

When Nuclear Umbrellas Work:
Signaling Credibility in Security Commitments through Alliance Design*

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Abstract: During the Cold War, doubts over the credibility of the US commitment to defend Western Europe led Great Britain and France to develop their own nuclear capabilities, despite their inclusion under the US “nuclear umbrella”. However, in other instances, the US nuclear umbrella appears to have been much more credible. For example, Japan, Taiwan, and South Korea did not pursue nuclear weapons, in large part because of their alliances with the US. Why did the US commitment to defend Europe lack sufficient credibility while its commitment to defend Asia seemed more effective? This paper develops one answer to this puzzle by exploring how the institutional design of nuclear umbrellas may affect their credibility. I argue that nuclear security commitments are more likely to be perceived as credible when they include costly reliability-enhancing provisions, such as greater precision in when alliance obligations apply, issue-linkages, and increased military institutionalization. In the empirical section of the paper, I demonstrate two observable implications of this logic that are consistent with a client state feeling more assured. I show that more precise and institutionalized alliances between a nuclear weapons state and non-nuclear client state are strongly associated with (i) lower defense spending in the client state and (ii) a lower likelihood that a client state will pursue its own nuclear weapon. These results have important implications for how policymakers and analysts evaluate the consequences of nuclear policy choices.

Neil Narang

Stanton Junior Faculty Fellow, Center for International Security and Cooperation (CISAC),
Stanford University. narang@stanford.edu

Assistant Professor, Department of Political Science, University of California – Santa
Barbara. narangn@polisci.ucsb.edu (*on leave AY 2013-14*)

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1. Introduction

In the early stages of the Cold War, officials in the United States struggled with how they could deter the Soviet Union from attacking Western Europe. With both sides in possession of large arsenals of nuclear weapons, it was well understood that war could quickly escalate into mutual destruction. Given this situation, the credibility of the US commitment to defend Western Europe turned on whether Soviet officials believed that the United States would risk New York to save London or Paris (Schelling 1966). In the end, it was doubts over precisely these types of concerns that led Great Britain and France to develop their own nuclear capabilities, despite their inclusion under the US “nuclear umbrella” as members of the NATO alliance (see Goldstein 2000, 140-154).

Interestingly, while the US nuclear umbrella seems to have lacked credibility in this instance, it appears to have been much more credible in other instances. For example, as the Cold War progressed into the early 1960s, a growing rift between the Soviet Union and China led the latter to seek and achieve its own nuclear arsenal by the mid-1960s (Goldstein 2000, 65-87).¹ This decision induced fear in neighboring India, which led it to produce its own nuclear weapon in the 1980s.² However, other states in the region that also had reason to fear China – like Japan, Taiwan, and South Korea – did not pursue nuclear weapons, in large part because they had defensive alliances with the United States. These alliances meant that – even though they did not have a nuclear deterrent of their own – they were protected under the US nuclear umbrella.³

¹ Countering the view that smaller nuclear powers sought nuclear weapons as status symbols, Goldstein provides evidence that Chinese officials sought nuclear weapons largely to provide a credible deterrent in the absence of a reliable superpower guarantee.

² The hypothesis that India pursued nuclear weapons primarily in response to security concerns presented by China is most forcefully argued by Paul (1998) and Singh (1998). Perkovich (2001, 447), who argues that domestic more than international security factors explain why India began developing nuclear weapons in the 1950s, also acknowledges that, “security concerns indubitably created conditions that ‘allowed’ Indian decision makers to develop nuclear weapons capabilities. Had China not defeated India in the 1962 war and acquired nuclear weapons in 1964, India might not have built upon the nuclear weapons capabilities made possible by the projects planned and initiated in the 1950s”.

³ There is evidence that defensive commitments by the Soviet Union induced similar restraint in its ally Syria, which was tempted to develop nuclear weapons in response to Israel (Frankel, 1993).

Why did the US commitment to defend its allies in Western Europe seem to lack credibility, while its commitment to defend its allies in Asia seemed more credible? More generally, under what conditions are commitments by a nuclear weapons state to defend a non-nuclear alliance partner likely to be perceived as credible? Finally, how can analysts ultimately assess whether commitments to extended nuclear deterrence are actually effective at assuring allies given that the beliefs of client states are impossible to directly observe and easy to misrepresent?

Understanding the conditions under which nuclear security assurances are actually effective is particularly important today in light of the ongoing nuclear crisis with Iran. In July 2009, former Secretary of State Hilary Clinton warned that the United States would consider formally extending the US nuclear umbrella over Israel and other American allies in the Middle East. The announcement came in response to increasing concern in Washington that other Middle East states might be tempted to pursue their own nuclear programs for fear that Iran was growing closer to realizing its presumed nuclear ambitions (Lander and Sanger, 2009). At the same time, the announcement was also meant to signal to Tehran that its nuclear ambitions could be countered militarily should efforts at negotiation fail. In Secretary Clinton's words, "We want Iran to calculate...that if the U.S. extends a defensive umbrella over the region...it's unlikely that Iran will be any stronger or safer."

And yet, if policymakers seek to extend the US nuclear umbrella in an effort to deter proliferation, much more attention is needed to understanding the conditions under which states are likely to perceive these commitments as credible. As Great Britain and France illustrated during the Cold War, extending the US nuclear umbrella to new states may only deter proliferation among allies to the degree that these commitments leave them feeling assured. Similarly, if extending the US nuclear umbrella is meant to deter proliferation among regional threats like Iran, much more attention is needed to understanding when states outside a nuclear umbrella perceive commitments by nuclear defenders to their potential targets as credible.

This paper seeks to provide one explanation for this puzzle. Drawing on existing theories of alliance design and treaty formation, I argue that nuclear umbrellas – alliances in which a nuclear weapons state makes a commitment to defend a non-nuclear alliance partner

in the event of an attack – are more likely to be perceived as credible when they include costly reliability-enhancing provisions, such as greater precision in when alliance obligations apply, issue-linkages, and increased military institutionalization.⁴ These design features lower the perceived risk of opportunism by a nuclear patron because the costs of negotiating and implementing more intricate and costly alliances serve as a signal of more reliable commitments (Mattes 2011).

