

# Signaling Alliance Commitments: Hand-Tying and Sunk Costs in Extended Nuclear Deterrence

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*How can states signal their alliance commitments? Although scholars have developed sophisticated theoretical models of costly signaling in international relations, we know little about which specific policies leaders can implement to signal their commitments. This article addresses this question with respect to the extended deterrent effects of nuclear weapons. Can nuclear states deter attacks against their friends by simply announcing their defense commitments? Or must they deploy nuclear weapons on a protégé's territory before an alliance is seen as credible? Using a new dataset on foreign nuclear deployments from 1950 to 2000, our analysis reveals two main findings. First, formal alliances with nuclear states appear to carry significant deterrence benefits. Second, however, stationing nuclear weapons on a protégé's territory does not bolster these effects. The analysis yields new insights about the dynamics of "hand-tying" and "sunk cost" signals in international politics.*

How can states credibly signal their commitments in competitive international environments? When leaders commit to future courses of action in international politics, they generally would prefer those commitments to be believed. Their true preferences and intentions, however, are not directly observable by others. Leaders therefore are compelled to employ signals to indirectly communicate their preferences and intentions (Fearon 1994; Jervis 1970; Schelling 1960).

While signaling one's interests is always difficult, demonstrating resolve in an alliance context is thought to be especially challenging (e.g., Huth 1988; Morrow 1994; Schelling 1966). States usually can be trusted to defend their own possessions, but demonstrating one's willingness to pay military costs on behalf of another state is

typically more problematic. For a defensive alliance to be effective, would-be adversaries must believe that an ally will provide military support to its protégé in time of war. However, throughout history, states have sometimes reneged on alliance commitments when they were challenged.<sup>1</sup> Thus, for leaders who are indeed willing to defend their allies with military force, the central challenge is to convince others of this fact without actually having to fight. How can this be done?

To signal their alliance commitments, states have two basic tools: words and deeds. On one hand, a state might simply issue a public, perhaps written declaration of its intention to defend another state. Alternatively (or in addition), the ally could take actions calculated to demonstrate its commitment, such as deploying military forces

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<sup>1</sup> Leeds, Long, and Mitchell (2009) show that allies renege on defensive alliance commitments about 25% of the time. See also Leeds (2003a), Leeds and Savun (2007), and Leeds, Mattes, and Vogel (2009). Siverson and King (1980) are even more pessimistic, suggesting that states fail to defend their allies about 75% of the time.

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on a protégé's territory during peacetime. In both cases, the objective is to persuade potential adversaries that the ally will indeed protect its protégé in time of war. Yet we know little about the comparative effectiveness of these two approaches. While costly signaling has been a central topic of scholarly inquiry for some time (e.g., Fearon 1994, 1997; Morrow 1992, 1994), scholars have not systematically investigated which specific military and diplomatic activities can credibly signal a state's alliance commitments.

This article evaluates the effectiveness of signaling in an alliance context using new data on one specific type of alliance: namely, defense pacts with nuclear-armed states. Can nuclear states achieve successful extended deterrence by announcing defensive alliances with protégé states? Or must they deploy nuclear weapons on an ally's territory before their commitment is seen as believable? During the Cold War, several nuclear states used extraterritorial nuclear deployments to signal their alliance commitments and deter aggression against allies. Yet it remains unclear whether these deployments achieved their intended aim. Did the foreign deployment of nuclear weapons bolster the deterrent effect of existing alliances, or were alliance promises alone sufficient to deter? Until recently, scholars have not had access to data that would provide answers to these questions. Since the end of the Cold War, however, this information has become publicly available. This study draws on these declassified data and an array of other sources to evaluate the extended deterrent effects of foreign-deployed nuclear forces.

Our analysis yields two principal findings. First, it demonstrates that formal defense pacts with nuclear states have significant deterrence benefits. Having a nuclear-armed ally is strongly associated with a lower likelihood of being targeted in a violent militarized dispute during the period we study. Second, foreign-deployed nuclear weapons appear to add little to the deterrent effect of these alliances. Deploying nuclear weapons on a protégé's territory does not reduce the likelihood that the protégé will be targeted in a militarized dispute, once we account for the effect of the alliance itself. Thus, while having a nuclear ally carries important security benefits, those benefits do not appear to be enhanced by hosting the ally's nuclear weapons. These results are robust across a variety of empirical models that account for nonnuclear alliances, conventional troop deployments, and other confounding variables. Our findings also hold when we account for possible endogeneity in the relationship between signals of alliance commitment and conflict.

The deterrent effects of alliance commitments have been the subject of much scholarly research. Several studies have explored the theoretical mechanics of alliance

signaling (Fearon 1997; Morrow 1994; Smith 1995), and others have investigated the empirical effects of alliance commitments (Benson 2011; Gibler and Vasquez 1998; Leeds, Long, and Mitchell 2000). For instance, Leeds (2003b) and Johnson and Leeds (2011) show that alliances exert strong deterrent effects, on average, when they are constructed for that purpose. However, we do not yet fully understand why alliances strengthen deterrence. Is the existence of a defense pact sufficient to achieve general deterrence? Or do alliances promote peace only when states signal their resolve by taking costly actions, such as stationing armaments on allied territory? Answering these questions is central to our understanding of the relationship between alliances and war, but because existing studies do not distinguish between words and deeds in alliance signaling, they have been unable to answer this question. This study is one of the first to disaggregate alliance commitment strategies in order to compare their effectiveness.

Most existing literature on extended nuclear deterrence focuses almost exclusively on "immediate" deterrence situations—that is, crises that occur after an adversary has already issued a challenge against a protégé (e.g., Huth 1988, 1990). Comparatively few studies, by contrast, have explored the relationship between nuclear weapons and extended *general* deterrence—in other words, whether nuclear weapons can prevent challenges against protégés in the first place. In addition, while a growing number of quantitative studies address whether nuclear weapons benefit their possessors, they rarely consider how nuclear arsenals influence alliance dynamics. This study is one of the first to explore the conditions under which nuclear weapons can deter the initiation of crises against allies. Our findings are consistent with the predictions of Fearon (1994), Huth (1990), and others who have argued that nuclear weapons are better at preventing challenges than at dissuading challengers from following through on threats they have already made.

More broadly, this study contributes to a growing scholarly literature on the political effects of nuclear weapons in international relations. Nearly 70 years into the nuclear age, we still lack a complete understanding of the ways in which nuclear weapons have impacted world politics. What forms of political leverage, if any, do nuclear weapons provide? Under what conditions are nuclear weapons useful instruments of political influence? Scholars have begun to explore these questions from a variety of perspectives, emphasizing the importance of bargaining dynamics (Beardsley and Asal 2009; Gartzke and Jo 2009), nuclear posture (Narang 2009, 2013, 2014), preventive war motives (Debs and Monteiro 2014; Fuhrmann and Kreps 2010), and learning (Horowitz 2009) for

understanding the consequences of nuclear proliferation. The results of this study help advance this research agenda, lending support to the view that nuclear weapons are useful as tools of deterrence, not as instruments of coercion (e.g., Sechser and Fuhrmann 2013).

We proceed in four parts. First, we discuss competing perspectives on the effectiveness of words and deeds as signals of alliance commitments. Second, we describe our new dataset of extraterritorial nuclear deployments and the sources used to generate it. Third, we evaluate the deterrent effects of alliance agreements and foreign nuclear deployments by assessing their impact on the likelihood of militarized interstate disputes. Conclusions and implications follow.

## Nuclear Alliances, Signals, and Deterrence

Even when states are willing to use military force to defend their allies, they would rather avoid having to do so. Violent conflicts are costly even for the victors, so states would prefer to achieve their foreign policy objectives without war. The purpose of making a deterrent threat—whether a general strategic commitment to an ally or a specific threat during a crisis—is to avoid having to execute it. The most effective alliance commitment, therefore, is not one that yields a war-winning coalition, but rather one that is never tested. How can allies ensure that their defense commitments are not challenged?

