alliance unreliability and potential entrapment.

Fearon’s formal treatment of arming decisions under uncertainty provides the baseline logic. In his 2018 model, the government’s utility from peace minus the expected utility of war falls with the marginal cost of defense investment, $C'(a)$, which grows faster than linearly as the chosen armament level a approaches the fiscal-capacity frontier (Fearon, 2018, 459–63). A state sliding down the power hierarchy therefore faces an unpleasant arithmetic: each additional battalion or frigate diverts progressively more resources from consumption or growth-enhancing investment, even while the strategic value of any extra capability is declining because the challenger’s relative strength is rising. The result is a diminishing-returns schedule that rapidly becomes unsustainable—what Coe labels a “runaway game” in which the defender races to maintain parity but finds each successive percentage point of GDP devoted to the military more politically painful (Coe, 2018, 143).

External redundancy offers an alternative trajectory. By pooling security with partner k , the declining state can substitute part of its own arms burden with the ally’s force posture. Let p be the probability that at least one node-disjoint guarantor intervenes successfully if deterrence fails, and let d be the diplomatic cost of maintaining that ally (side-payments, political concessions, potential constraints on foreign-policy autonomy). Expected utility is now

$$U = (1 - p)[V - C(a)] + p[V - C(a) - W] - d,$$

where V is the status-quo value of peace and W the expected wartime loss if both internal and allied forces prove insufficient. The choice variable becomes the composite bundle (a, p) . A forward-looking leader selects the bundle that maximizes U , subject to the constraint that p is itself a function of the credibility weights of prospective allies and the overall degree of redundancy—precisely the elements captured by the Alliance-Backup Capacity metric introduced in Section 4.

The comparative statics formalize the intuitive trade-off. As the anticipated relative capability gap widens (Bell and Johnson, 2015a), the marginal benefit of extra security rises, pushing the state rightward along both the a and p axes. Yet because $C''(a) > 0$, the cost of additional armament accelerates, while the marginal cost of acquiring another ally, d , is roughly linear. There exists a threshold decline Δ^* such that for larger expected losses, external redundancy dominates internal expansion:

$$\left. \frac{\partial U}{\partial a} \right|_{\Delta^*} = \left. \frac{\partial U}{\partial p} \right|_{\Delta^*}.$$

Beyond that point, rational leaders reallocate effort from tanks to treaties. Coe’s empirical survey of nineteenth- and twentieth-century arms races supports the comparative-historical intuition: decliners with stagnant fiscal bases—late Tsarist Russia and inter-war

France—shifted heavily toward alliance diplomacy when the arithmetic of further mobilization became prohibitive (Coe, 2018, 152-56).

The gamble, of course, is reliance risk. Allies may renege, defect, or pursue exploitation once the decliner grows dependent (Snyder, 1984). Fearon formalizes this with a nonzero probability that the guarantor withholds intervention, effectively reducing p and re-introducing vulnerability (Fearon, 2018, 468). The declining state thus pursues redundancy—multiple, node-disjoint alliances—so that the expected deterrent probability approaches $1 - \prod_k(1 - p_k)$, a function that increases with each credible backup but at a declining rate. Where high-depth partners are plentiful, the optimal bundle tilts decisively toward externalization; where credible allies are scarce, states accept higher internal costs.

In sum, the strategic trade-off for a declining power is governed by two convexities: escalating marginal costs of rearmament and decreasing marginal returns to unreliable allies. The empirical implication is clear. *Ceteris paribus*, states experiencing expected power loss and rising defense burdens should be observed constructing credible, redundant alliance webs rather than shouldering an ever-heavier domestic arms load. Conversely, where credible redundancy cannot be assembled—because suitable partners are unavailable or depth is low—leaders will either continue costly arming or, in extremis, contemplate preventive war. The next subsection formalizes how these strategic calculations translate into hypotheses about alliance formation and conflict onset.

Putting these pieces together yields the concept of credible redundancy: a configuration in which at least one node-disjoint backup ally is tied to the potential victim through a high-depth defense pact. The more such independent, credible channels connect a dyad, the less attractive aggression should appear under some conditions—while in entrenched rivalries those same channels can be read as preparation for the next clash. I label the stock of these channels Alliance-Backup Capacity (ABC). Substantively, ABC answers the question that concerns a declining state: "If my main patron blinks, how many other trustworthy friends

can still intervene?"

Chapter 3 details the data-construction steps: estimate yearly defense-tie probabilities with a TERGM, identify every node-disjoint two-step path, weight each path by the intermediary's treaty-depth score, sum these weighted paths, add one, and take the natural logarithm. The resulting ABC value records how many independent defenders a dyad can call on and how credible those defenders are. Two practical implications follow. Governments that cannot afford further rearmament should seek to lift their ABC by adding dependable allies instead of adding divisions. Whether that insurance deters or coincides with additional conflict depends on how adversaries interpret the signal; shallow pacts rarely shift expectations either way. These claims map directly onto Hypotheses H2 (domestic constraint), H4 (rivalry-linked conflict), and H5 (credibility amplifier).

A government that anticipates an imminent loss of relative capability confronts a sequential decision problem. First, expected decline heightens the incentive to bolster outside assistance before bargaining chips erode. Bell and Johnson's (2015) forward-looking power-shift scores show that the probability of a challenger victory rises well before the material balance actually flips; leaders therefore seek additional guarantors while still able to negotiate from strength. This "demand for back-ups" corresponds to mechanism (i): the steeper the projected loss, the stronger the preference for at least one extra defender who is not already tied to the pivotal patron.

Second, internal rearmament becomes costlier as fiscal slack diminishes. Coe (2018) demonstrate that each percentage-point increase in the military-expenditure-to-GDP ratio in a stagnant economy produces a disproportionate drop in long-run growth. Fearon (2018) formalize the consequence: when the marginal cost of an additional battalion exceeds the expected marginal deterrent benefit, rational leaders shift to external balancing. Mechanism (ii) follows: high arming cost pushes states to substitute alliances for armaments, but only if new treaties raise expected wartime support at lower domestic price.

Third, not every ally qualifies as a viable insurer. The alliance-reliability literature documents wide dispersion in compliance; only treaties with deep institutional commitments—integrated command, standing forces, no-separate-peace clauses—generate reputational penalties and readjustment costs large enough to deter defection (Leeds, 2003). Benson and Clinton (2016) capture that variation in their Depth index, a forward-looking credibility score derived from treaty text. Leaders therefore screen potential partners: mechanism (iii) predicts that among all available back-ups, states select those with above-median Depth, even if equally cheap, shallow pacts are plentiful.

These mechanisms operate most cleanly for unconditional defense treaties in the contemporary interstate system. From 1960 onward, the Alliance Treaty Obligations and Provisions (ATOP) project records clause-level data for virtually every defense pact, allowing credible-depth measurement; before 1960, many alliances lacked comprehensive coding. Consultation, neutrality, and non-aggression pacts are excluded because they impose no automatic duty to fight and thus supply little deterrent value in the short horizon relevant to preventive calculations (Morrow, 1994). Collective-security provisions such as NATO Article 5 extend deterrence to all members, but their multilateral decision rules complicate node-disjoint logic; focusing on dyadic defense clauses avoids that confound. Finally, decolonization by 1960 yields a system of sovereign actors whose alliance choices are discretionary rather than dictated by imperial hierarchy, matching the rationalist premise of voluntary balancing.

Together, anticipated decline generates demand, high arming cost makes external balancing attractive, and a reliability screen channels that demand toward credible, independent back-ups. These micro-foundations justify the Alliance-Backup Capacity measure and motivate the hypotheses tested in the remainder of the study.

2.3 Hypotheses

The argument developed so far suggests a sequence of linked phenomena. First, leaders who expect their state to lose ground in the dyadic balance of capabilities search for fresh guarantors; second, the fiscal burden of building additional forces strengthens this diplomatic impulse; third, partner choice is filtered through a credibility screen that favours treaties with deep institutional commitments. Taken together, these processes should leave two footprints in the historical record: a discernible pattern in the appearance of new defence ties and a related pattern in the frequency of militarised disputes. The network formation analysis captures the first footprint by estimating when a dyad adds an independent, node-disjoint alliance edge. A separate rare-event hazard model addresses the second by testing whether a higher stock of credibility-weighted back-up paths coincides with fewer conflict onsets. Each proposition below speaks directly to one of these empirical steps and ties back to the micro-mechanisms set out in Section 2.4.