In the empirical section of the paper, I test several observable implications of this logic. Given that states’ true beliefs about the credibility of an alliance commitment are impossible to directly observe, I demonstrate that more intricate and costly alliance commitments from nuclear weapons states generate systematic behavioral tendencies in client states that are consistent with them feeling more assured. Using data on defensive pacts between 1950 and 2001, I show that more precise and institutionalized alliances between a nuclear weapons state and non-nuclear client state are strongly associated with lower defense spending in the client state and a lower likelihood that a client state will pursue its own nuclear weapon.

The remainder of this paper proceeds in five parts. The first section provides an overview of the literature on extended nuclear deterrence and assurance. The second section lays out the theoretical argument for how we should expect alliance design to affect the credibility of a nuclear security assurance. The third section describes the research design and the fourth section discusses the results of the empirical analyses. Finally I conclude with a brief summary and avenues for future research.

2. Nuclear Security Assurances: Causes, Consequences, and Remaining Questions

The term “nuclear umbrella” was coined during the Cold War in reference to commitments made by nuclear weapons states – most often the United States or the Soviet

⁴ I use the terms guarantee, assurance, extended deterrence, and umbrella interchangeably to refer to the same construct throughout the paper. However, in the empirical section, the terms refer specifically to formal defense pacts codified in alliance relationships involving a nuclear-armed protector and non-nuclear client state.

Union – to defend a non-nuclear alliance partner in the event that it was attacked. In both the academic and policy literature, the term has been used interchangeably with nuclear “security assurance”, nuclear “defense pact”, and commitments to “extended deterrence” in order to refer to the protection provided by a nuclear patron state to a non-nuclear client state generally under a formal defense pact (Knopf 2012, 2).⁵

The intended purpose of a nuclear security assurance is to reduce the utility of nuclear weapons in coercive bargaining, and thereby reduce the incentive for states to acquire and maintain their own nuclear arsenal. In principle, this is posited to occur through two mechanisms. The first mechanism is by deterring potential adversaries from threatening nuclear war against an ally by promising an extended nuclear retaliatory response (Sechser and Fuhrmann 2014)⁶. This commitment is thought to mitigate the primary incentive for revisionary states to acquire a nuclear weapons capability: coercion. The second mechanism is by assuring allies that the nuclear patron is committed to defending the client state – possibly through nuclear retaliation – in the event that the client state is attacked or threatened by challenger. This assurance is thought to reduce the incentive for client states to seek their own nuclear weapons capability.

The two most famous examples of these commitments are the North Atlantic Treaty Organization (NATO) and the Warsaw Pact. NATO formed in 1949 and covered most of the states in Western Europe under a collective defense treaty with the United States, while the Warsaw Pact formed in 1955 and covered most of Eastern Europe in a defense pact with the Soviet Union. In both cases, the threat of nuclear retaliation against a potential attacker was a major component of the defensive commitment. Indeed, as Sechser and Fuhrmann (2014) note, 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

⁵ Like much of the literature, this paper focuses on “positive” nuclear security assurances, which involve a pledge to come to the aid of a non-nuclear weapons state, as opposed to “negative” security assurances which involve a pledge by a nuclear weapons state not to use or threaten to use nuclear weapons against a non-nuclear weapons state (Knopf 2012).

⁶ Several studies demonstrate that nuclear weapons can have complicated deterrence benefits (e.g. Waltz 1990; Beardsley and Asal 2009; Narang 2013; Sechser and Fuhrmann 2014), although these benefits may only hold under specific organizational assumptions (Sagan 1993, 1994). The compellence benefits of nuclear weapons, by contrast, are somewhat less clear (Gartzke and Jo 2009; Sechser and Fuhrmann 2013; Kroenig 2013)

its atomic and massive retaliatory striking power if the area is attacked”(Lay1953).

In practice, however, the influence that nuclear security assurances have on deterring potential challengers and assuring allies is far less clear. This is because, as Goldstein (2000) argues, both adversaries and allies have good reasons to doubt the reliability of such commitments, primarily because the costs of honoring an alliance in the event of war can render them incredible. Hymans (2006) also argues that leaders have little reason to be confident in an ally’s willingness to expose itself to nuclear retaliation, and sees no consistent relationship between alliances and leaders’ decisions to pursue nuclear weapons. Solingen (2007) is even more explicit in her skepticism, noting that, “defense pacts involving the United States and the Soviet Union did not induce abstention from nuclear weapons in too many other cases (Iran’s shah, Israel, Pakistan, North Korea, and Iraq among others). Indeed, if alliances told the tail, Britain (and arguably France) should never have gone nuclear.”⁷

A number of the quantitative empirical studies on nuclear security assurances have sought to determine whether they can effectively assure allies by estimating their impact on the likelihood of nuclear proliferation in client states. In most cases, these studies have either included security assurances by a nuclear weapons state as one variable among many potential correlates of nuclear weapons pursuit (Singh and Way 2004; Jo and Gartzke 2007), or as a control variable to estimate the independent effect of another potential causal factor (Fuhrmann 2009; Kroenig 2009a; Kroenig 2009b; Horowitz and Narang 2014). Overall, the results of these studies have been surprisingly inconsistent and far from definitive. For example, Singh and Way (2004) and Jo and Gartzke (2007) find that a defense pact with a nuclear ally reduces the likelihood that a non-nuclear state will *acquire* a nuclear weapon, but they find no statistically significant relationship between these assurances and the likelihood of nuclear weapons *pursuit* (see also Verdier 2008 and Kroenig 2009). However, others find that nuclear security assurances have the opposite effect in that they are positively correlated with the likelihood a state will initiate a nuclear weapons program or acquire a nuclear

⁷ For Solingen, the role of alliances “is mediated by the relative receptivity of domestic models to the alliance and denuclearization”

weapon (Fuhrmann 2009, Müller and Schmidt 2010). Meanwhile, the only study to make nuclear security assurances the central object of study found that nuclear security assurances have an unambiguous and statistically significant negative effect on the likelihood a non-nuclear state will explore, pursue and acquire a nuclear weapon (Bleek and Lorber 2014).