An ally's failure to establish credibility can be costly for all sides. For example, ambiguity about Britain's willingness to defend Belgium and France in July 1914 emboldened the German invasion that marked the outbreak of World War I (Sagan 1986). Had the British been more successful in convincing German diplomats of their readiness to intervene in a conflict in Western Europe, the war might have been avoided. Likewise, weak signals of commitment can damage alliance cohesion. Allies who do not trust one another's assurances may abrogate their own alliance commitments, defect to other alliances, or take actions that undermine collective alliance goals. During the 1960s, for instance, Charles de Gaulle publicly doubted American willingness to protect France from Soviet aggression, leading to France's eventual withdrawal from NATO's operational military command and the removal of allied troops from French soil.

Nuclear states have often attempted to protect their allies by raising the possibility of nuclear retaliation against would-be adversaries. The United States, for example, relied heavily on its nuclear arsenal to deter at-

tacks against its NATO allies during the Cold War: a 1953 National Security Council report declared that "the major deterrent to aggression against Western Europe is the manifest determination of the United States to use its atomic and massive retaliatory striking power if the area is attacked" (Lay 1953).<sup>2</sup> Ideally, the enormous costs of a nuclear war—even a victorious war—would deter potential aggressors from threatening or attacking a protégé, so long as the threat of allied retaliation was sufficiently credible.

To achieve extended deterrence, a nuclear patron must, at a minimum, convince potential attackers that it will defend its protégé in war. Nuclear states have two basic tools for achieving this objective. First, a nuclear state might simply declare its intention to protect an ally, perhaps by signing a formal defense pact with the protégé in question. While in practice an ally's nuclear umbrella is rarely evoked explicitly in defensive alliance agreements, it is often implied. Second, nuclear states might forward-deploy nuclear forces on the protégé's territory in hopes of persuading potential attackers that aggression will be met with nuclear retaliation. Below we discuss the theoretical merits and limitations of these two forms of signaling and derive observable implications to be tested in the following section.

## Nuclear Alliance Commitments

Nuclear weapons are believed to provide their possessors with strategic benefits because they substantially raise the costs of war for potential aggressors. Indeed, many scholars have argued that nuclear powers are less likely to be attacked (e.g., Jervis 1989; Waltz 1990).<sup>3</sup> Can nuclear powers extend the deterrent benefits of their nuclear arsenals to other states?

Since the beginning of the nuclear age, nuclear powers have attempted to achieve extended nuclear deterrence by signing alliance pacts with states they wished to protect. The Warsaw Pact and NATO are the two most well-known alliance systems forged by nuclear powers to defend friendly nations. But they are by no means the only defensive alliances created by nuclear states.

<sup>2</sup>Even today, nuclear weapons are a central component of NATO's deterrence strategy: the 2013 *NATO Handbook* emphasizes that "NATO's nuclear strategy and force posture are inseparable elements of the Alliance's overall strategy of war prevention.... They make the risks of aggression against NATO incalculable and unacceptable in a way that conventional forces alone cannot" (65).

<sup>3</sup>The compelling effects of nuclear weapons, however, are more controversial. See, for instance, Sechser (2011) and Sechser and Fuhrmann (2013).

The United States, for example, made multilateral defense commitments during the Cold War through the Rio Pact—which includes most of Latin America—and the Australia, New Zealand, United States (ANZUS) Security Treaty. The United States also signed bilateral defense treaties with countries such as Japan, the Philippines, and Taiwan. China, France, Russia, and Britain likewise formally pledged to defend a number of other states through multilateral or bilateral agreements. Britain, for instance, joined the Central Treaty Organization (CENTO) in the 1950s along with Iran, Iraq, Pakistan, and Turkey. Nuclear states forged these formal alliances, in part, to signal to potential aggressors that they were willing to defend their protégés with military force. It was hoped that these alliances would introduce the possibility of nuclear retaliation in a conflict, thus sending an especially strong message to third parties.<sup>4</sup>

One striking feature of many of these alliances is that they entailed few signals of commitment beyond verbal promises. While some alliances entail expensive military cooperation and foreign policy coordination (e.g., Morrow 1994), it is important to recognize that they need not do so. The United States, for example, stationed fewer than 100 military officers in most Rio Pact states during the Cold War, despite being the alliance's primary security guarantor. U.S. leaders apparently viewed their verbal commitment as sufficient to protect these states from attack, and they saw little need for costly policy coordination or military deployments. Other examples of alliance commitments that relied almost entirely on verbal commitments rather than actions such as foreign troop deployments include defense pacts between the Soviet Union and Finland (1948–91); the members of the Arab League (1950–present), China and Cambodia (1960–70), and Russia and several former Soviet republics (1992–present).<sup>5</sup>

How might verbal alliance commitments constitute credible signals? A common view in international relations argues that in an anarchic international system, verbal promises from allies are worthless since there is no higher authority to compel states to fulfill them (Mearsheimer 1994). However, recent theoretical literature suggests that a verbal alliance promise could, in fact, constitute a credible signal of commitment if it is made *publicly*. Alliances, in this view, engage the credibility and reputation of the patron state when they are publicly announced.<sup>6</sup> By declaring one's intention to de-

fend a protégé, the patron stands to incur damage to its reputation if it does not fulfill its obligations (Fearon 1997; Jervis 1970; Schelling 1966). Alliances therefore are not purely epiphenomenal: their existence alters the strategic calculations of patron states by creating potential costs for abrogating them. If the signal is effective, a patron will be more willing to defend its ally after signing a public defense pact than it otherwise would have been if a formal commitment had not been made.<sup>7</sup>

Several recent studies demonstrate that states indeed pay reputation costs when they fail to uphold their alliance obligations. For instance, Gibler (2008), Crescenzi et al. (2012), and Narang and LeVeck (2012) present evidence that states that have reneged on alliance pledges in the past have difficulty finding allies in the future. Moreover, these studies also show that states that have developed a reputation for being unreliable allies are less likely to deter challenges against their protégés. Reneging on alliance commitments therefore appears to carry significant costs.<sup>8</sup>

Engaging one's reputation in order to demonstrate credibility has the flavor of a classic "hand-tying" commitment device (Fearon 1997). Broadly, the objective of a hand-tying signal is to manipulate the sender's future payoffs in order to make a desired course of action more attractive. The signal is not itself costly to send; rather, the sender pays a cost only if the commitment is not upheld.<sup>9</sup> A public alliance commitment seems to fit this description, since the act of announcing the alliance places the patron's credibility on the line and makes reneging considerably less attractive than it would have been otherwise. While the verbal commitment itself is not costly to make, the patron stands to suffer significant reputation costs down the line if it fails to meet its alliance obligations.

For nuclear states, this logic implies that the construction of public alliances may be sufficient to accrue the extended deterrence benefits of nuclear weapons. Consider a nuclear patron state with a potential interest in protecting two identical states, Ally and Acquaintance. If the patron has a formal alliance with Ally but not Acquaintance, the theory described above would anticipate that the extended deterrent effects of the patron's nuclear

<sup>7</sup>Mattes and Vonnahme (2010) offer a similar argument with respect to formal nonaggression pacts.

<sup>8</sup>There remains a contentious debate, however, about whether states pay reputation costs for breaking commitments in other security contexts. See, for example, Sartori (2005), Press (2005), and Sechser (2010).

<sup>9</sup>Fearon (1997) contrasts hand-tying signals with "sunk-cost" signals: actions that are costly to undertake in the near term but do not impact the payoffs associated with future courses of action. See also Lektzian and Sprecher (2007).

<sup>4</sup>See, for example, Mearsheimer (1984) and Freedman (2003).

<sup>5</sup>See Gibler (2008) for descriptions of these alliances and their terms.