Bell and Johnson’s (2015) five-year forecasts reveal that even a one-percentage-point fall in a state’s projected share of dyadic CINC raises the likelihood that it will be targeted within the planning horizon. Governments that register this signal should look for additional defenders not already connected to their main patron. Because node-disjoint back-ups still stand if the pivotal ally hesitates, steeper expected decline should appear alongside a higher probability that such an independent tie is concluded.

H1: Anticipated relative decline raises redundancy: the greater a state’s forecast loss of relative capability vis-à-vis a potential adversary, the higher the probability that the dyad adds a new node-disjoint defence tie in year t , conditional on existing network structure and other covariates.

Internal rearmament is the principal alternative to alliance expansion, yet its marginal cost mounts sharply when growth slows. Coe (2018) estimates that each extra percentage-point of defence spending relative to GDP trims long-run growth by roughly one-third of

a percentage point, a burden that elected leaders and fiscal guardians resist. Lake (2009) shows that governments under such pressure often swap policy concessions for external security guarantees. A large defence burden should therefore coincide with greater reliance on independent allies.

H2: High arming cost pushes states outward: holding other factors constant, dyads in which at least one partner carries a higher military-expenditure-to-GDP burden are more likely to add a node-disjoint defence path than dyads with lighter burdens.

Redundancy enhances security only when at least one substitute ally is expected to act. Leeds (2003) finds that deep, institution-rich treaties are fulfilled in roughly three-quarters of wartime cases, whereas shallow agreements approach a coin-flip. Benson and Clinton's (2016) Depth index translates those design features into a forward-looking credibility score. If states rank potential partners by this metric, higher Depth should be associated with selection as a back-up even when cheaper, shallow alternatives exist.

H3: Reliable partners are favoured: conditional on strategic demand and arming cost, the likelihood that a redundant defence tie is formed rises with the prospective back-up ally's treaty-depth score; low-depth candidates are chosen less often.

Turning from formation to security outcomes, the Alliance-Backup Capacity statistic (ABC) counts node-disjoint two-step paths between two states and weights each path by the intermediary's Depth. A higher ABC value implies more potential interveners whose institutional design signals stronger commitment. Deterrence logic suggests that dyads with larger ABC should experience fewer Militarised Interstate Disputes, once geography, power, trade, regime, rivalry, and major-power status are taken into account.

H4: Alliance-Backup Capacity and conflict: a higher lagged ABC—the logged, reliability-weighted count of node-disjoint two-step defence paths—corresponds to a lower annual hazard that a dyad experiences a Militarised Interstate Dispute.

Credibility moderates this association. If every available back-up falls in the bottom quartile of Depth, potential challengers discount the probability of effective intervention to the point where redundancy provides little extra assurance. Under such conditions the negative ABC–MID relationship should flatten and may even reverse. A dummy LowTrust = 1 flags dyad-years where all back-ups lie below that threshold.

H5: Redundancy deters only when credible: the pacifying association between ABC and MID onset weakens, and may disappear, when all back-up allies fall below the twenty-fifth-percentile treaty-depth threshold (LowTrust = 1). Formally, the interaction term $ABC \times \text{LowTrust}$ is expected to enter the conflict model with a positive sign, offsetting the negative main effect of ABC.

These five propositions map directly onto the empirical strategy. The network analysis gauges whether anticipated decline and high arming costs coincide with an uptick in independent ties, and whether those ties gravitate toward high-depth partners. The hazard model then asks whether dyads with more, credible back-ups are less prone to militarised conflict, and whether that protective relationship erodes when credibility is uniformly low. By linking the two analyses through ABC computed from predicted rather than observed ties, the design assesses whether credible redundancy accompanies the transition from looming decline to preserved peace without claiming deterministic causation.

CHAPTER 3

DATA & MEASUREMENT

3.1 Data Sources

I construct an undirected dyad-year panel that spans every pair of the 199 sovereign members of the Correlates of War (COW) system from 1960 to 2000, yielding 474,775 dyad-years and 19,701 unique dyads. The temporal bounds are dictated by the coverage of Bell and Johnson’s forward-looking forecasts of Composite Index of National Capability (CINC) scores, which are indispensable for their constructing of Anticipated Power Shift (APS) indicators (1818-2000). Other sources involved in constructing this dyad-year panel involve: see table blow:

Table 3.1: Data Sources

Source	Unit	Key variables used	Years
ATOP v5.0 (Leeds)	Dyad-year	Alliance treaty commitment types	1815–2018
Benson and Clinton (2016)	Treaty	Depth index	1816–2000
COW MIDs v5	Dyad-year	Duration_Index	1816–2014
Bell & Johnson (2015)	Directed Dyad-year	Anticipated Powershift (5 year, 3 year, 1 year)	1817–2000
SIPRI Military Expenditure (Du Bois, 2024)	State-year	Military expenditure/GDP (current \$)	1949–2024
COW Trade (v4.0) (Barbieri et al., 2009)	Dyad-year	Trade flow (current \$)	1960–2014
Polity V (Marshall and Gurr, 2020)	State-year	Polity2 score	1800–2018
V-Dem v15 (Coppedge et al., 2025)	State-year	Polyarchy (<i>v2x_polyarchy</i>)	1789–2023
Unified Democracy Scores (UDS) (Marquez, 2016)	State-year	Unified Democracy Score	1946–2012
COW Contiguity (?)	Dyad-year	Land/sea contiguity	1816 -2016
Klein et al. (2006)	Dyad-year	Enduring rivalry	1816–2000
CINC v6 (Singer, 1987)	State-year	Composite Index of National Capability (CINC)	1816–2016

3.2 Dependent Variable

The TERGM treats the presence of an unconditional defense pledge between two states in year t as the dependent variable. Observations are drawn from the dyad-year version of the

ATOP 5.0 dataset and span 1960-2000. I restrict the sample to alliance treaties whose commitment obligation include defense; neutrality-only, non-aggression, and consultation pacts are excluded because they do not obligate active military assistance and therefore cannot furnish the “backup capacity” that underpins the theory of redundant deterrence. Although ATOP identifies a small subset of asymmetric defense obligations, defense clauses are overwhelmingly reciprocal, thus the alliance-tie variable is coded as undirected: once a defense commitment exists, it is assumed to bind both members equally for network-formation purposes.

I treat militarized-dispute onset as the first calendar year in which a new Correlates-of-War MID involving the dyad is recorded; coding the dependent variable this way focuses the analysis on whether conflict begins at all—the key deterrence outcome—rather than on its duration or intensity, and it avoids conflating escalation dynamics with the decision to start a dispute in the first place.

3.3 Mechanism Variables

Anticipated power shift (APS) is drawn from Bell and Johnson (2015a) five-year ex-ante forecasts of each dyad’s war-winning probability and captures leaders’ forward-looking expectations about how the bilateral balance of capabilities will evolve. For every dyad-year I recover the two directional projections— $PS_{i \rightarrow j,t}$ and $PS_{j \rightarrow i,t}$ —and retain the figure with the larger absolute value: the resulting signed score, $APS_{ij,t}$, is negative when one partner is predicted to lose at least one percentage point of the dyadic capability share over the next five years and positive when a comparable gain is forecast. To operationalise the theoretical concern with decline, I recoded the $APS_{ij,t}$ as

$$APS_decline_{ij,t} = \max(0, -\Delta P_{ij,t}^{t+5}),$$

so the indicator is zero unless state i is forecast to suffer a drop in its war-winning odds vis-à-vis j . Because the forecasts are directed, I symmetrize the measure by keeping the larger of the two directed scores within each undirected dyad-year, ensuring that the variable records the steeper of the two possible declines. Because the forecasts rely only on observables from year t —economic output, military spending, demographic capacity, regime type, rivalry history, and the existing alliance portfolio—they are exogenous to alliance choices at $t + 1$. Both indicators are divided by 100, standardized within 1960-2000, and lagged one year in the TERGM and in the MID model, matching Bell and Johnson’s validated planning horizon while preserving temporal ordering for causal inference.

A central requirement of this project is a forward-looking gauge of how “hard to exit” any given defense pact actually is, because my theory posits that states hedge with redundant allies only when they doubt that at least one of their formal guarantors will remain steadfast under pressure. I therefore adopt Benson and Clinton (2016) Depth index as the operative measure of treaty credibility. Conceptually, Depth captures “the degree to which the agreement contains formalized and binding commitments” that impose peacetime costs—financial, organizational, and reputational—on the signatories, over and above the risks they already incur by pledging to fight together. These sunk formation and coordination costs raise the price of future abandonment and thus make threats of defection less believable. Depth therefore functions as an ex-ante signal: the higher the cost of exit that leaders voluntarily accept at the moment of signature, the more credible observers judge the promise to uphold the alliance when war clouds gather.