One reason that previous studies have reached contradictory conclusions is that many of them use different estimation techniques over different populations of cases (i.e. different countries over different time periods). However, another important reason is that – while the relationship between a nuclear security guarantee and nuclear proliferation is generally negative – the standard errors in the estimates are generally so large that the estimated effect is not statistically significant. Substantively this means that, while nuclear security assurances appear to work on average, there are several important cases in the data where a patron state issues nuclear security assurances, only to have these commitments consistently fail at assuring the client state (Paul 2000, 153-4; Knopf 2012, 18).

What explains why nuclear security assurances often fail to assure allies? Or, in other words, why is that – conditional on receiving a defensive security assurance from a nuclear weapons state – some commitments appear to effectively assure a non-nuclear client state and others appear to have only a modest effect if any at all? To date, there have been very few attempts to evaluate the potential utility of nuclear security assurances that go beyond estimating the overall impact to identify the conditions under which they are more or less likely to be effective. And yet, something about these commitments must differ to explain the apparent variation in their impact.⁸

In contrast to previous work, this study begins with the empirical observation that nuclear security assurances do not appear to be uniformly effective at assuring allies across cases or over time, and it seeks to outline a theory for why this effect may vary. Drawing on

⁸ One notable exception in the literature that seeks to address this possibility is a recent volume edited by Knopf (2012), which attempts to construct a general theory of security assurances from which he derives hypotheses to test using structured focused comparisons of seven case studies. Knopf and his contributors find that security assurances appear to have a modest effect in most but not all cases. In particular, they find that the *credibility* of the assurance is important and far from automatic, but that the factors that produce credibility tend to be highly context dependent (Knopf 2012, 6).

general theories of alliance politics and international institutions, I argue that one important answer lies in the design of the alliance commitment itself. Given that the risk of opportunism often renders nuclear security assurances inherently incredible, I posit that defensive pacts with nuclear weapons states that include more costly reliability-enhancing provisions should be systematically more likely to assure client states.

3. Theory: Signaling Credibility in Security Commitments through Alliance Design

3.1 Alliances and Nuclear Security Assurances as Costly Signals

Nuclear umbrellas – or nuclear security assurances – are a type of alliance commitment. Alliances are institutions entered into voluntarily that help their members cooperate militarily in the event of war (Keohane and Martin 1995; Lake 1999). In contrast to more informal coalitions, formal alliance treaties are non-binding contracts between two or more states that clearly specify standards of behavior or expectations about how members will act under certain conditions. For instance, a defensive alliance represents a promise to come to another state's defense if it is attacked, but often times contingent on a specific set of conditions being true. Many defensive pacts, for example, only come into effect if a state is attacked directly on its home territory by a particular country.

States form alliance commitments of all types because they generally entail some security benefits for the parties involved (Lake 1999). When the interests of two or more states are sufficiently aligned with respect to the division of some issue, the military capabilities of one state can be joined with the capabilities of another in an alliance, thereby increasing the combined bargaining power of the allied states relative to a third party (Lake 2000). In the event that opponents are unable to settle their disputes, the formation of an alliance shifts the likely outcome of war in favor of the allied states. In addition to these wartime benefits, the prospect that a state will intervene on behalf of an alliance partner generates security benefits for the alliance members by deterring a potential challenger from initiating a crisis in the first place (Huth 1988, 1990; Leeds 2003; Johnson and Leeds 2011). As a subtype of alliance commitments, nuclear security assurances are thought to hold even more substantial deterrence benefits by threatening to impose enormous costs on would-be

adversaries through nuclear retaliation (Lay 1953; Waltz 1990; Mearsheimer 1984; Sechser and Fuhrmann 2014).

However, these wartime and deterrence benefits ultimately turn on the willingness – and perceived willingness – of a state to intervene on behalf of its alliance partner (Schelling 1966; Huth 1988; Morrow 1994). For example, the deterrence benefits of an alliance depend on the assumption that a prospective challenger and target both believe that an ally will intervene in the event of a war. If two parties in a crisis have different beliefs about what an ally will do, this uncertainty can create divergent assessments of relative capabilities and heighten the risk bargaining failure leading to war (Sagan 1986)⁹.

Uncertainty over the likelihood of compliance is ubiquitous to all international agreements, including all types of alliance commitments and security guarantees between states (Morrow 1992, 1994; Fearon 1994, 1997). The relatively anarchic nature of international relations means that alliance agreements are always entered into voluntarily, and thus they ultimately represent non-binding commitments to help each other in the event of an armed conflict (Altfeld and Bueno de Mesquita 1979; Sabrosky 1980; Siverson and King, 1980; Smith 1995; Leeds 2000). Moreover, even when the interests of two or more states are sufficiently aligned such that they choose to form an alliance, these common interests are not sufficient to guarantee that an alliance will ultimately be honored in the event of a war. This is because alliance commitments are ultimately costly for an ally to carry out (a time-inconsistency problem) (Lake 1999), and there can be strong incentives to bluff about the willingness to intervene in order to deter adversaries. Combined, the incentives to renege on an alliance commitment help explain why – by one count – states historically honor their alliance commitments less than 75 percent of the time (Leeds, Long, and Mitchell 2000).

The resolution of this uncertainty is perhaps the primary reason states sign formal alliance commitments: they seek to influence the beliefs of their alliance partners and any prospective challengers by publically signaling their intention to intervene in the event of a war (Morrow 1994; Smith 1995; Fearon 1997). Compared to informal alignments and alliances made in secret, formal alliance treaties signal greater credibility by publically

⁹ Sagan (1986) shows that the German invasion that marked the beginning of World War I was largely driven by ambiguity over whether Britain would defend France and Belgium.

engaging the international reputation of a state, and thereby exposing it to reputational costs if it defaults on its commitment to intervene (Schelling 1966; Jervis 1970; Fearon 1997).¹⁰ Additionally, formal alliance treaties signal greater credibility by increasing the risk that a state will be drawn into a war, by publically announcing a common interest in the outcome (Snyder 1990). These costs may help to partially explain why relatively few states have been willing to send this signal over the last two hundred years. According to the Alliance Treaty Obligation and Provision (ATOP) data, in the period from 1815 to 2003, there have been only 648 formal alliance treaties signed out of hundreds of thousands of potential dyadic commitments in the two-century period (Leeds, Ritter, McLaughlin and Long 2002).