<sup>6</sup>Our research design excludes secret alliances, as we discuss below.



arsenal would be more potent in the case of Ally, other things being equal. The reputation costs associated with renegeing on its commitment to Ally would enhance the likelihood that the patron would fight in Ally's defense, thereby raising the probability of nuclear escalation in any war involving Ally. By contrast, since the patron has not made a commitment to defend Acquaintance, it would suffer fewer reputation costs from not defending it. This fact, in turn, could harm the patron's ability to deter an attack against Acquaintance. We can summarize this prediction as follows:

**Hypothesis 1.** *Having a public defense pact with a nuclear state reduces the likelihood of being targeted in a militarized interstate dispute.*

### Foreign Nuclear Deployments

A different perspective on alliance credibility suggests that extended deterrence requires more than mere promises. In an anarchic system with no centralized enforcement of contracts, verbal or written declarations may lack credibility since they are not binding. Even more importantly, leaders face strong temptations to exaggerate which interests they would fight to defend: even if a state would not, in fact, be willing to defend an ally, it would like potential attackers to believe otherwise. Consequently, "sincere" allies must distinguish themselves from "insincere" types by taking costly actions that an insincere ally would not. According to this logic, paying significant costs during peacetime bolsters the credibility of alliance commitments because "states that are less committed to the alliance and the interests it advances should be less likely to suffer these costs in order to form the alliance" (Morrow 2000, 70).<sup>10</sup>

Nuclear states have often paid such "peacetime costs" by stationing nuclear forces on an ally's homeland. Indeed, our research reveals that states deployed nuclear forces on the territory of their allies on nearly two dozen occasions from 1950 to 2000. In many of these cases, the primary objective was to demonstrate the credibility of the patron's nuclear umbrella and thus strengthen extended deterrence. For example, the United States introduced tactical nuclear forces in certain NATO countries (Britain, Italy, Turkey, and West Germany) during the 1950s mainly to reduce the risk of Soviet aggression (Freedman 2003; United States Department of Defense

1978). An implicit assumption underlying these deployments was that a less resolved ally would be reluctant to station nuclear weapons on a protégé's territory; thus, by deploying nuclear weapons abroad, these states hoped to identify themselves as staunch allies and distinguish themselves from less resolute types. The shadow of allied intervention and nuclear escalation, in turn, would dissuade potential aggressors from attacking protégé states.<sup>11</sup>

Stationing nuclear forces on allied territory could increase the credibility of an alliance commitment in at least three ways. First, foreign nuclear deployments might shift the local balance of power in favor of the protégé. Tactical nuclear weapons in particular might improve the protégé's ability to fend off an attack (or impose costs on the adversary), which in turn would make war a less attractive option for the adversary. During the Cold War, for example, it was commonly argued that U.S. tactical nuclear forces in Western Europe strengthened deterrence by improving NATO's ability to thwart a Soviet attack. Analysts argued that forward-deployed tactical nuclear weapons could respond more rapidly to a Soviet assault, allowing the United States to destroy invading troops before they achieved their objectives (Biddle and Feaver 1989). Further, many policy makers believed that forward-deployed nuclear weapons posed a more credible threat of nuclear retaliation, since local commanders in the heat of battle might be more willing than political leaders to order the use of nuclear weapons (Bracken 1983). Weapons stationed on a patron's homeland, by contrast, would not carry this advantage. Forward-deployed nuclear weapons therefore might strengthen deterrence simply by virtue of their proximity to the adversary.

Second, foreign nuclear deployments could serve as "tripwire" forces whose central purpose in wartime is not to defeat the enemy but rather to be destroyed, thereby creating domestic political pressure for the patron to enter the war wholeheartedly. Indeed, once the United States developed long-range nuclear delivery capabilities, observers began to argue that U.S. tactical nuclear deployments in Europe were militarily superfluous, and that they would have a relatively small effect on a war's outcome (e.g., Schelling 1966, 111–16; Record 1974, 68). Instead, they argued, the presence of U.S. nuclear weapons in Europe was valuable because it ensured that American forces would be killed in a Soviet invasion—an event likely to trigger large-scale U.S. intervention (Freedman 2003, 353). In this way, forward-deployed nuclear weapons might bolster deterrence not because of their intrinsic

<sup>10</sup>Fuhrmann (2009, 2012), for example, argues that distributing foreign nuclear aid to protégé states can reduce the risk of third-party aggression since an uncommitted ally would be unwilling to pay such costs.

<sup>11</sup>For a good review of the various arguments that have been made for deploying U.S. nuclear weapons abroad, see Dyer (1977).

military utility, but because their destruction would invoke the full commitment of the patron to the protégé's defense.

Third, the sheer expense of foreign nuclear deployments could signal a patron's resolve, since a less committed ally might be unwilling to endure the economic and political costs associated with forward-deployed units (Morrow 1994, 2000). While the marginal cost of a nuclear warhead may be low compared to an equivalent quantity of conventional explosives, nuclear weapons require a considerable amount of supporting infrastructure, including: specialized transportation and storage systems, defense systems (early-warning radar, air defenses, and satellite, aerial, and naval reconnaissance), specially trained personnel, command and control infrastructure, delivery vehicles (bomber aircraft, submarines, and missiles), bases to support those vehicles (missile launch sites, airfields, and naval bases), safety and security systems, and logistics platforms.<sup>12</sup> Moreover, foreign-deployed nuclear weapons often require special delivery vehicles, which are expensive to develop and deploy. For example, the United States spent more than \$9 billion to develop and deploy intermediate-range nuclear missiles, which were placed in Europe during the 1980s and later withdrawn under the Intermediate-Range Nuclear Forces Treaty.<sup>13</sup> A less resolved patron might not be willing to incur the cost of these deployments, thus rendering them credible signals of commitment when they are undertaken. O'Neill (1990), for example, has argued that intermediate-range nuclear missiles in Europe were effective signals of the U.S. alliance commitment precisely because they were wastefully expensive. He characterizes these deployments as the equivalent of burning money: their main effect, in his view, was to inflict self-damage that a more cost-sensitive—and therefore less resolved—ally would have found intolerable.

Foreign nuclear deployments also incur costs in the form of safety and security risks. Nuclear weapons are thought by some to be destabilizing, in part, because they may be prone to accidental or unauthorized use (Sagan 1994). Placing nuclear weapons abroad may increase this danger, particularly when foreign governments are granted some degree of control over the weapons.<sup>14</sup> During the 1950s, for example, West German fighter pilots virtually commanded U.S. nuclear bombs when on alert, raising the possibility—however unlikely—that the

weapons might be used without U.S. approval (Norris, Arkin, and Burr 1999, 30).<sup>15</sup> Forward-deployed nuclear weapons might also be vulnerable to theft or sabotage in the event of political instability. For instance, during the 1967 military coup in Greece, U.S. officials worried about the vulnerability of its nuclear forces following “political tension in the vicinity of some of our nuclear storage facilities.”<sup>16</sup> Similar concerns ensued during the Turkish invasion of Cyprus in 1974, when custodians of U.S. nuclear weapons reportedly “held our breath” as local troops stormed a Turkish Air Force base where U.S. nuclear weapons were stored (Reed 2004, 173). Deploying nuclear forces abroad has never led to a serious nuclear incident, in part because nuclear states typically take a multitude of measures to avoid them.<sup>17</sup> Yet, because states are unlikely to accept the risk of such an incident unless they are firmly committed to the defense of the protégé, foreign nuclear deployments may constitute a credible signal of a patron's resolve.