Depth refers to the ex-ante credibility of an alliance pledge—the degree to which the treaty’s design raises exit-costs, embeds partners in joint military structures, and therefore convinces third-parties that assistance will actually materialize if a member is attacked. In conceptual terms, I follow Benson and Clinton’s distinction between the scope of an obligation (how many contingencies trigger help) and its depth (how hard it is for an ally to shirk).

Clauses such as integrated command, no-separate-peace promises, joint basing, pre-agreed force contributions, or permanent consultative bodies all require peacetime investment; they are costly to negotiate, difficult to unwind, and observable to adversaries. Deeper agreements should thus generate higher perceptions of reliability, mitigate abandonment fears inside the coalition, and—by the same token—heighten any conflict-spiral risk when redundant back-up treaties are layered on top.

Depth operates in the analysis in two complementary ways. Within the TERGM that estimates alliance formation, greater treaty depth—signaled by integrated commands, automatic-assistance clauses, and similar provisions—reduces the likelihood of new ties but increases their durability, reflecting the higher entry costs of deeply institutionalized commitments. In the deterrence model, the same depth measure conditions the impact of backup capacity: a Low-Trust indicator is set to one whenever every available backup lies in the bottom quartile of the depth distribution. When redundancy is flagged as low-trust, additional allies may embolden rather than dissuade potential challengers, capturing the idea that ‘redundancy without credibility’ can be counter-productive.

The key explanatory construct of this study is Alliance-Backup Capacity (ABC), an empirical translation of the theoretical idea that deterrence depends not only on having allies but on having independent and credible back-ups if a primary guarantor fails. Conceptually, ABC captures the number and quality of second chances a target state possesses: i and j deter an aggressor to the extent that at least one third-party k , unconnected to the first, is both willing and able to join the fight. The resulting index folds three distinct features—redundancy (how many back-up allies exist), independence (whether those allies are node-disjoint and thus not simultaneously vulnerable), and reliability (how credible each back-up is)—into one continuous, strictly non-decreasing score.

Formally, for each undirected dyad $\langle ij \rangle$ in year t , I enumerate every node-disjoint two-step defense path, $i \rightarrow k \rightarrow j$, where k is an intermediary ally that links the pair through

separate treaties. Paths are restricted to length ≤ 2 because longer chains raise coordination problems that existing evidence suggests states discount sharply. Using the tie-specific probabilities produced by the Stage-1 Temporal Exponential Random Graph Model (TERGM), each potential link ik and kj is first converted into a Bernoulli draw; the product yields the predicted probability that the whole path is available when needed. To incorporate credibility, every intermediary ally k is weighted by its Benson-Clinton Depth score, R_k , rescaled to $[0, 1]$ and imputed when necessary. The resulting formula is

$$\text{ABC}_{ij,t} = \ln\left(1 + \sum_{k \in \mathcal{P}_{ij,t}} R_k \Pr(i \leftrightarrow k) \Pr(k \leftrightarrow j)\right),$$

where $\mathcal{P}_{ij,t}$ is the set of node-disjoint two-step paths linking the dyad in year t . The natural logarithm compresses the heavy right tail while preserving ordinal differences—adding a tenth high-credibility back-up does not raise deterrence ten times more than adding a first. The $+1$ term ensures that dyads with no redundant paths take a valid zero value before logging.

The path-search algorithm is run on predicted rather than observed defense networks, ensuring that the same data-generation process underlies both the formation and conflict stages. ABC is lagged one year in the MID model to minimize simultaneity. Values exceeding the 99th percentile are winsorised to prevent a small number of exceptionally interconnected alliance systems—such as the network centered on the United States within NATO—from exerting disproportionate leverage on the distribution.

The count of distinct k 's captures redundancy, the node-disjoint rule captures independence, the Depth weight captures credibility, and the log transform imposes diminishing returns—so higher ABC scores mark dyads that possess more, separate, and credible back-up allies, a configuration whose relationship to conflict risk our empirical tests evaluate—showing it can either bolster deterrence or coincide with higher danger, especially

within entrenched rivalries.

3.4 Control Variables

Geographic proximity shapes both alliance formation and conflict, so the TERGM includes two spatial controls. First, contiguity flags dyads that share a land or river border or lie no more than twelve nautical miles apart across water, following the Correlates of War contiguity criteria (Stinnett et al., 2002). This threshold captures the strategic reality that forces stationed on opposite shores of a narrow strait face engagement costs comparable to those on a land frontier. Because contiguous states experience higher opportunity and threat salience (Bremer, 1992), they are more likely to require formal defense pacts and, absent such pacts, more prone to militarized disputes. Including the dummy isolates the effect of Alliance-Backup Capacity from the baseline hazard that derives purely from geography. Second, same-region matching employs the COW geographic-region. States located within the same region share colonial histories, cultural affinities, and regional security institutions that influence network closure beyond physical distance (Lemke and Werner, 1996; Dorff et al., 2023). Accounting for regional homophily prevents the model from attributing patterns driven by, say, NATO’s Euro-Atlantic confinement or ASEAN’s Southeast-Asian focus to the substantive variables of interest. Together, the two controls separate local geography (contiguity) from broader regional context, ensuring that estimated covariate effects reflect political mechanisms rather than spatial clustering.

Differences in national capability shape the incentives both to ally and to fight, so the models include a continuous measure of dyadic power disparity. Following Hegre (2008) and Bennett and Stam (2000b), I compute the log capability ratio

$$\text{LCR}_{i,j,t} = \ln\left(\frac{\max(\text{CINC}_i, \text{CINC}_j)}{\min(\text{CINC}_i, \text{CINC}_j)}\right),$$

where CINC scores are drawn from the Singer (1987) Composite Index of National Capability. The transformation is symmetric: LCR equals zero when states are matched, and rises smoothly as one side grows stronger. This specification captures the classic power-parity versus preponderance debate. Power-transition theorists argue that near-parity promotes preventive war because declining hegemons fear a closing gap (Organski and Kugler, 1981); balance-of-power logics suggest the opposite, that large asymmetries increase bargaining power and therefore tempt the stronger state to coerce the weaker (Reed 2003). Empirically, Bremer (1992) shows that both extremes raise conflict risk relative to moderate disparities, while Lemke and Werner (1996) find that equal powers are more willing to sign mutual defense pacts. Controlling for LCR therefore prevents ABC from picking up spurious effects driven by the underlying distribution of power: highly capable states such as the United States and Russia sit at the core of dense alliance hubs and also participate in a disproportionate share of MIDs. Including LCR at $t - 1$, standardized within the sample, removes that confounding pathway without imposing a rigid functional form on capability itself. Robustness checks confirm that replacing LCR with a parity dummy (log ratio < 0.19) or with the squared log ratio leaves the ABC coefficients virtually unchanged, underscoring that the main findings are not artifacts of omitted power structure.

Jointly democratic dyads sign more alliances and fight each other less often than any other pairing, a pattern established by Maoz and Russett (1993) and confirmed across successive datasets Oneal and Russett (1997); Leeds (2003). Autocracies also cluster—often in ideologically aligned or patron–client blocs—which shapes alliance topology and conflict exposure Olivella et al. (2021). Leaving these systematic differences uncontrolled would confound the estimated effect of backup capacity with regime-driven partnership preferences. I therefore include two dyadic dummies. The dyadic joint democracy equals 1 when both states qualify as democracies; the dyadic joint autocracy equals 1 when both states meet the autocracy threshold. The reference category is mixed-regime dyads, the most heterogeneous

set. Coding follows a hierarchical rule to maximize coverage 1960-2000: Polity V scores of $\geq +6$ (democracy) and ≤ -6 (autocracy); if Polity is missing, V-Dem polyarchy ≥ 0.50 or < 0.30 ; if both absent, Unified Democracy Scores > 0 or ≤ 0 . Anocracies remain zero in both dummies. I code just two dyadic dummies—one for jointly democratic pairs, one for jointly autocratic pairs—so the model stays compact, and each coefficient reads directly as the change in the likelihood that such a pair signs a defence pact compared with a mixed-regime dyad, the approach used in recent network studies Dorff et al. (2020); Cranmer et al. (2017).