3.2 Tying Hand and Sinking Costs through Alliance Provisions

Although the costs of signing a formal alliances treaty should itself increase the credibility of an alliance commitment on average, the mere existence of a formal commitment is not a perfect separating signal of states' latent intention to intervene on behalf of an ally in the future. After all, some 25 percent of states have historically pooled on sending this signal, only to abrogate their formal commitment when their alliance obligation was eventually invoked.¹¹ Given that the formation of an alliance is a somewhat "noisy" signal, states can – and often do – agree to implement costly reliability-enhancing provisions as part of a treaty in order to further increase the credibility of their commitment. Indeed, Mattes (2011) demonstrates that states attempting to overcome a perception of unreliability are systematically more likely to incur the costs of negotiating and implementing more intricate and costly alliance designs to signal their commitment.

In general, security commitments of all types typically exhibit a number of features designed to increase the likelihood an ally will fight on another's behalf. For example, some alliances include provisions that are designed to decrease the costs of fighting in the event of

¹⁰ Several studies provide empirical support for the supposition that states pay reputational costs for violating formal alliance commitments (Gibler 2008; Crescenzi et al. 2012; Narang and LeVeck 2012). However, other studies suggest that states may not pay reputational costs in all security contexts (Sartori 2005; Press 2005; Secsher 2010)

¹¹ Siverson and King (1980) offer an even more negative assessment about the reliability of alliances, estimating that states fail to defend their allies about 75 percent of the time.

a war, such as provisions requiring joint decision-making, joint military planning and exercises, and stationing troops on an ally's soil. In addition to these "sunk cost" provisions paid upfront, certain features of an alliance may be understood to "tie hands" by making it more difficult to back down from a commitment to fight in the event of a war (Fearon 1997). In total, the ATOP dataset documents variation in 22 different provisions across five different types of alliance obligations in the 648 alliance treaties from 1815 to 2003.

Drawing on the "rational design literature" (Abbott and Snidal 2000; and Koremenos, Lipson, and Snidal 2001), Mattes (2011) suggests that three of these design features stand out as particularly good solutions for the reliability concerns in alliances: greater precision in the formulation of terms, provisions for issue linkage, and deeper levels of military institutionalization. First, alliance agreements in which members precisely define the conditions under which the core obligations need to be fulfilled are much more likely to be reliable (Abbott and Snidal 2000). The logic holds that by specifying the particular conditions under which the alliance is invoked at the outset, leaders can limit the applicability of the agreement to situations in which they actually expect to be willing and able to honor their obligations (Leeds 2003b). As a result, security commitments with more precise language should be honored more often than broader, blanket commitments that are unlikely to withstand unexpected changes in the environment (e.g. changes in power, information, etc.) (Leeds 2003b; Leeds and Savun 2007).

A second design feature that enhances the perceived reliability of an alliance agreement is when members link the agreement to cooperation in other issue areas. This is because issue linkages in treaties raise the value of the agreement by promising gains in other areas, thereby increasing the opportunity costs of abrogating the agreement (Koremenos, Lipson, and Snidal 2001). As a result, Mattes and others argue that security commitments with more issue linkages should – on average – be honored more than unlinked commitments that do not entail these same benefits. One example of this is an alliance that combines military obligations with commitments to economic cooperation, such as the granting of most-favored-nation (MFN) status or providing economic aid.

Finally, a third design feature that enhances the perceived reliability of an alliance agreement is when members opt for greater institutionalization of the commitment (Lake

2001). This is because greater centralization can make it more difficult for members to extract themselves from an agreement given the sunk costs and greater monitoring by other members. This, in turn, helps solve the underlying enforcement problem (Koremenos, Lipson, and Snidal 2001). As an empirical matter, the extent to which activities are centralized varies considerably across security commitments, with the most centralized agreements creating standing military organizations, coordinating military planning among members during times of peace, providing military training or technology to allies, and allowing allies to use bases. Thus, Koremenos et al. (2001) and Mattes (2011) argue that security commitments with greater institutionalization should be honored more often than commitments without these same institutionalized features.

3.3 Hypotheses: Alliance Design and the Credibility of Nuclear Security Assurances

The observation that states appear to deliberately vary the design of cooperative security agreements – by including costly reliability-enhancing provisions to signal their commitment – has important implications for when nuclear umbrellas are likely to be perceived as credible. As a type of security commitment, the credibility of nuclear security assurances should also increase as a function of these same design features. However, beliefs about the credibility of a security commitment are impossible to directly observe, which makes it difficult to evaluate this proposition empirically (Murdoch 2009).¹² Further complicating matters is that any direct statements by recipients about the credibility of security assurances are not certain to accurately reflect their true beliefs.¹³ With respect to

¹² In a report on extended deterrence and assurance, Murdoch (2009) and his coauthors, including Linton Brooks, Elaine Bunn, and Franklin Miller, acknowledge that “there is no agreed-upon, direct way to assess the impacts of changes in the U.S. nuclear posture upon the effectiveness of deterrence or assurance...” However, the authors conclude that a subjective assessment can be made by “engaging allies to understand what affects their trust”. They propose that “consultations” are essential for “listening and talking” to allies. The authors do not seriously entertain the possibility that client states may have an incentive to misrepresent their level of assurance.

¹³ Client states always have an incentive to claim that they are not assured in order to extract even greater assurances from a nuclear patron. For example, consider the following quote from Yukio Sato, the former Japanese Ambassador to the United Nations: “If the credibility of the U.S. commitment is the question at issue, it is Japanese perceptions that matter. The U.S. commitment to provide extended deterrence to Japan has been repeatedly affirmed by

nuclear umbrellas, client states always have the incentive to misrepresent how assured they actually are in order to extract even greater assurances from nuclear patron states (Sechser and Fuhrmann 2014). This makes it difficult to directly assess the impact of costly reliability-enhancing provisions on the perceived credibility of a nuclear umbrella.