To sum up, this logic suggests that costly actions such as extraterritorial nuclear deployments can bolster the credibility of alliance commitments and deter potential aggressors:

**Hypothesis 2.** *Hosting another state's nuclear weapons on one's territory reduces the likelihood of being targeted in a militarized interstate dispute.*

## Dataset and Operationalization of Variables

We test these hypotheses on signaling and extended nuclear deterrence using a dataset that contains information about states in the international system from 1950 to 2000.<sup>18</sup> The unit of analysis is the directed dyad-year. This data structure allows us to distinguish between initiators and targets in militarized disputes: in our data, for example, a dispute instigated by Japan against North Korea is treated as distinct from a dispute initiated by North Korea against Japan. In principle, each dyad-year represents one “opportunity” for the challenger to initiate a militarized dispute. However, analyzing all conceivable

<sup>12</sup>See Schwartz (1998) for detailed discussions.

<sup>13</sup>See Cushman (1987).

<sup>14</sup>The notion that forward-deployed tactical nuclear weapons may be vulnerable to theft or accidental use is widely discussed in the policy community. See, for example, Potter and Sokov (2000).

<sup>15</sup>The United States later tightened security measures by introducing locking mechanisms known as permissive action links (PALs).

<sup>16</sup>“Symington Finds Flaws in NATO's Warhead Security; Greek Incident Hinted,” *New York Times*, July 24, 1975.

<sup>17</sup>The effectiveness of these measures, however, has been questioned: for instance, Sagan (1993) identifies several serious vulnerabilities in the safety procedures employed by nuclear states.

<sup>18</sup>We begin our analysis in 1950 because this is the first year for which we have data on all of the independent variables.

country pairs would artificially inflate the sample size because many dyads (e.g., Burkina Faso–Guyana) cannot plausibly be said to have a realistic opportunity to fight. Consistent with standard practice in the literature, we therefore include in our sample only dyads that contain either neighboring countries or at least one major power (Lemke and Reed 2001).<sup>19</sup>

For information about our dependent variable (MILITARY CONFLICT), we employ Version 3.1 of the Correlates of War (COW) Militarized Interstate Dispute (MID) dataset (Ghosn, Palmer, and Bremer 2004). The MID dataset includes information about historical disputes between countries, including but not limited to threats to use force, alerts, military mobilizations, seizures, border clashes, and attacks. Because we are interested in the connection between extended deterrence and violent conflict, we limit our analysis to cases that resulted in fatalities.<sup>20</sup> VIOLENT CONFLICT is a dichotomous variable that is coded 1 if the challenger initiates a militarized dispute against the target that results in at least one fatality in year  $t$  and 0 otherwise.<sup>21</sup>

To measure military alliances, we consult two sources. Our primary models use Version 3.03 of the COW Formal Alliance dataset (Gibler and Sarkees 2004). The dichotomous variable DEFENSE PACT WITH NUCLEAR POWER is coded 1 if a potential target of a dispute has a public defense pact<sup>22</sup> with a nuclear-armed state and 0 otherwise.<sup>23</sup> Forty-four percent of the directed dyad-year observations in the sample are coded as having nuclear protection.<sup>24</sup>

<sup>19</sup>We define neighbors as countries that are located within 400 miles of one another. Note that the findings are substantively similar when we include all directed dyad-years in our estimation sample (see the online appendix for this article).

<sup>20</sup>Many of the nonviolent MIDs involve fishing trawler incidents and other trivial events where we would not expect nuclear weapons to play a role (e.g., Downes and Sechser 2012). We coded an alternate dependent variable that included MIDs where countries used military force and excluded cases where states merely “threatened” or “displayed” force, according to the dataset. As we show in the online appendix, the findings are largely unaltered.

<sup>21</sup>There are 239 militarized disputes involving fatalities in our sample. We code the dependent variable missing if information on the number of fatalities in a dispute is unavailable in the MID dataset.

<sup>22</sup>This dataset allows us to exclude secret alliances; see Gibler (2009, 451, note 6).

<sup>23</sup>We classify nuclear powers as follows: the United States (1950–2000), Russia (1950–2000), Britain (1952–2000), France (1960–2000), China (1964–2000), Israel (1967–2000), South Africa (1979–90), Pakistan (1987–2000), and India (1988–2000). These codings are adapted from Singh and Way (2004). While North Korea may currently possess a nuclear capability, it was probably not acquired until after 2000.

<sup>24</sup>Both the nuclear alliance and nuclear deployment variables are coded 0 in cases where the potential challenger in the dyad shares

To confirm the robustness of our results, we recode the nuclear alliance variable using the Alliance Treaty Obligations and Provisions (ATOP) dataset (Leeds et al. 2002). The ATOP and COW datasets are largely consistent in their coding of defense pacts, but there are some differences. For example, ATOP classifies the U.S.–South Korea partnership as a defense pact, whereas COW does not.<sup>25</sup>

The second independent variable—NUCLEAR DEPLOYMENT—is not available in existing datasets. Indeed, comprehensive data on foreign nuclear deployments were typically classified during the Cold War.<sup>26</sup> However, governments have declassified documents that divulge previously unavailable details about when and where their nuclear weapons were stationed abroad (see, e.g., United States Department of Defense 1978). Drawing on these documents and relevant historical literature, we constructed a new dataset of extraterritorial nuclear deployments.<sup>27</sup> These data allow us to evaluate, for the first time, the comparative deterrent effects of formal alliances and foreign nuclear deployments.

Our research reveals that the United States, Great Britain, and the Soviet Union together stationed nuclear weapons in more than 20 countries between 1950 and 2000 (see Table 1). Some states (such as Cuba and Denmark) housed nuclear weapons for just a few years, whereas others (such as Germany and Greece) had weapons on their soil for decades. The variable NUCLEAR DEPLOYMENT is coded 1 if a state had foreign-deployed nuclear weapons on its territory in a given year and 0 otherwise. Extraterritorial nuclear deployments occur in about 13% of the directed dyad-year observations in our estimation sample.

We exclude three possible types of foreign nuclear deployments from our analysis. First, we exclude the “accidental” nuclear deployments of Soviet nuclear

a nuclear defense pact with the target, since it is implausible that a state might be deterred by its own nuclear umbrella. For example, Japan is not coded as having nuclear protection in U.S.–Japan dyads.

<sup>25</sup>The ATOP and COW nuclear alliance variables are highly correlated ( $r = 0.86$ ) in our estimation sample.

<sup>26</sup>While governments that deployed nuclear weapons abroad often kept the locations of their warheads concealed from the public, this information typically was known to other states. Likely adversaries in particular used their intelligence services to identify the location of other states’ forward-deployed nuclear bombs. For example, satellite images allowed the United States to identify the presence of Soviet nuclear missiles in Cuba in October 1962, shortly after the weapons were introduced. Moreover, recognizing that nuclear weapons could only deter conflict if their presence was known to aggressors, allied defenders may have revealed the presence of nuclear weapons on allied territory through diplomatic back channels.

<sup>27</sup>A list of sources we consulted to produce this dataset is available in the online appendix.