For each dyad-year I compute mutual trade dependence as

$$\text{MutDep}_{ij,t} = \min\left(\frac{\text{Trade}_{ij,t}}{\text{GDP}_{i,t}}, \frac{\text{Trade}_{ij,t}}{\text{GDP}_{j,t}}\right),$$

where Trade is the sum of bilateral exports and imports from the Cow trade dataset (Gleditsch, 2002). Taking the minimum share focuses on the weaker partner’s exposure—the portion of commerce both governments would forfeit if the link collapsed (Oneal and Russett, 1997, 1999). Anything above that ceiling is one-sided dependence and cannot deter conflict that the less vulnerable partner is willing to risk. I log the measure, lag it one year to reduce simultaneity, and include it as a dyadic covariate in both the TERGM and the MID model. In alliance tie formation model, it absorbs the well-known tendency for heavily interdependent pairs to formalize defense ties; in modeling MID onset it controls for the opportunity-cost mechanism that lowers dispute onset. A separate asymmetry term is omitted because the core theory does not hinge on coercive leverage, and tests show that its inclusion leaves all other coefficients stable. The specification follows the standard practice established by the trade–conflict literature and keeps faith with critiques that stress the need to separate reciprocal vulnerability from unreciprocated flows (Barbieri et al., 2009).

Shared rivalry captures whether the two states in a dyad are simultaneously locked in the same enduring rivalry as identified by the Klein et al. (2006) data. Including this indicator is essential for two reasons. First, the alliance-formation equation must distinguish ties created

to hedge against a chronic external threat from ties driven by the fiscal and credibility mechanisms that are central to the theory. Enduring rivalries define exactly the kind of persistent, behaviorally demonstrated hostility that motivates “security clustering” among otherwise dissimilar states and can inflate the baseline probability of a defense pact (Diehl and Goertz, 2000; Cranmer and Desmarais, 2011). Second, rivalry is one of the strongest empirical predictors of militarized disputes; omitting it from the MID onset model would bias the estimated effect of Alliance-Backup Capacity upward by attributing rivalry-driven conflicts to the alliance network instead (Senese and Vasquez, 2008; Bennett and Stam, 2000b). The KGD series offers year-specific on/off coding, symmetric within dyads, and full coverage for 1960-2000, making it compatible with the undirected network framework. Lagging the variable one year ensures it enters both stages as a pre-treatment control rather than a consequence of the alliances or conflicts being modeled.

Major powers possess global interests, large force projection, and extensive diplomatic reach, which make them both alliance hubs and frequent participants in militarised disputes. Walt (1987) argues that great powers “set the structure” of international politics; empirical work shows they sign defence pacts at higher rates (Morrow, 1991) and face a distinctive conflict hazard even after geography and capabilities are held constant. To isolate the effects of redundancy and credibility from this systemic role, I include a binary variable that equals = 1 when at least one member of the dyad is coded as a major power in the Correlates of War classification. The covariate enters the alliance-formation TERGM and the MID model lagged one year, absorbing the baseline propensity of great-power dyads to ally and fight irrespective of backup structure.

Table 3.2: Descriptive Statistics, dyad-years 1960–2000
(analysis sample: $N = 474,775$)

Variable	N	Mean	SD	Median	IQR (p25–p75)
<i>Key predictors</i>					
ABC, weighted ($t-1$) [z]	474,775	0.00	1.00	0.02	-0.67 – 0.63
Low-trust dummy (<Q1 depth)	474,775	0.26	0.44	0	0 – 1
ABC \times Low-trust	474,775	0.01	0.28	0.00	-0.03 – 0.03
Alliance Treaty Depth	474,775	0.09	0.11	0.00	0 – 0.22
Cost of Arming	474,775	0.14	0.54	0.07	-0.22 – 0.44
<i>Geopolitical Context</i>					
Contiguity (land/sea)	474,775	0.02	0.14	0	0 – 0
Shared rival ($t-1$)	474,775	0.01	0.07	0	0 – 0
APS asymmetry ($t-1$) [z]	419,849	0.00	1.00	0.14	-0.50 – 0.60
APS decline ($t-1$) [z]	419,849	0.00	1.00	-0.39	-0.53 – 0.08
<i>Capability / economics</i>					
Capability ratio ($t-1$) [z]	474,775	0.00	1.00	0.12	-0.52 – 0.56
Mutual trade dependence ($t-1$) [z]	474,775	0.00	1.00	-0.11	-0.47 – 0.23
<i>Regime Similarity</i>					
Joint democracy	474,775	0.14	0.35	0	0 – 0
Joint autocracy	474,775	0.17	0.38	0	0 – 0
<i>Major Power Presence</i>					
Either state is a major power	474,775	0.07	0.26	0	0 – 0

Notes: All continuous variable are z -scores standardized within 1960–2000. All covariates enter models lagged one year except contiguity, joint-regime, and major power indicators. Depth scores were multiply imputed with predictive-mean matching in mice (van Buuren & Groothuis-Oudshoorn 2011), using the full covariate set; 20 imputations were pooled with Rubin’s rules (Rubin 1987), following White et al. 2011’s guidance for single-variable MAR gaps.

CHAPTER 4

RESEARCH DESIGN

The empirical strategy must follow the theoretical sequence that links anticipated decline to alliance formation and, in turn, to deterrence, while avoiding post-treatment bias and common-method error. The analysis therefore concentrates on unconditional defense pacts among COW-recognized sovereign states between 1960 and 2000, the only interval in which forward-looking capability forecasts, clause-level treaty depth, and complete MID coverage coincide. Two complementary models operationalize the argument. A Temporal Exponential Random Graph Model (TERGM) estimates where node-disjoint defense ties emerge. A dyad-year hazard model connects the resulting Alliance-Backup Capacity (ABC) to subsequent dispute onset. All covariates enter both models lagged to preserve temporal order; ABC itself is calculated from predicted, rather than observed, alliance networks, eliminating simultaneity with conflict behavior.

4.1 Temporal Exponential Random Graph Models (TERGMs)

The TERGM accommodates the dual reality that a new defense pact reflects both dyadic attributes and the existing alliance web. It generalizes the static ERGM to a sequence of yearly networks and specifies the conditional probability of an edge as

$$\Pr\left(Y_{ij,t} = 1 \mid \mathbf{Y}_{t-1}, \mathbf{X}_{ij,t-1}\right) = \text{logit}^{-1}\left(\theta_0 + \theta_1 \text{APS Decline}_{i,t-1} + \theta_2 \text{Depth}_{ij,t-1} + \theta_3 \text{Cost}_{i,t-1} + \boldsymbol{\gamma}^\top \mathbf{Z}_{ij,t-1} + \boldsymbol{\eta}^\top \mathbf{g}(\mathbf{Y}_t, \mathbf{Y}_{t-1})\right)$$

$\mathbf{Z}_{ij,t-1}$ contains the standard control set—contiguity, rivalry, capability ratio, trade interdependence, regime pairing, regional homophily, and major-power presence—each measured at $t - 1$. The vector $\mathbf{g}(\mathbf{Y}_t, \mathbf{Y}_{t-1})$ captures endogenous structure through an edges term,

a geometrically weighted degree statistic, and shared-partner closure, together with a persistence term that represents alliance inertia: once two states sign a defense pact the tie is retained in the network unless the covariates and structural statistics drive its estimated log-odds sharply downward.¹ The geometrically weighted degree statistic captures preferential attachment in alliance politics—states that already hold many defence pacts attract new partners at a diminishing rate—so omitting it would overstate the effect of covariates on hub formation.

A TERGM estimates the probability of observing the entire alliance network, not a single dyadic tie, by comparing the realized graph with the universe of graphs that have the same set of actors and overall density. Because the number of possible networks among roughly two hundred states is astronomically large, the likelihood is approximated with bootstrapped maximum-pseudolikelihood estimation (MPLE). Model coefficients express the change in the log-odds that the observed network would arise—in a draw from all equally dense networks—given a one-unit shift in the corresponding statistic. In the absence of endogenous terms, the TERGM reduces to a standard logistic regression on dyadic covariates; the additional network statistics capture the clustering and hub-and-spoke features that characterize real alliance systems.

Convergence diagnostics compare observed and simulated degree distributions, geodesic distances, and triad census counts. The coefficients on APSDecline, Cost, and Depth map directly onto Hypotheses 1, 2, and 3.

Every explanatory variable is fixed at least one year before the alliance decision. The anticipated-power-shift score relies only on economic and demographic data dated at $t - 1$,

1. Persistence is represented by a geometrically weighted edge term computed on the lagged network Y_{t-1} . Setting the decay parameter to $\rho = 0.96$ assigns each defence pact from the previous year a baseline contribution of $\log(\rho/(1 - \rho)) \approx 3.18$ to the log-odds that the tie endures into year t . For ties that have persisted longer than one year, the marginal effect of each additional year declines multiplicatively by $(1 - \rho) = 0.04$, producing a first-order geometric decay. The term therefore models strong but not immutable inertia: alliances tend to endure, yet their pull on the present network weakens gradually rather than fixing ties in perpetuity (Cranmer et al., 2012b).

so contemporaneous or future alliances cannot affect it. Depth is a treaty design attribute locked at signature and invariant in the short run. A lagged enduring-rivalry indicator captures persistent hostility not already reflected in power forecasts and blocks a major confounding path. Any residual bias would mute rather than inflate the estimated effects, strengthening confidence in positive findings.