Given that the beliefs of client states are impossible to directly observe and easy to misrepresent (LeVeck and Narang 2012), I argue that more intricate and costly security commitments from nuclear weapons states to non-nuclear client states should generate systematic behavioral tendencies that are consistent with the client state feeling more assured. First, it is reasonable to suppose that client states that are truly assured by a commitment to extended nuclear deterrence from a nuclear patron should have less incentive to spend resources building and maintaining their own military. Indeed, Lake (2009) shows that subordinate countries in hierarchical security relationships systematically spend less of their own resources on security and rely more on the efforts of their dominant protector. More anecdotally, Lake points out that in the 1990s, Japan – a near protectorate of the United States – spent less than one percent of its GDP on defense while the US was spending nearly 4 percent of its GDP. Similarly, countries in Western Europe that were also subordinate to the US – though to a lesser degree – spent on average 1.8 percent of their GDP on defense. Central American and the Caribbean countries that the US has long dominated spent less than 25 percent of the global average (roughly 2 percent) on their defense. Assuming the domestic military expenditures of subordinate states vary – in part – as a function of how assured client states actually are, the logic above suggests that the more reliability-enhancing provisions included in a nuclear security commitment, the more likely the commitment will be perceived as credible, and the fewer domestic resources the client state will spend on defense.

Hypothesis 1: the more reliability enhancing provisions that are included in alliances between a nuclear patron state and non-nuclear client state, the less the client state will spend on defense.

presidents...Nevertheless, Japanese misgivings and doubts about American commitment persist...the Japanese government, let alone the public, will have to be speculative about the credibility of U.S. commitment.” (Roberts 2013, 14) Although Japanese leaders may genuinely be unassured by the US commitment, it would be difficult to confirm this from such statements.

It is important to note that security assurances provided under a nuclear umbrella are generally, though not always, thought to be invoked specifically in the event of an *offensive nuclear threat* against a client state. As a result, it is reasonable to suppose that nuclear security assurances might have less of an effect on a state's domestic military expenditures overall, and more of an effect on the specific type of security that is being outsourced. That is, it may be the case that more credible nuclear security assurances allow client states to simply shift defense expenditures to produce other forms of security. Therefore, an important corollary of the hypothesis above is that the more reliability-enhancing provisions included in a nuclear security commitment, the more likely the commitment will be perceived as credible, and thus the client state will be less likely to expend resources pursuing its own nuclear weapon.

Hypothesis 2: the more reliability enhancing provisions that are included in alliances between a nuclear patron state and non-nuclear client state, the less likely the client state will be to pursue its own nuclear weapon.

4. Research Design and Methodology

This section outlines a research design to test the systematic effect of greater reliability-enhancing provisions in nuclear security commitments on the likelihood that the commitment will be perceived as credible by a client state.¹⁴ The unit of analysis for the study is the client state-year. To construct a population of client state-years, I started with a dataset of all state-years from 1950-2001 following Sechser and Fuhrmann (2014).¹⁵ This produces 8951 state-year observations. To determine which of these state-years were client state-years, I used the Alliance Treat Obligations and Provisions (ATOP) dataset to identify observations in which a client state received a defensive commitment from a nuclear weapons state. According to the ATOP data, there were a total of 340 bilateral and

¹⁴ Like previous empirical studies on this topic, I focus only on the impact of “positive” security assurances codified in a formal defensive alliance treaty, not “negative” security assurances like the Nuclear Nonproliferation Treaty

¹⁵ Sechser and Fuhrmann use 1950-2001 because this is the period for which complete data on all of the independent and dependent variables are available

multilateral alliances active in the period from 1950 to 2001, of which 152 were defensive pacts where members agreed to provide active military support in defense of their ally. Only 67 of these defensive pacts included an alliance member that was a nuclear weapons state.¹⁶ These 67 defensive alliances covered 2245 unique client state-years in which 64 different client states were protected through a defensive pact with a nuclear weapons state (I exclude nuclear patrons from coverage under their own umbrella). Twelve of these 67 defensive alliances were multilateral defense pacts in which more than two states promised to come each other's defense in the event of an attack.¹⁷

To measure the key explanatory variables – the inclusion of costly reliability-enhancing provisions in the design of nuclear security assurances – I follow the coding of alliance provisions proposed by Mattes (2011). Mattes uses the ATOP data, which provides detailed information on whether an alliance includes limiting conditions on when an obligation is invoked, whether it provides for issue linkage, and the degree to which it institutionalizes military cooperation.

The measure for whether alliance obligations are *conditional* is a dummy variable that is coded 1 if alliance obligations are limited to particular adversaries, locations, conflicts, numbers of adversaries, fulfillment of demands, or nonprovocation. According to this rule, 130 alliances in the data (57 percent) include limitations on primary obligations.

Issue linkage is also operationalized as a dummy variable coded 1 if the alliance provides for economic cooperation, including the granting of trade concessions such as MFN status, economic aid, and postwar reconstruction. While alliance agreements can contain statements regarding cooperation in a variety of areas – including cultural and scientific exchanges – Mattes focuses on economic concessions because they lend themselves more effectively to binding the members of the alliance. According to this rule, 29 alliances in the data (13 percent) include economic aid provisions.

¹⁶ I use Sechser and Fuhrmann's classification of nuclear powers, which is: 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). Their codings are adapted from Singh and Way (2004)

¹⁷ The twelve multilateral defense pacts involving a defensive commitment by a nuclear weapons state are the following ATOP IDs: 3075, 3130, 3150, 3180 (NATO), 3215, 3260 (SEATO), 3285 (Warsaw Pact), 3395, 3405 (OAS), 4220, 4400, 4985.