TABLE 1 The Foreign Deployment of Nuclear Weapons, 1950–2000

Host Country	Nuclear Patron	Years	Defense Pact
Belgium	United States	1963–2000	Yes
Canada	United States	1964–1984	Yes
Cuba	Soviet Union	1962	No
Cyprus	Great Britain	1961–1975	No
Czechoslovakia	Soviet Union	1969–1990	Yes
Denmark	United States	1958–1965	Yes
East Germany	Soviet Union	1958–1991	Yes
Great Britain	United States	1954–2000	Yes
Greece	United States	1960–2000	Yes
Hungary	Soviet Union	1974–1989	Yes
Italy	United States	1956–2000	Yes
Malaysia	Great Britain	1963–1965	Yes
Mongolia	Soviet Union	1967–1992	Yes (1967–91), No (1992)
Morocco	United States	1954–1963	No
Netherlands	United States	1960–2000	Yes
Philippines	United States	1957–1977	Yes
Poland	Soviet Union	1967–1990	Yes
Singapore	Great Britain	1965–1970	No
South Korea	United States	1958–1991	No
Spain	United States	1958–1976	Yes (1970–76), No (1958–69)
Taiwan	United States	1958–1974	Yes
Turkey	United States	1959–2000	Yes
(West) Germany	Great Britain	1972–1998	Yes
	United States	1955–2000	Yes

Note: Defense pact data are from Gibler and Sarkees (2004). Data are right-censored.

weapons in Ukraine, Belarus, and Kazakhstan during the 1990s. While these three states technically hosted Russian weapons on their soil during this period, this is because they inherited the weapons when the Soviet Union collapsed; Moscow did not intentionally deploy them on the territory of independent states. Second, we exclude three cases in which the United States deployed nuclear weapons without their fissile cores, thereby rendering the weapons nonnuclear. These cases involve U.S. deployments in Cuba, France, and Japan. Third, while Washington deployed nuclear weapons on the Japanese islands of Chichi Jima, Iwo Jima, and Okinawa, we also exclude these cases since these territories were entirely under U.S. control during the period of deployment.<sup>28</sup>

To properly evaluate the effects of nuclear weapons on extended deterrence, we must also account for measures taken by states to signal their alliance commitments using conventional military power. We code two indica-

tors of conventional protection that mirror the previously discussed nuclear variables. First, DEFENSE PACT WITH NON-NUCLEAR POWER is coded 1 if a state shares a defense pact with a country that does not possess nuclear weapons and 0 otherwise.<sup>29</sup> We also account for troop deployments, which can be employed to signal a commitment to the defense of a protégé without invoking nuclear weapons.<sup>30</sup> Such deployments often occur in peacetime, as in Europe during the Cold War. However, foreign troops may also arrive during a crisis: after Saddam Hussein invaded Kuwait in 1990, for instance, the United States deployed thousands of troops to Saudi Arabia to signal its commitment to the defense of that country. Unfortunately, comprehensive time-series data on global troop deployments during the period we study are not readily available, making it difficult to measure the efforts of all states to extend deterrence by deploying military forces. However,

<sup>28</sup>Note, however, that including these three types of cases in our coding of NUCLEAR DEPLOYMENT produces substantively similar findings (see the online appendix).

<sup>29</sup>Fifty-two percent of the dyad-year observations in the estimation sample include defense commitments from nonnuclear states.

<sup>30</sup>Conventional troop deployments may also serve a “tripwire” function, as discussed in the previous section.



we were able to obtain annualized, country-specific data about U.S. foreign troop deployments from 1950 to 2000 (Kane 2004). We therefore create the variable *U.S. TROOPS*, which measures the total number of American soldiers stationed in the target country in a given year.<sup>31</sup>

We also control for several other factors that are believed to influence conflict initiation. First, since a state's own nuclear arsenal is likely to influence international conflict behavior, we include dichotomous indicators of nuclear status for the challenger (*NUCLEAR CHALLENGER*) and target (*NUCLEAR TARGET*) in each dyad.<sup>32</sup> Second, *CONTIGUITY* is coded 1 if the states in the dyad are contiguous by land and 0 otherwise, since neighbors are significantly more likely to engage in militarized conflicts than non-neighbors (Bremer 1992). Third, *ALLIANCE WITH CHALLENGER* is coded 1 if the challenger and target share a defense pact and 0 in all other cases.<sup>33</sup> Dyadic alliances are widely believed to impact conflict propensities, although scholars disagree about whether allies are more or less likely to engage in conflicts with one another (Bueno de Mesquita 1981; Morrow 2000).

As a fourth control, we include a variable capturing the congruence of foreign policy interests of dyad partners, based on voting at the United Nations (Voeten and Merdzanovic 2009). This variable, *FOREIGN POLICY SIMILARITY*, ranges from  $-1$  to  $1$ , with values closer to  $1$  indicating more congruent voting patterns.<sup>34</sup> Fifth, we account for the conventional material capabilities of the challenger and the target using COW Composite Indicators of National Capabilities (CINC) data (Singer, Bremer, and Stuckey 1972). Consistent with standard practice in the literature, *POWER RATIO* measures the ratio of the challenger's material capabilities to the sum of both states' capabilities in the dyad (Leeds 2003b). Finally, we account for the possibility that democracies are unlikely to

initiate disputes against other democratic states (Russett and Oneal 2001). Following Gartzke and Jo (2009), we include three variables using the widely employed 21-point Polity IV composite indicator (Marshall, Gurr, and Jaggers 2009): *CHALLENGER POLITY*, *TARGET POLITY*, and *CHALLENGER POLITY*  $\times$  *TARGET POLITY*.<sup>35</sup>

Lastly, our analysis accounts for possible temporal dependence in the data. The likelihood of a dispute between the United States and North Korea in year  $t$ , for example, might be influenced by the frequency of recent disputes between the two states. Following Carter and Signorino (2010), we address this issue by including a variable that counts the number of years that have passed without conflict within each dyad (*TIME*), its square (*TIME*<sup>2</sup>), and its cube (*TIME*<sup>3</sup>).

## Empirical Analysis

Because the dependent variable in our analysis (*MILITARIZED DISPUTE INITIATION*) is dichotomous, we employ a probit estimator, clustering the standard errors by directed dyad to address heteroskedastic error variance.<sup>36</sup> Table 2 presents the results of these regressions.

The baseline model (Model 1) shows that targets' nuclear defense pacts are negatively associated with dispute initiation at conventional levels of statistical significance ( $p < 0.001$ ). On average, the probability that a state will be targeted in a violent conflict decreases from 0.0034 to 0.0009 when *DEFENSE PACT WITH NUCLEAR POWER* is changed from 0 to 1 and all other factors are held constant.<sup>37</sup> In other words, states lacking defense commitments from nuclear powers are more than three times as likely to be targeted in violent disputes than states with nuclear-armed allies. While the absolute probability of dispute initiation remains small even in the absence of nuclear protection, it is important to recall that violent conflict occurs infrequently, and the likelihood that a state will experience a fatal dispute in any given year is very small.<sup>38</sup>

<sup>31</sup>This variable is coded 0 if the United States experienced a dispute with the target that resulted in at least 25 fatalities, based on the UCDP/PRIO Armed Conflict dataset (Themnér and Wallenstein 2013). In these cases, U.S. troops were deployed to a country primarily to initiate combat operations against it (e.g., Serbia in 1999). We divide the total number of troops by 1,000 for ease of interpretation.

<sup>32</sup>These variables are coded 1 if the relevant country possesses nuclear weapons in a given year and 0 otherwise.

<sup>33</sup>This variable is based on the COW Formal Alliance dataset (Gibler and Sarkees 2004).

<sup>34</sup>One drawback of this variable is that some key states in the international system did not cast votes at the United Nations (e.g., China prior to 1971). Including *FOREIGN POLICY SIMILARITY* in our model therefore reduces our sample size by 13%. However, as we show in the online appendix to this article, the findings are similar when we estimate our model in a larger sample that excludes *FOREIGN POLICY SIMILARITY* from the analysis.

<sup>35</sup>Polity scores range from  $-10$  to  $+10$ . Before constructing the interaction term, we rescale *CHALLENGER POLITY* and *TARGET POLITY* so that they range from 0 to 20.

<sup>36</sup>Since violent disputes occur relatively infrequently in the dataset, we also estimate the models using rare events logit (King and Zeng 2001). The findings, which are reported in the online appendix, are unchanged with respect to statistical significance.

<sup>37</sup>All other variables are set at their means (for continuous variables) or modes (for dichotomous variables); the controls for time dependence are held constant at 0.

<sup>38</sup>Violent disputes occur in 0.28% of the directed dyad-year observations in our sample.