4.2 Alliance-Backup Capacity

After fitting the TERGM, one thousand alliance networks are drawn from the posterior predictive distribution. For each draw, all node-disjoint two-step defense paths connecting any dyad are enumerated. Every path receives the intermediary’s depth weight, the weighted paths are summed, one is added, and the natural logarithm is taken. Averaging across simulations yields the expected ABC for year t . This procedure transforms edge probabilities into a dyad-level stock of credible redundancy while retaining the uncertainty inherent in alliance formation. ABC is then lagged one year before entering the conflict model, preventing contemporaneous feedback from disputes to alliance expectations. The resulting measure is the key predictor in the tests of Hypothesis 4 and Hypothesis 5.

4.3 Dyad-Year Hazard Model

Dispute onset is modeled with a mixed-effects complementary-log-log specification. The specification reads

$$\Pr(\text{MID}_{ij,t} = 1) = 1 - \exp[-\exp(\eta_{ij,t})],$$

$$\eta_{ij,t} = \alpha + \beta_1 \text{ABC}_{ij,t-1} + \beta_2 (\text{ABC} \times \text{LowTrust})_{ij,t-1} + \mathbf{X}_{ij,t-1}^\top \gamma + u_{ij}$$

with $u_{ij} \sim \mathcal{N}(0, \sigma^2)$. The control vector $\mathbf{X}_{ij,t-1}$ matches the TERGM covariates and includes a cubic B-spline in calendar time to absorb secular trends. Random intercepts capture

dyad-specific propensities toward conflict. Hypothesis 4 implies $\beta_1 > 0$, while Hypothesis 5 predicts $\beta_2 < 0$ (i.e. the positive ABC effect weakens when all back-ups are low-trust).

Three design features guard against endogeneity. First, ABC is constructed exclusively from predicted networks dated $t - 1$; it cannot embed knowledge of a MID that begins at t . Second, all covariates are lagged at least one year, blocking reverse causation. Third, random dyad intercepts absorb unobserved, time-invariant factors such as historical animosity. Placebo tests corroborate these safeguards. Replacing defense paths with neutrality-pact paths produces no relationship with MID onset, and regressing ABC on future rather than past disputes yields null results.

Simulated-observed comparisons confirm that the TERGM reproduces the global alliance structure, while MCMC t-ratios remain below two, indicating convergence. The hazard model attains a Brier score below 0.02 and an average ROC-AUC of 0.87 in ten-fold cross-validation (See Table 6.1). Variance-inflation factors stay under 2.5. Re-estimating the hazard with a two-year ABC lag, excluding major-power dyads, or replacing depth-weighted paths with unweighted counts leaves the principal coefficients well within their original confidence intervals.

The empirical strategy follows the theory in two steps. First it links projected losses in relative capability to the decision to sign an independent defense pact. Second it traces the security effect of the resulting stock of credible back-ups. A TERGM estimates the probability that a dyad adds a node-disjoint defense tie in a given year; simulated draws from that model produce predicted networks, from which Alliance-Backup Capacity is calculated. A mixed-effects complementary-log-log model then tests whether larger ABC scores precede fewer dispute onsets. All covariates enter at least one year before the outcome, ABC is built from predicted rather than observed edges, and placebo tests replace defense clauses with neutrality pacts. Together these design choices block simultaneity and curb omitted-variable bias, clarifying whether credible redundancy reduces the vulnerability of declining states.

CHAPTER 5

RESULTS

5.1 Alliance Formation

I estimate the probability of alliance tie formation using MPLE with bootstrapping for 500 TERGM simulations. Column 1 of Table 5.1 reports a structure-only benchmark. Column 2 supplements those endogenous terms with the standard geopolitical and economic controls. Column 3 then introduces the three mechanism variables—anticipated decline, arming cost, and treaty depth—providing the specification that speaks directly to Hypotheses 1–3.

Table 5.1: TERGM Estimates for the Formation of Alliance Ties, 1960–2000

	(1) Baseline	(2) Controls	(3) Cred. + Costs
Edges	−2.06*** [−2.55, −1.70]	−3.92*** [−4.50, −3.47]	−4.09*** [−4.73, −3.61]
Popularity (GW-degree)	−6.26*** [−7.39, −5.31]	−5.55*** [−6.51, −4.73]	−5.36*** [−6.15, −4.63]
Transitivity (GW-ESP)	0.35*** [0.22, 0.47]	0.30*** [0.13, 0.44]	0.26*** [0.10, 0.41]
Shared partners (GW-DSP)	−0.14*** [−0.16, −0.13]	−0.10*** [−0.12, −0.08]	−0.10*** [−0.12, −0.08]
Memory	1.31*** [1.17, 1.51]	1.04*** [0.90, 1.19]	0.82*** [0.73, 0.96]
Major power	−	1.31*** [0.77, 1.79]	1.00*** [0.33, 1.62]
Same region	−	3.16*** [2.84, 3.56]	3.05*** [2.65, 3.46]
Contiguity	−	0.45*** [0.23, 0.64]	0.60*** [0.38, 0.79]
Capability ratio	−	0.21*** [0.13, 0.29]	0.15*** [0.07, 0.25]
Joint democracy	−	0.63*** [0.39, 0.93]	0.72*** [0.40, 1.05]
Joint autocracy	−	−0.65*** [−1.00, −0.29]	−0.75*** [−1.07, −0.36]
Trade dependence	−	0.35*** [0.09, 0.56]	0.03 [−0.22, 0.29]
Shared rivalry	−	0.88*** [0.33, 1.52]	1.13*** [0.46, 1.81]
Anticipated decline	−	−	0.07** [0.01, 0.14]
Cost of arming	−	−	1.89*** [1.35, 2.40]
Treaty reliability (Depth)	−	−	16.52*** [13.65, 20.22]

Note: 95% bootstrap confidence intervals in brackets. Stars denote that the interval does not include zero (*** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$). All specifications are estimated with 500 bootstrap replications. The memory term is a time-weighted count of past alliances capturing inertia. ATOP sample restricted to treaties with defense commitments.

The structural coefficients consistently reflect expected network behavior. The strongly

negative Edges term (-4.09 in column 3) confirms that unconditional defense alliances remain rare events, given the approximately 20,000 dyads in each year. The negative geometrically-weighted degree (GW-degree) statistic indicates preferential attachment with diminishing returns. This pattern suggests that states with existing defense alliances continue to attract additional partners, but each new tie contributes progressively less, reflecting a plateau effect rather than unlimited hub formation. The positive coefficient on the geometrically-weighted edgewise shared partners (GW-ESP) term (0.26 in column 3) indicates that fully closed triangles are common in alliance networks, whereas the negative coefficient on the geometrically-weighted dyadwise shared partners (GW-DSP) statistic (-0.10) suggests that dyads sharing the same ally do not automatically ally themselves. The Memory coefficient remains significantly positive (0.82), confirming strong, though not irreversible, inertia in existing defense commitments. The goodness-of-fit diagnostics (Figure 6.1, Appendix A.) show that simulated networks from the model closely match observed network statistics.

The marginal cost of arming exerts a considerably stronger effect. The large and significant coefficient (1.89) implies that shifting from the 25th to the 75th percentile of military-expenditure-to-GDP increases the odds of a new alliance formation by a factor of about six, aligning clearly with Hypothesis 2.

Treaty depth shows the most pronounced effect. The substantial coefficient (16.52) reflects that depth scores range narrowly between 0 and approximately 0.20 in practice. Raising depth from its median (around 0.06) to the 90th percentile (around 0.20) corresponds to an increase in log-odds of approximately 2.3, translating into roughly a tenfold jump in the probability of forming an additional independent tie. This result strongly supports Hypothesis 3, suggesting states systematically select partners whose treaty commitments impose high institutional exit costs.

Control variables align well with established literature. Dyads within the same geographic

region, sharing a land or maritime border, or involving major powers are significantly more likely to sign defense treaties. Joint democracies are also positively associated with alliance formation, whereas joint autocracies show a reduced propensity after controlling for other factors. The coefficient for trade dependence becomes statistically insignificant once the cost-of-arming measure is included, though the correlation between these two variables is modest (around 0.09, $VIF \approx 1.3$), indicating that fiscal pressures rather than trade per se may be more directly related to alliance formation decisions. Capability imbalance remains positively associated with new alliances, reinforcing existing arguments that dyads with uneven power relationships formalize security ties to secure great-power protection.