Finally, the measure of *military institutionalization* is based on an index proposed by Leeds and Anac (2005) and used in Wallace (2008) to capture alliance institutionalization in a single measure. The measure ranges from 0 to 2, with 2 reflecting a high level of military institutionalization. The variable is coded as a 2 if the alliance provides for an integrated military command during peace and wartime, a common defense policy (including joint planning, training, and equipment purchases), joint troop placement, or the use of bases in each other's territory. The variable is coded as a 1 if the alliance calls for peacetime contacts between the military staffs of the member states, creates a formal military organization, arranges for training exchanges or military technology transfers, provides for the subordination of forces of one member to another's command, or specifies contribution levels of troops or weaponry. According to this rule, 47 alliances in the data (21 percent) provide for high levels of institutionalization and 21 alliances (9 percent) require medium levels of institutionalization.

In the analyses below, there are several client states that are members of two or more defensive alliances with a nuclear patron state at the same time. This occurs in 665 client state-year observations (30 percent). Most of the time (560 client state-years) this is because a client state is involved in two different alliance commitments with the same patron state – one multilateral and one bilateral.¹⁸ When this occurs, it is almost always because a client state is a member of the NATO alliance (317 client state-years) or Warsaw Pact (131 client state-years), in addition to being in a bilateral defense pact with a nuclear weapons state. Because multilateral alliances like NATO and the Warsaw Pact are much more precise and institutionalized than bilateral alliances, the values for the key independent variables are generally taken from the higher multilateral alliance commitment when a client state holds more than one defensive alliance with a nuclear weapons state.

To test Hypothesis 1, I estimate the relationship between the inclusion of these reliability-enhancing provisions in a defense pact with a nuclear weapons state and the defense effort of the non-nuclear client state – operationalized as military expenditures as a share of GDP. Data on the dependent variable, military expenditures, is from the Correlates of War National Material Capabilities Dataset. The data codes all resources devoted to

¹⁸ In less than 3-percent of the observations (61 client state-years), a client state is protected by three separate defensive pacts that include a nuclear weapons state.

military forces that could be deployed. I divide this number by each client state's GDP for a comparable measure of relative defense effort.

To test Hypothesis 2, I estimate the relationship between the inclusion of the same reliability-enhancing provisions in a defense pact with a nuclear weapons state and the likelihood a non-nuclear client state will pursue its own nuclear weapon in a given year. Data on the dependent variable, pursuit of a nuclear weapon, is taken from Gartzke and Kroenig (2009). These data represent a consensus of several authors working in the field (Jo and Gartzke 2007; Fuhrmann 2009; Kroenig 2009a; Kroenig 2009b; Horowitz and Narang 2014).

5. Results

In this section, I report the results for Hypothesis 1 and Hypotheses 2. First, recall that Hypothesis 1 posited that the more reliability enhancing provisions that are included in alliances between a nuclear patron state and non-nuclear client state, the less the client state will spend on defense. I argued that defense expenditures as a percentage of GDP is a key observable indicator for how assured the client state likely feels from a defensive commitment by a nuclear alliance partner. Note that the analysis below estimates a dose-response for reliability enhancing provisions within all cases treated with a nuclear security assurance in order to explain variation in when assurances are likely to be perceived as credible.

Table 1 reports the results of a simple model that estimates the relationship between the reliability-enhancing provisions outlined above, and the military expenditures of client state as a percentage of its GDP. I estimate four models: one full model with all three of the components estimated simultaneously, and three reduced models with each of the three components estimated individually to check for the possibility of co-linearity across the estimates. In this preliminary analysis, I only include one control variable to account for the possibility that treaty design is non-random with respect to defensive effort: the security environment of the client state. Previous research has proposed using the number of shared land borders (or less than 25 miles of separation by sea) a state shares with other states (Stinnett et al. 2002) to proxy for the level of security threat a state faces (Way and Weeks

2014). I use this measure instead of other variables measuring MID participation, whether a country is in an enduring rivalry, or whether a country faces a nuclear threat, because these individual factors may be post-treatment consequences of potential challengers observing a more robust security guarantee. Thus, including these variables could lead to post-treatment bias (Gleman and Hill 2006; Angrist and Pischke 2008). I estimate all parameters using ordinary least squares regression. Given potential nonindependence of observations across the same country over time, I use robust standard errors clustered on the client state.

As expected, the results in Table 1 demonstrate a consistent relationship between the number of reliability enhancing provisions in a defensive security assurance from a nuclear weapons state and the level of defense expenditures as a percentage of GDP. Across the four models, the relationship between the precision and institutionalization of an alliance commitment with a nuclear weapons state is negative and generally significant.

When client states receive defensive security assurances from a nuclear patron with greater *conditionality* negotiated into the terms of the treaty, client states appear to expend significantly less effort on providing for their own defense compared to client states protected under imprecise commitments. The coefficient on the conditionality term indicates that clients spend roughly 16-percent less on defense when members pay the transaction costs to specify particular adversaries, locations, conflicts, and other conditions. Similarly, when client states receive defensive security assurances that provides for *economic cooperation*, they spend roughly 10-percent less on defense compared to client states protected under security assurances that do not include such provisions (9.8-percent in Model 1 and 11.27-percent in Model 3). Finally, the greater the *military institutionalization* of an alliance (e.g. when they provide for integrated military command, a common defense policy, joint troop placement, or the use of bases in each other's territory), the less effort a client state appears to expend in providing for its own security. Though not statistically significant in Model 1, the results of Model 3 suggest that client states protected by security assurances with the highest level of military institutionalization, spend roughly 13-percent less on defense compared to alliances with no military institutionalization. Client states protected under security assurances with intermediate values of institutionalization spend roughly 6.5-percent less on defense. **Figure 1** plots the mean effect with 95-percent confidence intervals of each reliability enhancing provision on client states' military expenditures as a percentage of GDP.

Turning to Hypothesis 2, I posited that the more reliability-enhancing provisions included in alliances between a nuclear patron state and non-nuclear client state, the less likely the client state will pursue its own nuclear weapon. The effort expended by a client towards acquiring its own nuclear weapon is perhaps the most direct indicator of whether it feels assured by a patron's commitment to extended nuclear deterrence. Unlike previous research – which has found mixed and generally inconclusive evidence for whether nuclear security assurances can reduce the risk a client state will seek its own nuclear weapon – I focus on explaining the apparent variation in the effect.