TABLE 2 Probit Estimates of Militarized Dispute Initiation

	Model 1: Baseline	Model 2: ATOP	Model 3: Interaction Term	Model 4: Allies' Conventional Power
Defense pact with nuclear power	-0.388*** (0.0938)	-0.219* (0.0959)	-0.410*** (0.0970)	-0.389*** (0.0988)
Nuclear deployment	0.0969 (0.153)	0.0161 (0.152)	-0.264 (0.357)	0.0961 (0.154)
Defense pact with nuclear power × nuclear deployment			0.427 (0.396)	
Defense pact with nonnuclear power	0.0126 (0.101)	-0.0220 (0.104)	0.00919 (0.102)	0.00429 (0.107)
U.S. troops	-0.00109 (0.00188)	-0.00110 (0.00189)	-0.00121 (0.00191)	-0.00131 (0.00191)
Nuclear challenger	-0.0507 (0.103)	-0.0149 (0.104)	-0.0457 (0.104)	-0.0123 (0.0919)
Nuclear target	0.107 (0.123)	0.152 (0.126)	0.105 (0.122)	0.0665 (0.105)
Contiguity	1.153*** (0.0911)	1.193*** (0.0972)	1.153*** (0.0914)	1.149*** (0.0934)
Alliance with challenger	-0.0103 (0.0867)	-0.0812 (0.0944)	-0.00179 (0.0867)	-0.0115 (0.0890)
Foreign policy similarity	-0.331*** (0.0683)	-0.309*** (0.0702)	-0.336*** (0.0686)	-0.334*** (0.0684)
Power ratio	0.108 (0.163)	0.122 (0.164)	0.107 (0.164)	0.00948 (0.150)
Challenger polity	0.0177* (0.00735)	0.0179* (0.00744)	0.0174* (0.00735)	0.0178* (0.00736)
Target polity	0.0318*** (0.00822)	0.0282*** (0.00841)	0.0314*** (0.00825)	0.0318*** (0.00818)
Challenger polity × target polity	-0.00231*** (0.000549)	-0.00227*** (0.000561)	-0.00226*** (0.000545)	-0.00230*** (0.000554)
Time	-0.0914*** (0.0170)	-0.0929*** (0.0169)	-0.0913*** (0.0169)	-0.0912*** (0.0170)
Time <sup>2</sup>	0.00346*** (0.000950)	0.00351*** (0.000946)	0.00344*** (0.000950)	0.00345*** (0.000950)
Time <sup>3</sup>	-0.0000401** (0.0000147)	-0.0000409** (0.0000146)	-0.0000398** (0.0000147)	-0.0000400** (0.0000146)
Constant	-2.861*** (0.171)	-2.875*** (0.175)	-2.852*** (0.172)	-2.804*** (0.184)
Observations	85,306	85,306	85,306	85,306

Note: Robust standard errors in parentheses.

\*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001(two-tailed tests).

These probabilities rise considerably if we base our calculations on longer periods of time. For example, our results indicate that the probability that a state without nuclear protection will be targeted by a particular challenger sometime during a 50-year period (rather than a one-year period) is 0.156, compared to 0.047 for coun-

tries that share a defense pact with a nuclear power.<sup>39</sup> This evidence suggests that nuclear alliances indeed deter violent conflict initiation—a conclusion that holds when we

<sup>39</sup>We made these calculations by applying the binomial probability theorem, assuming that all factors remain constant during the 50-year period.

code alliances using the ATOP dataset (Model 2). Foreign nuclear deployments, on the other hand, are statistically unrelated to conflict: in all four models in Table 2, the coefficient for NUCLEAR DEPLOYMENT is statistically indistinguishable from zero.<sup>40</sup>

The null finding with respect to foreign nuclear deployments might be an artifact of nuclear powers' varied motivations for stationing forces abroad. Although countries generally forward-deploy nuclear forces to strengthen extended deterrence, this is not their only reason for doing so. Historically, three additional factors have also influenced nuclear deployments (Fuhrmann and Sechser 2014).<sup>41</sup> First, patrons sometimes station weapons abroad to defend states other than the host. Britain, for instance, deployed nuclear bombs in Singapore during the 1960s so that it could hit targets in East Asia in the event of war between China and the South East Asia Treaty Organization (SEATO).<sup>42</sup> Second, states sometimes station nuclear forces abroad to prevent host nations from developing an indigenous nuclear capability (Reiter 2014). For example, the United States kept nuclear weapons in South Korea during the late 1970s and 1980s—despite Jimmy Carter's pledge to withdraw them during the 1976 presidential campaign—in large part to reduce Seoul's desire for an independent nuclear deterrent (Hersman and Peters 2006). Third, foreign nuclear deployments are sometimes designed to reassure anxious allies rather than to deter attacks against them. Indeed, some U.S. nuclear deployments in Europe during the Cold War appear to have been intended primarily for a European audience rather than a Soviet one (United States Department of Defense 1978). It is therefore possible that nuclear deployments enhance extended deterrence only when they are explicitly undertaken for that purpose, but not otherwise. The findings reported above, however, are similar when we recode the deployment variable to exclude cases that, in our judgment, were not intended to protect the protégé from attack.<sup>43</sup>

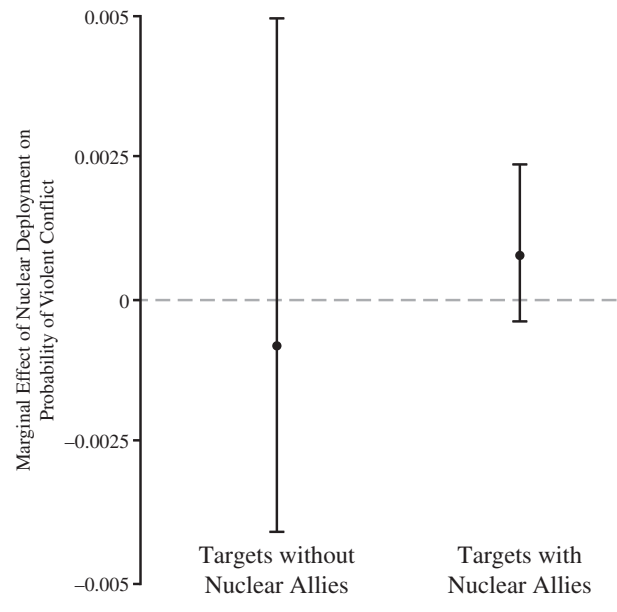
<sup>40</sup>Nuclear deployments are statistically related to violent conflict in a simple cross-tabulation analysis (see the online appendix), but Table 2 shows that this relationship washes away once we control for confounding factors such as alliances.

<sup>41</sup>Note, however, that nuclear weapons might still deter attacks against a host state even if they are not deployed principally for that purpose.

<sup>42</sup>The goal of these deployments was not to deter attacks against Singapore itself; instead, British planners aimed to exploit Singapore's geographic location to protect nearby states. Britain's Valiant, Vulcan, and Victor aircraft (the "V-bombers") did not have the range to reach China if they launched from bases in Europe (Moore 2001, 61).

<sup>43</sup>Deployments that, in our view, were not intended to deter include the U.S. deployments to Canada, Morocco, and Spain, and

**FIGURE 1 The Marginal Effect of Hosting Nuclear Weapons on the Probability of Being Targeted in a Violent Dispute**



Note: Model 3 estimates. The 90% confidence intervals are shown.

Another possibility is that the deterrent effect of nuclear deployments is conditional on the presence of a formal nuclear alliance. Indeed, defense pacts are neither necessary nor sufficient conditions for deployments. Countries sometimes have stationed nuclear weapons on the territory of states with which they do not have defense commitments (see Table 1); conversely, numerous countries have enjoyed a patron's nuclear protection without having nuclear weapons deployed on their soil (e.g., Japan, North Korea, and Norway). It is possible that stationing nuclear weapons on the territory of a protégé bolsters deterrence in the presence of an alliance guarantee but has no effect on conflict in the absence of such a defense commitment.