In sum, these TERGM results suggest that credible redundancy in alliances does not occur randomly. Instead, it systematically emerges among states that anticipate relative capability decline, face substantial domestic fiscal constraints, and can access allies whose treaty commitments impose significant institutional exit penalties. These findings support the theoretical mechanisms articulated earlier and justify the construction of the reliability-weighted Alliance-Backup Capacity measure from model-predicted rather than observed alliances.

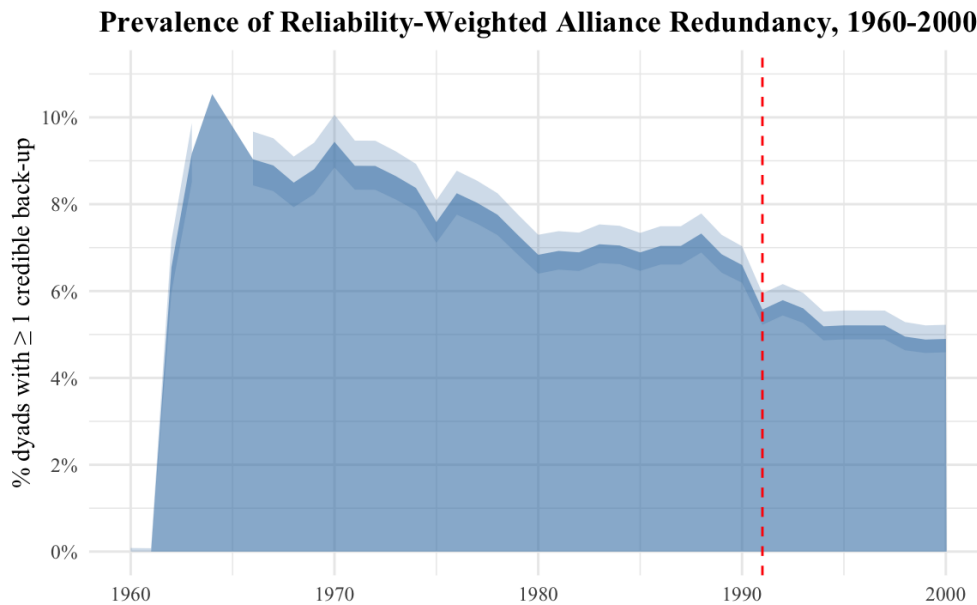


Figure 5.1: Prevalence of Reliability-Weighted Alliance Redundancy (with CI), 1960-2000

Figure 5.1 plots, for each calendar year, the proportion of dyads that possessed at least one depth-weighted Alliance-Backup Capacity (ABC) path in the preceding year. Coverage rises rapidly during the early 1960s, reaching about 11 percent as NATO, the Warsaw Pact, and U.S. hub-and-spoke treaties mature. It then drifts downward: *détente*, the Sino-Soviet split, and a wave of post-colonial treaty lapses cut the share to roughly 7 percent by 1980. After the Warsaw Pact collapses (vertical line at 1991) the series settles below 5 percent. Later NATO enlargements leave the curve flat because most new members connect through the existing U.S. hub rather than create node-disjoint back-ups. The figure underscores that reliability-weighted redundancy is scarce and largely confined to Cold War bloc structures—context that frames the deterrence tests in the next section.

5.2 Conflict Onset

Table 5.2 summarizes three complementary-log-log mixed-effects models assessing annual MID onset. All variables enter at $t - 1$, and a random intercept absorbs unobserved dyad-level propensities to fight. Column 1 contains only structural covariates; column 2 adds lagged reliability-weighted Alliance-Backup Capacity (ABC); column 3 introduces the Low-Trust indicator and its interaction with ABC—the specification that maps directly onto Hypotheses 4 and 5.

The coefficient on depth-weighted ABC in column 3 is 0.16 (95% CI: 0.07–0.26). With a clog-log link, a positive sign means a higher hazard. In a representative dyad (covariates at their means, Low-Trust = 0, year = 1980), raising ABC by one standard deviation lifts the predicted annual MID probability from 0.22% to 0.27%, a relative increase of about 23%.

Consistent with Hypothesis 4, greater redundancy—when the treaties are deep—coincides with a higher risk of conflict.

Low-Trust on its own enters negative (−0.46, CI: −0.86 to −0.07). Dyads whose back-ups are uniformly shallow are often peripheral to major security competitions; they begin with

Table 5.2: Complementary-log-log Mixed Models of MID Onset, 1960–2000

	(1) Controls	(2) + ABC	(3) + ABC × Credibility
Alliance redundancy	–	–	–
ABC ($t - 1$) (z)	–	0.07* [0.00, 0.13]	0.16** [0.07, 0.26]
Low-Trust dummy	–	–	–0.46* [–0.86, –0.07]
ABC ($t - 1$) × Low-Trust	–	–	–0.13* [–0.24, –0.02]
Structural controls	–	–	–
Contiguity	3.48*** [2.90, 4.05]	3.46*** [2.89, 4.03]	3.38*** [2.81, 3.95]
Rivalry (lagged)	1.67*** [1.43, 1.92]	1.65*** [1.40, 1.89]	1.74*** [1.47, 2.00]
Either major power	1.77*** [1.26, 2.28]	1.79*** [1.29, 2.30]	1.81*** [1.29, 2.33]
Capability ratio	–0.26*** [–0.39, –0.14]	–0.27*** [–0.40, –0.14]	–0.28*** [–0.41, –0.14]
Joint democracy	–0.83*** [–1.15, –0.50]	–0.90*** [–1.24, –0.56]	–0.90*** [–1.24, –0.56]
Joint autocracy	0.07 [–0.20, 0.33]	0.06 [–0.20, 0.33]	0.03 [–0.25, 0.31]
Trade dependence	0.24*** [0.10, 0.38]	0.23** [0.09, 0.38]	0.23** [0.07, 0.38]
Year spline (4 df)	Yes	Yes	Yes
Random dyad effect	Yes	Yes	Yes
Obs. / Dyads	218,409 / 13,081	218,409 / 13,081	183,914 / 11,490
AIC	6,546	6,544	6,001

Note: Log-hazard ratios from complementary-log-log mixed models; 95% confidence intervals are shown in brackets. Random intercepts for dyads absorb dyad-specific, time-invariant heterogeneity, and a cubic B-spline with four knots captures long-run temporal trends. Stars denote that the interval excludes zero: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Low-Trust = 1 when every potential back-up treaty lies below the 25th-percentile Benson-Clinton depth score.

a lower baseline hazard. The interaction term is also negative (-0.13 , CI: -0.24 to -0.02), which flattens the ABC slope under Low-Trust conditions.

That sign matches Hypothesis 5, which anticipated that shallow redundancy would dampen—rather than intensify—the escalation pattern associated with credible overlap.

Control estimates conform to established findings: contiguity, enduring rivalry, major-power presence, and trade dependence raise dispute risk; capability preponderance and joint democracy reduce it. Model fit improves once ABC and the interaction are included: AIC falls from 6,546 to 6,001, a drop of 545 points, and the log-likelihood rises accordingly. Ten-fold cross-validation yields a Brier score of 0.019 and a mean ROC-AUC of 0.87 (see Table 6.1)—both better than the control-only benchmark.

Two mechanisms could account for the positive ABC coefficient. First, states embedded in dense, credible alliance webs are often pivotal members of opposing blocs; their high redundancy may signal strategic importance that attracts challenges rather than deters them. Second, adversaries may discount backup pledges if they expect collective-action problems within large coalitions, blunting any deterrent premium from additional credible allies.

5.3 Mediation Analysis

Table 5.3 probes whether the positive coefficient on lagged, depth-weighted ABC in the hazard model traces back to the simple fact that many high-ABC pairs are already locked in enduring rivalries. The mediator is a yearly indicator that equals $=1$ when the same dyad is classified as an enduring rivalry.