Table 2 reports the results for a very simple model estimating the relationship between the reliability-enhancing provisions outlined above, and the likelihood a client state will pursue its own nuclear weapon in a given year. Like before, I estimate four models: one full model and three reduced models for each of the three individual components. In this analysis, I control for the total number of shared land borders as well as two economic variables – *GDP per capita* and *GDP per capita squared* – to account for the capacity of a country to build a nuclear weapon. This reduced model of nuclear proliferation has been shown to produce consistent estimates for key variables when compared to larger and more complicated models of nuclear proliferation (Horowitz and Narang 2014). As in previous work, I estimate the likelihood a client state pursues a nuclear weapon in a given year using a probit model with time splines counting the number of years, years² and years³ that a country has not pursued a nuclear weapon to account for temporal dependence, and robust standard errors clustered by client state for nonindependence across observations for the same country (Jo and Gartzke 2007; Fuhrmann 2009; Kroenig 2009a; Kroenig 2009b Horowitz and Narang 2014).

Consistent with the theory, the results in Table 2 demonstrate a consistently negative relationship between the number of reliability-enhancing provisions in a defensive security assurance from a nuclear weapons state, and the likelihood that a client state will pursue its own nuclear weapon in a given year. All three reliability-enhancing provisions are negative in Model 1, though *economic issue linkage* just misses the 10 percent significance level. However, when the effect of each design provision is estimated independently, the measure for economic issue linkage is strongly negative and significant at the 1 percent level. The *military institutionalization* is also strongly negative and significant. When commitments by nuclear

weapons state to a non-nuclear client state include provisions that enhance the level of institutionalization of the commitment, nuclear client states are significantly less likely to pursue their own nuclear weapon in any given year. The negative coefficient on the *conditionality* variable is also consistent with theory, though not statistically significant.

Figure 2 shows the simulated change in the probability of nuclear weapons pursuit in a client state (with 95-percent confidence intervals) by estimating the first difference from the minimum to the maximum value of each reliability enhancing provision. Compared to client states protected under nuclear security assurances without each provision, client states protected under nuclear security assurances where obligations are *conditional* appear 12.6-percent less likely on average to pursue a nuclear weapon. They are 11.7-percent less likely to pursue nuclear weapons on average when defensive security assurances provide for *economic cooperation*. Finally, client states appear 19.7-percent less likely to pursue nuclear weapons on average when defensive security assurances provide for the maximum level of *military institutionalization* compared to security assurances with no institutionalization. Although the baseline probability that a state will pursue a nuclear weapon in any given year is very low, these relative effects appear to be substantial.

6. Conclusion

When do nuclear umbrellas work to assure allies and deter adversaries, and how can analysts actually know whether they are working or not? For as long as there have been nuclear weapons, analysts have sought to understand the conditions under which commitments to extended nuclear deterrence might assure allies and deter adversaries. However, recent developments in the Iranian nuclear program and the emergence of a nuclear-armed North Korea have renewed interest in these issues. As noted above, former Secretary of State Hilary Clinton only recently warned in 2009 that the United States would consider extending its nuclear umbrella over its allies in an effort to deter proliferation.

And yet, we still know surprisingly little about when such commitments are likely to be effective. Instead, recent empirical research has generally focused on evaluating whether the *existence* of a security assurance from a nuclear weapons state can reduce the risk of

nuclear weapons pursuit among client states on average, or whether the *existence* of such assurances can deter would-be challengers on average. The results to date have been remarkably inconclusive, mostly because of the large standard errors in the estimated effect. While the relationship between nuclear security assurances and nuclear proliferation is generally negative, it is rarely statistically significant because commitments to extended nuclear deterrence can oftentimes dramatically fail at assuring client states.

This paper sought to provide one explanation for this empirical puzzle. I argued that not all security assurances are created equal and that treating them as such makes it impossible to explain important variation in when they are actually effective at assuring client states and deterring challengers. Drawing on theories of treaty formation and alliance design, I argued that nuclear umbrellas – alliances in which a nuclear weapons state makes a commitment to defend a non-nuclear alliance partner in the event of an attack – are more likely to be perceived as credible when they include costly reliability-enhancing provisions, such as greater precision in when alliance obligations apply, issue-linkages, and increased military institutionalization. This is because the costs of negotiating and implementing more intricate and costly alliances serve as a signal of more reliable commitments.

The preliminary results are consistent with the theory. Using data on defense pacts between 1950 and 2001, I show that more precise and institutionalized alliances between a nuclear weapons state and non-nuclear client state are strongly associated with lower defense spending in the client state and a lower likelihood that a client state will pursue its own nuclear weapon. Future analysis will explore the impact of reliability-enhancing on other behavioral tendencies in client states that are consistent with them feeling more assured. Such tests are critical for evaluating the efficacy of nuclear security assurances because states' true beliefs about the credibility of an alliance commitment are impossible to directly observe and prone to misrepresentation.

The results of this study make two main contributions. First, it provides an answer to an empirical puzzle that has only been rediscovered rather than answered by existing empirical tests. Extant empirical studies have evaluated the impact of nuclear security assurances using a coarse, binary indicator for the existence of such commitments, only to find that their influence on client states is too inconsistent to draw definitive inferences. In

contrast to these studies, I demonstrate how variation in the institutional design of nuclear security assurances explains when and why client states are likely to be more or less assured. A second contribution of the paper is in showing convergent validity across multiple observable indicators of a client state's latent level of assurance. These measures provide one avenue through which analysts and policy makers can evaluate the impact of nuclear policy choices on the effectiveness of deterrence and assurance.