Model 3 tests this conditional argument by including an interaction term between the two signaling variables. The findings, which are illustrated in Figure 1, confirm the limited utility of nuclear deployments for extended deterrence. The marginal effect of nuclear deployments—the change in predicted probability of conflict that results from shifting the deployment variable from 0 to 1 while holding all other factors constant—is statistically

the British deployments to Cyprus and Malaysia/Singapore. These results are contained in the online appendix. The findings are similar if we include only U.S. deployments to NATO members, South Korea, and Taiwan—the cases that, in our view, represent the clearest attempts to bolster extended deterrence.

insignificant regardless of whether nuclear alliances are present or absent: the 90% confidence interval includes zero in both scenarios. Deploying nuclear weapons does not, on average, provide reliable deterrence benefits regardless of whether a nuclear power has signaled its commitment to a protégé by forming an alliance.

In terms of the control variables, *DEFENSE PACT WITH NONNUCLEAR POWER* and *U.S. TROOPS* are statistically insignificant, suggesting that conventional signals of alliance commitment are less effective than alliance pacts with nuclear states in deterring violent conflict.<sup>44</sup> Yet, it could be the case that the conventional capabilities of nuclear powers play a role in deterring militarized disputes, even if defense commitments made by nonnuclear weapons states are not, on average, associated with peace. For example, the deterrent effects of NATO could stem from the overwhelming conventional superiority of the United States rather than its nuclear arsenal. Model 4 shows, however, that *DEFENSE PACT WITH NUCLEAR POWER* remains statistically significant and negative when we recalculate *POWER RATIO* to include the conventional capabilities of a target's allies using CINC data (Singer, Bremer, and Stuckey 2011).<sup>45</sup> Thus, nuclear weapons appear to provide unique benefits for extended deterrence.

Results for the remaining variables are largely consistent with those reported in other studies. Both *NUCLEAR CHALLENGER* and *NUCLEAR TARGET* appear to be unrelated to dispute initiation. Contiguous countries are much more likely to experience violent disputes than noncontiguous states. Foreign policy similarity is likewise associated with a lower risk of conflict. The presence of an alliance between a challenger and target is generally unrelated to conflict initiation, and so is the balance of conventional capabilities—even when we account for the aggregate capabilities of a state's patrons (Model 4). Additionally, the findings show that democratic challengers are more likely to initiate disputes in general but less likely to attack democratic targets.

<sup>44</sup>The insignificance of *DEFENSE PACT WITH NONNUCLEAR POWER* is particularly notable because many nonnuclear regional powers form defense commitments to protect their friends. For example, Ethiopia—which is generally regarded as one of the most conventionally powerful states in Africa—forged defensive alliances with Libya and Yemen during the 1980s. Our analysis indicates that defense pacts such as these are generally ineffective at promoting peace through extended deterrence.

<sup>45</sup>We aggregated CINC scores for all of the states with which the target shares a defense pact and recalculated *POWER RATIO* based on the following formula: (challenger's CINC + challenger's allies' CINC)/(challenger's CINC + challenger's allies' CINC + target's CINC + target's allies' CINC). Model 4 is a replication of Model 1 using this modified power ratio variable.

## Selection Effects and Foreign Nuclear Deployments

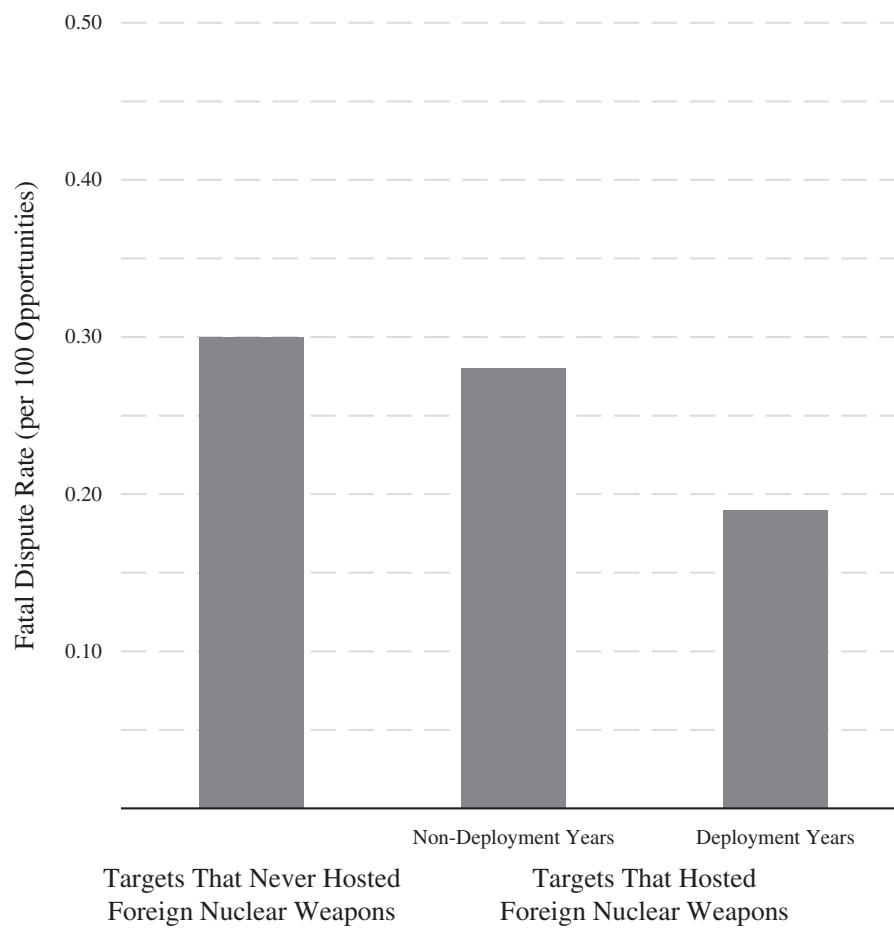
The evidence presented above indicates that defense pacts with nuclear-armed states appear to bolster extended deterrence, but foreign nuclear deployments do not. However, it could be the case that these findings reflect a selection effect because our “treatment” and “control” groups are not randomly assigned. As noted above, nuclear states may be more likely to make defense commitments and deploy weapons abroad for allies that are seen to be at risk of attack. If this is the case, then we might observe a positive correlation between signals of alliance commitment and conflict not because these signals are ineffectual, but because they are likely to be sent only when the propensity for conflict is already high.

If this sort of selection effect indeed operates in the cases we evaluate, it would make one of our findings—the deterrent effect of nuclear alliances—all the more notable. The logic of selection effects asserts that nuclear states are more likely to form alliances with protégés that are already likely to be attacked. As a result, we might observe a positive (or null) correlation between alliance formation and militarized disputes—even if alliances exert a deterrent effect—simply because of the unfavorable conditions under which alliances are likely to form. However, our results demonstrate a negative relationship between militarized conflict and alliances with nuclear states. This suggests two possibilities: either the selection effects logic is incorrect, or nuclear alliances have even stronger deterrent effects than the results suggest. In other words, if the logic of selection effects is correct, then our results demonstrate that a nuclear alliance can transform a dyad from being relatively more conflict-prone than other dyads to one that is reliably less conflict-prone. This would constitute strong support for the deterrent properties of alliance commitments.

A selection effect might, however, account for the null relationship we find between foreign nuclear deployments and conflict. If nuclear weapons are more likely to be deployed to high-conflict areas, unadjusted correlations between deployments and conflict may obscure the deterrent effect of these deployments. The evidence, however, does not appear to support this claim. Figure 2 shows that the rate of fatal MIDs among targets that never hosted foreign nuclear weapons (0.30%) is nearly identical to the conflict rate of eventual host states during their non-deployment years (0.28%).<sup>46</sup> Thus, nuclear powers are not, on average, more likely to introduce forces into

<sup>46</sup>Among states that never hosted nuclear weapons, 267 of 89,852 observations in our dataset experienced violent conflict. Seventeen of 6,140 pre-deployment observations included fatal disputes.