Under sequential-ignorability assumption, the mediation analysis indicates that the average causal mediation effect (ACME) is 0.332 and highly significant. The average direct effect (ADE) is 0.047 and not distinguishable from zero at conventional levels. The indirect pathway therefore accounts for about 88% of ABC's total association with the MID hazard: $0.332/(0.332+0.047)$. Thus, depth-weighted redundancy is linked to higher MID risk mainly

Table 5.3: Mediation of the Alliance–Backup Effect on MID Onset through Dyadic Rivalry

Effect	Estimate	S.E.	z	95% CI	p
Indirect (ACME)	0.332	0.055	6.09	[0.224, 0.439]	< 0.001
Direct (ADE)	0.047	0.032	1.45	[-0.016, 0.111]	0.147
Total	0.379	0.063	5.98	[0.255, 0.503]	< 0.001

Note: ACME = average causal mediation effect; ADE = average direct effect. Brackets show 95% confidence intervals based on Sobel/Delta standard errors clustered by dyad. Models include random dyad intercepts and a cubic year spline with four knots. Significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

because the dyads with many credible back-ups are almost always long-standing rivals; once rivalry is held constant, redundancy itself shows no additional connection to dispute onset.

Hypothesis 4 anticipated that higher, credibility-weighted redundancy would be associated with a higher MID hazard, largely because those configurations cluster in entrenched rivalries. The mediation test confirms this expectation: 88% of the total ABC effect is transmitted through the rivalry pathway, and the residual direct effect is small and statistically indistinct from zero.

Hypothesis 5 further posited that the escalation pattern should weaken when redundancy rests entirely on shallow treaties (Low-Trust = 1). That logic is consistent with the negative $ABC \times \text{Low-Trust}$ interaction in the hazard model and with the negligible direct effect of ABC once the rivalry channel is isolated. Hence, both revised hypotheses receive empirical support.

In substantive terms, enduring rivals expect recurrent crises and therefore accumulate multiple, deep defense ties; those credible overlaps mark anticipated danger rather than pacify relations. Shallow redundancy offers little deterrence but also little additional risk. Credible redundancy, in contrast, mirrors—and may magnify—the security competition already present in hardened rivalries.

Table 5.4 presents the predicted probabilities of militarized interstate dispute (MID) onset, derived from the complementary log-log mixed-effects model (Table 5.2, column 3). Results are disaggregated by the credibility of backup treaties—measured by treaty-depth

quartiles—and compare scenarios of low (one standard deviation below the mean) versus high redundancy (one standard deviation above the mean).

Table 5.4: Predicted Annual MID Probability by Treaty-Depth Quartile and Alliance Redundancy (Table 5.2 Col 3)

<i>Treaty-depth quartile</i>	Low redundancy	High redundancy	Absolute Δ	Relative risk
	Pred. MID probability ($\times 10^{-4}$ dyad-years)			
Q1 (shallow)	0.55 [0.35, 0.78]	0.58 [0.38, 0.80]	0.03 [-0.05, 0.10]	1.05 [0.91, 1.21]
Q2 (lower-mid)	0.60 [0.39, 0.83]	0.72 [0.46, 1.03]	0.12 [0.03, 0.22]*	1.20 [1.05, 1.38]*
Q3 (upper-mid)	0.59 [0.37, 0.81]	0.74 [0.48, 1.04]	0.15 [0.05, 0.26]**	1.25 [1.07, 1.46]**
Q4 (deep)	0.55 [0.34, 0.78]	0.76 [0.49, 1.07]	0.21 [0.10, 0.32]***	1.38 [1.18, 1.61]***

Note: "Low" ("High") redundancy = Alliance-Backup Capacity one standard deviation below (above) its mean. Probabilities are predicted from Model 3 from Table 5.2 using a complementary-log-log link; all other covariates are fixed at their sample means (continuous) or medians (binary) and the dyad random intercept is set to zero. Brackets contain 95% simulation intervals based on 5,000 draws from the variance-covariance matrix. Relative-risk column reports the ratio of high- to low-redundancy risk. Stars indicate that the interval for Δ (or the risk ratio) excludes the null: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

For dyads whose backup treaties rank in the lowest depth quartile (Q1, “shallow”), shifting from low to high redundancy changes the predicted MID risk minimally, from 0.55 to 0.58 per 10,000 dyad-years. The absolute difference of 0.03 per 10,000 dyad-years and a relative risk ratio of 1.05 are statistically indistinguishable from zero (95% CI: 0.91–1.21). Hence, additional redundancy consisting solely of shallow treaties neither clearly increases nor decreases the probability of MID onset. This aligns with the expectation that redundancy alone, without credible treaty obligations, exerts minimal influence on deterrence outcomes.

In dyads with treaties of intermediate credibility (Q2 and Q3), higher redundancy corresponds to moderately increased MID probabilities, rising from approximately 0.60 to around 0.72–0.74 per 10,000 dyad-years. These increases in absolute terms (0.12 to 0.15 per 10,000) represent relative risk increases of 20–25% and are statistically significant at conventional levels. This pattern suggests that moderately credible backup treaties, rather than stabilizing dyadic relations, may signal potential weakness or preparation for conflict, thus possibly provoking rather than deterring disputes.

Dyads in the highest treaty-depth quartile (Q4, “deep”) show the largest predicted increase in MID onset probabilities as redundancy rises. The probability shifts from 0.55 to 0.76

per 10,000 dyad-years—a substantial absolute difference of 0.21 per 10,000 dyad-years, or approximately a 38% relative risk increase. This difference is statistically significant (95% CI: 1.18–1.61). Such results indicate that rather than providing reassurance, highly credible redundant alliances seem associated with elevated conflict risk, likely signaling heightened security threats or reinforcing perceptions of aggressive intentions.

These findings directly inform Hypotheses 4 and 5. Hypothesis 4 anticipated that higher Alliance-Backup Capacity (ABC) would coincide with a higher MID hazard, and Table 5.4 shows precisely that pattern: the increase is monotonic across treaty-depth quartiles and rises most steeply when redundancy is backed by deep, institutionalized pacts.

Hypothesis 5 predicted that this escalation pattern would be *conditional* on credibility—weak or absent when all backup treaties are shallow and strongest when at least one backup scores high on depth. The quartile comparison corroborates the claim: the Q1 row shows no meaningful change, whereas the Q4 row registers the largest absolute and relative risk gains. The negative $ABC \times \text{Low-Trust}$ interaction in the main hazard model delivers the same message statistically.

Taken together with the mediation evidence, the predicted-probability exercise underscores rivalry as the central pathway. Dyads that are already entrenched rivals accumulate deep, overlapping alliances as insurance, and that very insurance is interpreted by adversaries as confirmation that another confrontation is looming. Shallow redundancy neither reassures nor inflames; credible redundancy marks—and may magnify—an existing competition for security.

In short, the predicted-risk profiles provide additional support for both revised hypotheses: credible, redundant alliances are least common where peace prevails, and where they do appear—chiefly in rivalrous pairs—they are associated with a measurable uptick in conflict onset.

CHAPTER 6

CONCLUSION

This thesis asked two linked questions. First, under what conditions do states form credible, redundant alliances? Second, once these redundant ties are in place, do they deter or increase the risk of conflict? The findings offer clear answers to both. States anticipating future capability decline, facing high domestic costs for re-armament, and having access to partners willing to sign deeper treaties are significantly more likely to establish redundant defense ties. Moving from the 25th to the 75th percentile of military-expenditure-to-GDP increases the odds of forming a redundant alliance six-fold, while a jump from median treaty depth to the 90th percentile raises those odds roughly ten-fold. Yet the redundancy created by such alliances is associated with a higher—not lower—likelihood of militarized interstate disputes. A one-standard-deviation increase in redundancy lifts annual MID risk by about 23 per cent, especially among rival states. In other words, declining states build credible safety nets precisely in dyads already marked by tension, leading observers to interpret credible redundancy as a warning rather than reassurance, whereas redundancy built solely on shallow treaties leaves dispute risk largely unchanged.

Put differently, the statistical link between ABC and MID onset is an empirical gauge of “provocation versus reassurance”: deeper, node-disjoint redundancy correlates with provocation (higher hazards), while shallow overlap yields little observable reassurance or danger.

Classical deterrence and “chain-ganging” arguments often treat treaty credibility as exogenous or fixed, rather than a design choice that states can manipulate. This study shows that credibility actively shapes partner selection: leaders favor allies whose commitments impose higher exit costs, supporting a fiscal-credibility mechanism and sharpening balance-of-threat logic. On conflict outcomes, the results challenge the common claim that deep alliances are uniformly stabilizing. Once treaty depth and network redundancy are separated, the stabilizing effect proves compositional: roughly 88 per cent of the ABC–MID association is

mediated by enduring rivalry, leaving no independent pacifying influence after rivalry is held constant.

The dissertation introduces Alliance-Backup Capacity (ABC)—a credibility-weighted count of node-disjoint defense paths—and embeds it in a two-stage design that links a TERGM network-formation model to a complementary-log-log hazard analysis. The approach provides a tractable way to model rare conflict events, capture endogenous alliance structure, and improve out-of-sample predictive performance in large- N dyadic designs.