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Tables and Figures

Table 1: Reliability-enhancing provisions in alliances with nuclear weapons states, and defense expenditures as percentage of GDP in client states, 1950-2001

	Model 1 DV:Defense Spending/ GDP	Model 2 DV:Defense Spending/ GDP	Model 3 DV:Defense Spending/ GDP	Model 4 DV:Defense Spending/ GDP
<u>Alliance Design</u>				
Conditionality of obligations	-16.04*	-15.25*		
	(9.035)	(8.713)		
Economic issue linkage	-11.27**		-9.806***	
	(5.459)		(3.708)	
Military institutionalization	-9.871			-6.426*
	(6.642)			(3.847)
<u>Control Variables</u>				
Number Shared Land Borders	0.995	1.039	1.106	1.074
	(0.763)	(0.750)	(0.815)	(0.819)
Constant	23.19**	21.98**	11.18**	11.50**
	(10.96)	(10.39)	(5.467)	(5.615)
No. of Countries	64	64	64	64
Observations	1997	1997	2078	2078

Standard errors in parentheses
 ***p<0.01, ** p<0.05, * p<0.10

Figure 1: Percent Change in Military Expenditures/GDP in Client State as a Function of Each Reliability-Enhancing Provision

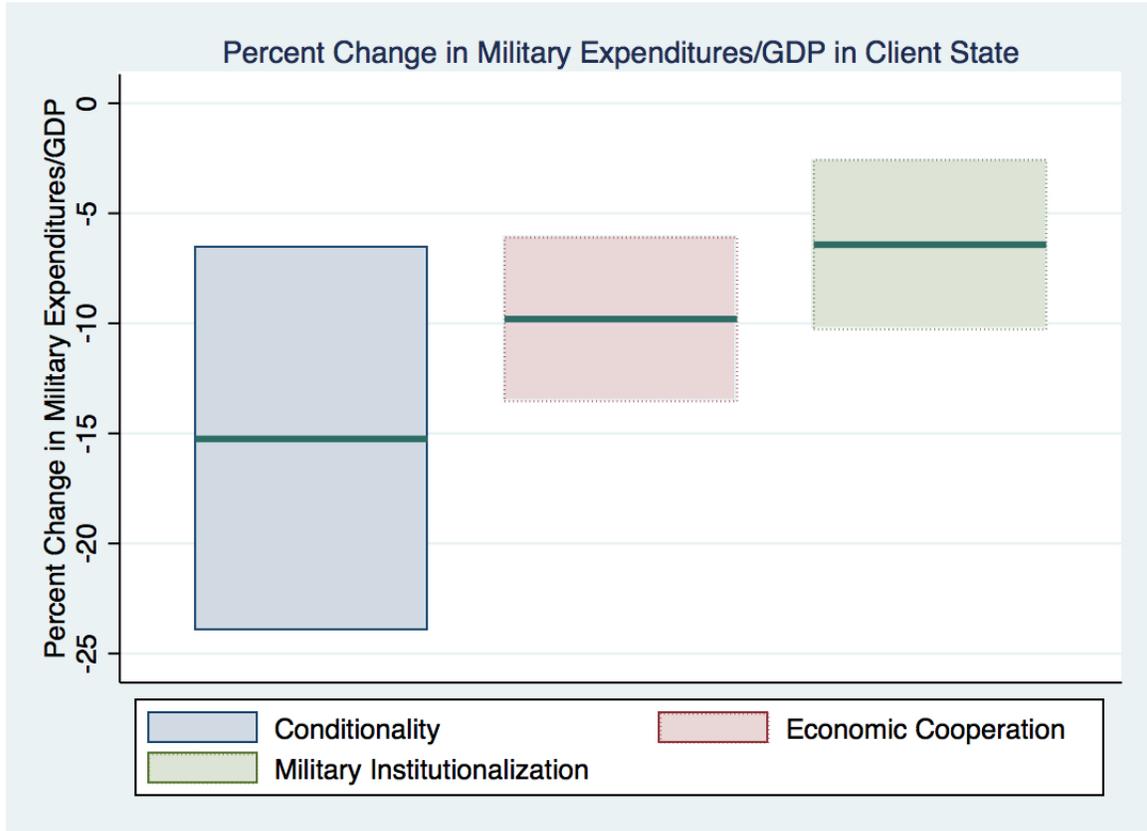


Table 2: Reliability-enhancing provisions in alliances with nuclear weapons states and the probability of nuclear weapons pursuit in a client state, 1950-2001

	Model 1 DV: Pursuit Nuclear Weapons	Model 2 DV: Pursuit Nuclear Weapons	Model 3 DV: Pursuit Nuclear Weapons	Model 4 DV: Pursuit Nuclear Weapons
<u>Alliance Design</u>				
Conditionality of obligations	-0.0423* (0.0259)	-0.0332 (0.0260)		
Economic issue linkage	-0.119 (0.0769)		-0.219*** (0.0418)	
Military institutionalization	-0.134* (0.0740)			-0.149** (0.0573)
<u>Control Variables</u>				
Number Shared Land Borders	0.0111** (0.00470)	0.0119** (0.00486)	0.0108** (0.00464)	0.00989** (0.00453)
GDP per capita	9.85e-07 (4.54e-06)	-1.63e-07 (4.51e-06)	-2.72e-07 (3.72e-06)	-7.45e-07 (3.69e-06)
GDP squared	-5.51e-11 (1.61e-10)	0 (1.51e-10)	0 (1.28e-10)	-0 (1.31e-10)
Spline 1 (years)	-0.0706*** (0.0109)	-0.0702*** (0.0112)	-0.0708*** (0.0119)	-0.0715*** (0.0119)
Spline 2 (years ²)	0.00259*** (0.000409)	0.00260*** (0.000422)	0.00261*** (0.000448)	0.00263*** (0.000445)
Spline 3 (years ³)	-2.77e-05*** (4.46e-06)	-2.81e-05*** (4.65e-06)	-2.82e-05*** (4.92e-06)	-2.83e-05*** (4.86e-06)
Constant	0.497*** (0.0858)	0.477*** (0.0865)	0.470*** (0.0863)	0.486*** (0.0866)
No. of Countries	64	64	64	64
Observations	1,972	1,972	2,072	2,072

Standard errors in parentheses
***p<0.01, ** p<0.05, * p<0.10

Figure 2: Percent Change in Predicted Probability of Nuclear Weapons Pursuit by Client State as a Function of Each Reliability-Enhancing Provision