**FIGURE 2 Nuclear Deployments and Fatal Dispute Rates**

high-conflict zones, contradicting the selection effects argument.<sup>47</sup> The figure also shows that the rate of fatal MID initiation declines slightly when states host foreign nuclear forces, but the difference between their deployment and non-deployment periods is statistically insignificant ( $p = 0.229$ ).

To further rule out the possibility that the statistically insignificant effects of *NUCLEAR DEPLOYMENT* reported in Table 2 are due to strategic selection, we employ a bivariate probit model that is designed to estimate two equations with dichotomous outcomes (Maddala 1983).<sup>48</sup> The first

<sup>47</sup>Indeed, nuclear states have often declined to deploy weapons to conflict-prone allies and instead chosen to provide forces to protégés that were unlikely to be attacked. For example, many of the states that hosted U.S. nuclear forces (e.g., Canada, Morocco, and Spain) were not targeted in any violent disputes during the 10 year period that preceded the deployments. Conversely, the United States never deployed nuclear weapons to conflict-prone Pakistan, a SEATO ally.

<sup>48</sup>This sort of model is frequently employed when the dependent variable and the endogenous regressor are both dichotomous (e.g., Beardsley 2008; Sondheimer and Green 2010).

equation accounts for whether a state has foreign nuclear weapons on its territory, based on an existing model of the causes of foreign nuclear deployments (Fuhrmann and Sechser 2014). In the second equation, we estimate the probability of conflict initiation while accounting for the possible correlation of error terms between the two models ( $\rho$ ). The model that we employ is recursive; unlike some strategic selection models, the outcome in the first equation is not a precondition for being included in the second equation.<sup>49</sup>

The findings from the bivariate probit analysis, which are reported and discussed in the online appendix, reaffirm that our initial findings are not driven by a strategic selection effect. Foreign nuclear deployments fail to achieve statistical significance, and nuclear alliances continue to be statistically associated with successful deterrence.

<sup>49</sup>This is important because countries can be attacked with or without having nuclear weapons deployed on their soil.

## Conclusion

Costly signaling has been the subject of much theoretical research in international relations, but we have little empirical data about the relative effectiveness of specific military and diplomatic signals. The analysis above compared the efficacy of two types of signals in the context of extended nuclear deterrence: public alliance commitments and extraterritorial nuclear deployments. Two main findings emerged. First, alliance commitments from nuclear states reduce the risk of being targeted in a militarized dispute. In other words, alliances with nuclear states appear to deter violent conflict. Second, however, hosting an ally's nuclear weapons does not have the same effect. States that host nuclear weapons do not enjoy a diminished risk of militarized disputes.<sup>50</sup> Thus, while nuclear weapons appear to carry substantial extended deterrent benefits, those benefits do not require that nuclear weapons be stationed directly on allied territory.<sup>51</sup>

These results bear on an important and ongoing debate about signaling strategies in international politics. They suggest that, in a general deterrence context, hand-tying signals may be more effective than previously believed. The efficacy of hand-tying alliance commitments has been doubted by some scholars, who argue that such signals are not very useful for preventing challenges against protégés. Instead, they argue, hand-tying works mainly to prevent escalation once a crisis has already been initiated (e.g., Fearon 1997, 71). Our analysis, however, suggests that this view may be too pessimistic. We find that hand-tying proclamations of alliance commitments by nuclear states significantly strengthen general deterrence and prevent challenges against protégés—even without other costly signals such as conventional military deployments. It may indeed be the case, as Fearon (1997) suggests, that hand-tying is more commonly used as a commitment strategy during international crises rather than beforehand, but our analysis suggests that tying hands by engaging one's reputation can prevent crises as well.

<sup>50</sup>Indeed, in some cases, foreign-deployed nuclear weapons may even raise the risk of militarized disputes: the 1962 Cuban missile crisis, for example, was triggered by the Soviet Union's attempt to deploy nuclear weapons in Cuba.

<sup>51</sup>The finding that nuclear deployments do not promote peace in the absence of defense pacts is significant because, in practice, states often consider stationing military forces on the territory of friendly states that are not formal allies. As discussed earlier, the United States deployed nuclear weapons in a handful of states to which it did not formally offer nuclear protection. The United States also maintains a conventional military presence in several countries (e.g., Israel, Kyrgyzstan, and Saudi Arabia) with which it has not signed a defense pact.

In addition, the analysis sheds new light on the deterrent effects of military alliances. It lends support to the view that alliances—despite being “scraps of paper”—can be credible signals of commitment under some conditions. In this respect, our results are consistent with those of Leeds (2003b), Johnson and Leeds (2011), and others who find alliance protection to be an effective deterrent. Alliances appear to carry important signaling value, at least in a nuclear context, even when patrons do not take other costly actions to support their commitments. Achieving credibility in extended nuclear deterrence remains one of the most difficult problems in foreign policy, and successful deterrence is never guaranteed. But our findings suggest that public alliance commitments can improve the effectiveness of deterrence, even if they do not ensure success every time.

At the same time, however, our results suggest that not all alliance commitments are created equal. Specifically, alliance commitments appear to bolster deterrence mainly when they are made by nuclear states. Alliance commitments by nonnuclear states, however, do not deter militarized disputes to the same extent. The ability to signal one's alliance commitments through public pronouncements therefore may be a luxury available only to nuclear states. Nonnuclear states may need to undertake conventional troop deployments or other measures to effectively signal their commitments. Although several studies have found that verbal alliance commitments strengthen deterrence generally, our findings suggest that these results may have been driven largely by nuclear patrons. The benefits of alliances with nonnuclear states, by contrast, are much more limited.

From a practical standpoint, our findings question the use of future nuclear deployments to bolster the protection of U.S. allies in troublesome regions. For example, the United States has reportedly considered placing some of its Middle East allies under the U.S. nuclear umbrella in the event that Iran acquires nuclear weapons (Landler and Sanger 2009). Our analysis suggests that nuclear weapons deployments need not accompany such guarantees in order to maintain deterrence. Indeed, if U.S. policy makers expect nuclear deployments to reduce the frequency with which our allies engage in militarized conflicts, they may be disappointed. If history is any guide, defense pacts that rely on the existing posture of the U.S. nuclear arsenal will be just as effective.

Yet these results do not necessarily imply that U.S. nuclear weapons could be precipitously withdrawn from their current locations in Europe without serious political consequences. Indeed, this study highlights an important gap in our understanding of signaling in international politics: what are the effects of signals that are rescinded

or reversed? While the results here suggest that new foreign nuclear deployments would likely have few extended deterrent benefits, the outright termination of existing deployments could undermine deterrence if an adversary inferred from such an event that the alliance was weak. As one observer has noted, “nuclear weapons [in Europe] are kind of like the wedding ring of the marriage . . . once you start wearing one, it means something entirely different to be seen without it than it does for someone who never wore one” (Murdock and Yeats 2009, 31). Future research might evaluate the validity of this simile.

These results are also subject to an additional caveat: although foreign nuclear deployments do not appear to strengthen deterrence, they may have other positive political effects. Reiter (2014), for example, demonstrates that states hosting U.S. nuclear weapons during the Cold War were significantly less likely to proliferate. Others argue that foreign military deployments strengthen alliance cohesion in observable ways. Indeed, the presence of U.S. nuclear weapons in Europe and elsewhere traditionally has been justified on the grounds that the weapons reassure allies and improve intra-alliance cooperation. Even today, official NATO policy holds that U.S. nuclear weapons in Europe provide an “essential political and military link between the European and North American members of the Alliance” (NATO 2006, 66). Further research is needed to investigate whether these reassurances have entailed tangible—rather than merely psychological—benefits for the United States and its allies.

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## Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's website:

- Foreign Nuclear Deployment Dataset: Cases and Sources.
- Bivariate Probit Analysis
- Additional Robustness Checks