Treaty depth relies on expert coding that may embed subjective bias; power-shift forecasts can misclassify underlying capability trends; multiple imputation might upwardly bias depth where missingness is systematic. Defining redundancy through two-step paths may under-count relevant longer chains—though existing evidence suggests credibility decays quickly with path length—so testing sensitivity to three- or four-step paths would be informative. Future work can sharpen measurement by applying text-as-data techniques to treaty clauses, validating power-shift indicators with exogenous shocks, stress-testing imputation routines, and experimenting with alternative path lengths.

First, the analysis stops in 2000, omitting Indo-Pacific minilaterals and recent NATO enlargements; updated ATOP and MID data will permit re-evaluation of the argument. Second, strategic endogeneity may linger: unobserved threat perceptions could jointly drive redundancy and conflict, even though the models control for lagged rivalry and mediation results attribute most of the effect to that channel. Natural-experiment or difference-in-differences designs exploiting sudden defense-budget shocks could improve causal identification. Third, complementary-log-log estimation can overstate hazards when events are rare; Bayesian hierarchical or rare-event logit models would offer robustness checks once computational resources allow.

For policymakers, the analysis counsels caution. In rivalry-rich regions such as Eastern Europe or the Western Pacific, adding credible overlapping alliances may signal insecurity

and provoke rather than deter potential challengers. Shallow, fiscally convenient pacts, by contrast, rarely move the needle on conflict probabilities—leaders may incur political costs without gaining either deterrence or escalation. Contemporary Indo-Pacific "mini-laterals" (e.g., the Quad, AUKUS, Japan-Philippines-US security dialogues) illustrate the trade-off. Most are explicitly US-linked and only loosely institutionalized: they diversify partners but do not yet create deep, US-disjoint defense paths. According to this study's findings, such low-depth arrangements are unlikely to embolden China outright, yet they also provide limited deterrent insurance for the weaker members. Crafting alliance policy therefore requires balancing the fiscal appeal of redundancy against the signaling risks that accompany deeper, node-disjoint guarantees—and recognizing that shallow mini-laterals may offer symbolism more than security.

The thesis opened with France's 1939 paradox: an elaborate alliance web that ultimately advertised vulnerability. The same logic endures. Alliances provide security up to the point where their very abundance signals growing danger. Pinpointing when prudent hedging tips into costly over-insurance remains the central challenge—one that metrics such as Alliance-Backup Capacity begin to address, but that future data and research designs must refine.

SOFTWARE

All analyses were conducted using R version 4.5.0 (R Core Team, 2025). The following R packages were used throughout the data management, modeling, and visualization process: `btergm` (Leifeld and Cranmer, 2016), `countrycode` (Arel-Bundock et al., 2018), `data.table` (Dowle and Srinivasan, 2024), `dplyr` (Wickham et al., 2023), `ergm` (Handcock et al., 2024), `ggplot2` (Wickham, 2016), `glmmTMB` (Brooks et al., 2017), `MASS` (Ripley and Venables, 2021), `msm` (Jackson, 2023), `parallel` (Team, 2025a), `peacesciencer` (Miller, 2023), `psych` (Revelle, 2024), `sandwich` (Zeileis, 2024), `splines` (Team, 2025b), and `WDI` (Arel-Bundock and Gjoza, 2023). The open-source developers and contributors who maintain these packages provide an essential and underappreciated service to the scientific community, and their work is acknowledged here with appreciation.

REPLICATION

All data and code required to reproduce this thesis's results are available at <https://github.com/chqiye/conflict-network-thesis>. The archive includes cleaned datasets, all analysis scripts, and a README with replication instructions. Analyses can be reproduced using R version 4.5.0 and the packages cited above. Minor differences in results may occur due to software versioning or random seeds.

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APPENDIX A.

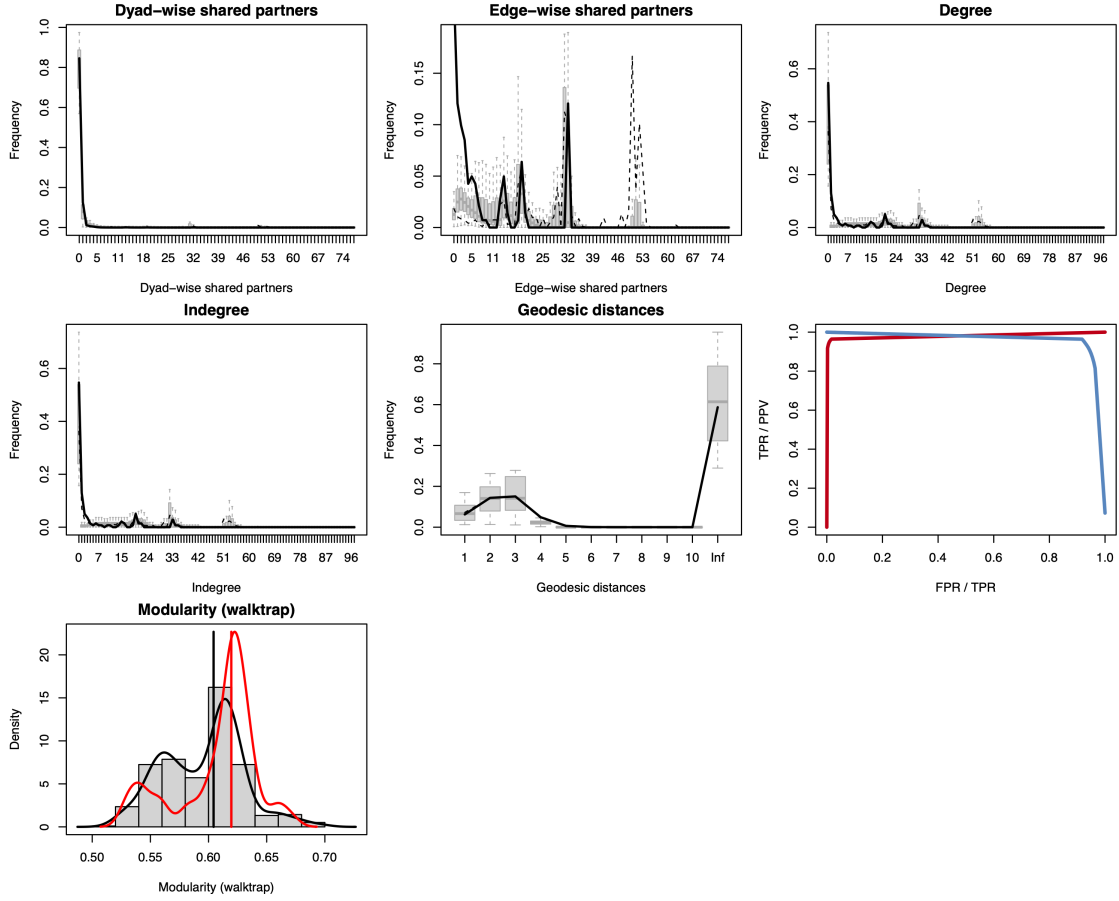


Figure 6.1: Goodness of fit for Model 3 in Table 5.1

The panel compares the observed 1960–2000 defense-pact network (solid black curves / bars) with 500 networks simulated from the fitted TERGM (grey dashed curves or box-plots) across seven statistics: dyad-wise shared partners, edge-wise shared partners, degree distribution, in-degree distribution, geodesic distances, ROC/PR prediction curves, and modularity (walk-trap). The ROC/PR plot shows an out-of-sample $AUC > 0.97$.

Table 6.1: Out-of-Sample Predictive Accuracy of the MID Hazard Models
 10-fold cross-validation, 474,775 dyad-years, 1960–2000

Model specification	Brier score	ROC AUC
Controls only ^a	0.0202 (0.0004)	0.829 (0.013)
+ Alliance-Backup Capacity	0.0186 (0.0004)	0.872 (0.011)
+ ABC and ABC×Low-Trust ^b	0.0184 (0.0004)	0.878 (0.011)

Notes: Values are fold-weighted means; parentheses give the standard error across folds. Lower Brier scores indicate smaller probabilistic error; higher ROC AUC values indicate better separation of dispute and non-dispute years. The baseline incidence of new MIDs in the sample is 0.21%.

^a Contiguity, shared rivalry, capability ratio, trade dependence, regime similarity, major-power presence, and cubic time spline, with dyad random intercepts.

^b Interaction term coded only when all back-ups lie below the 25th-percentile treaty-depth threshold.