On the Capacity of Great Powers to Influence Nuclear Proliferation

Christopher R. Dittmeier

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Approved by:
Mark J.C. Crescenzi
Navin A. Bapat
Anna Bassi
Skyler J. Cranmer
Stephen E. Gent

ABSTRACT

Christopher R. Dittmeier:
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(Under the direction of Mark J.C. Crescenzi)

Nuclear proliferation is an important contemporary security issue, yet is a different problem than the one faced during the Cold War. The diffusion of nuclear weapons beyond the great powers invites a new analysis of structural effects on proliferation outcomes. The second-tier states—those for which the nuclear debate is currently playing out—do not interact in a strictly-anarchic system, but in a system conditioned by the preferences and behaviors of the tier of great-power states. The great powers' capacity (or lack thereof) to make concessions, enforce commitments, or otherwise alter the expected consequences of second-tier behavior changes the rational decisionmaking process for these states. This dissertation examines how the structural differences experienced by second-tier states affect the problem of nuclear proliferation, providing insights for the extent of great-power ability to influence future diffusion.

Keywords: *commitment problem; extended deterrence; great powers; nuclear proliferation; second-tier states; systemic theory*

Ad maiorem Dei gloriam inque hominem salutem.

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DISCLAIMER

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Nuclear weapons remain an important concern for the stability of the international community as the world moves toward a post-American order. The ranks of *de facto* nuclear weapons states continues to grow. The might imparted by these weapons to each future nuclear state fundamentally affects the balance of power on which the international system depends. However, the problem of nuclear proliferation in the 21st century is not the same as the issue faced during the height of the Cold War. Nuclear proliferation is no longer the domain of the superpowers, subject to Kennedy's infamous "balance of terror." Since the 1970s, the nuclear issue has crept beyond the great powers into the realm of second-tier politics. Scholars and policymakers of the time argued that only great-power politics could affect the fundamental stability of the international system.[1] However, the diffusion of nuclear weapons gives substantial power outside the clique of states responsible for maintaining the system. Understanding the drivers of these states' behaviors is an essential—and underdeveloped—component of addressing the problem of nuclear proliferation

The interactions of middle-level powers are mediated by the same rationalist expectations and strategic incentives that mediate great-power behavior.[2] The difference lies in the structure, or environment, in which those interactions occur. Modern great-power behavior is dominated by the anarchic structure of the broader international system (Waltz 1979; Keohane 1984). Interactions beyond the great powers are not anarchic in the strict sense, but rather are structured by the great powers, who have the ability to impose constraints on the behaviors of less-powerful states. This ability is not unlimited in scope—it does not approach the level of institutionalization seen in most domestic politics—but great-power

[1] cf. Kissinger (1974); Waltz (1979); Organski and Kugler (1981); Levy (1983); Porter (1994); Kennedy (2004).

[2] cf. Fearon (1995).

constraints can materially affect the behavior of the second tier when doing so favors the great powers' interests. Under these conditions, problems that result from anarchy, including the security dilemma and dynamic commitment problems, may be avoided through the exercise of great-power influence to structure second-tier states' behaviors.

The following essays address two ways in which great-power structure alter the behavior of second-tier states within the substantive field of nuclear proliferation. They discuss the influence of great powers both on the direct incentives for states to pursue nuclear weapons as well as on the expected consequences of that pursuit for regional balances of power.

Great-Power Promises and Nonproliferation

Great-Power Nuclear Strategy

The first essay examines changes in nuclear proliferation behavior resulting from the formal nonproliferation regime, embodied by the 1968 Nuclear Nonproliferation Treaty. The regime centered on a "grand bargain:" states that did not possess nuclear weapons at the time of the treaty would forswear their acquisition, while the five declared nuclear powers agreed to eventually eliminate their nuclear arsenals.[3] This bargain is believed to have politically linked the proliferation impetus (the likelihood of further nuclear proliferation) to the number of outstanding nuclear weapons. Using data on American and Soviet nuclear arsenals during the period 1951–2000, a statistical analysis finds that a correlation between great-power nuclear arsenal size and nuclear proliferation does exist. Furthermore, this relationship becomes stronger after the creation of the formal nonproliferation regime, indicating that American and Soviet commitments to nuclear disarmament (however unfaithful they may have been intended) are taken seriously by the broader international community.

In linking nuclear disarmament to nonproliferation, the United States and Soviet Union created a mechanism with which to leverage other states that may be considering nucleariza-

[3]Open access to nuclear technology for civilian energy purposes was also assured in the interim.

tion. Real movements toward the reduction of nuclear weapons among the great powers, notably the series of START treaties, are shown to coincide with decreases in the number of states pursuing nuclear weapons, while the nuclear buildups of the "balance of terror" coincided with an inability of the great powers to impede nuclear proliferation.

Great-Power Influence and Dynamic Commitment in Proliferation

Proliferation, Preemption, & Intervention

The second essay examines nuclear proliferation as an instance of a dynamic commitment problem.[4] Because nuclear proliferation imparts a substantial amount of military power to new proliferators, it threatens to upset the local balance of power. Because this change can be anticipated, states that stand to lose from this change have an incentive to strike preemptively in order to maintain their position within the system. Using a formal model, this essay shows that—under conditions of anarchy—nuclear proliferation should result in many more preventive wars than have been observed historically. A model extension explains that the lack of military action may be due to the presence of great-power influence over the interactions of second-tier states. When their own foreign policy interests give them incentive to do so, great powers can extend a deterrent influence over their allies. The intention of extended deterrence is to protect friendly states from aggression, but it also increases the protected state's tolerance for risky behavior. Whereas the pursuit of nuclear weapons may have previously resulted in war, the shadow of great-power protection allows nuclearization to occur isolated from these natural consequences.

Great Power Patronage

The third essay, building on the findings of the formal model, analyze its implications in two historical case studies. India—in the 1960s a large, though weak, regional power in South

[4] cf. Powell (2004, 2006).

Asia—developed nuclear weapons in response to the perceived threat emanating from China. Technologically, India had few problems developing the necessary industries to support a nuclear weapons program. Its success, however, was based in its growing alignment with the Soviet Union, which had grown disenchanted with China's "revolutionary" communism. As China was both a nuclear weapons state in its own right and conventionally-superior to India, New Delhi relied on Soviet political and material support to prevent Beijing from exploiting regional issues to prevent Indian nuclearization. In contrast, Syria failed to acquire political support for its nuclear weapons program from any of the great powers. Forced to the nuclear black market, Syria acquired the technical means of beginning a nuclear weapons program, but could not deter its regional adversary—Israel—from attacking that program. In 2007, an Israeli Air Force strike on Dar ez-Zour set back Syria's program by a decade, as well as brought international attention to bear on Syria's surreptitious activity, effectively (if not actually) bringing an end to its nuclear pursuit.

Research Value

For International Relations Theory

These essays contribute to the theoretical development of the international relations field by drawing attention to the differential structure of the international system and its effects on state behavior. More research is being conducted on the behavior of second-tier states, as economic and military power—as well as the problems associated with these forms of power—become more diffused. However, the assumption of a purely-anarchic international system, central to the discipline for thirty years, does not hold true for all states. The great powers do deal with anarchy, as even formal international institutions are only effective as long as they reflect these states' underlying preferences.[5] However, the framework used to analyze these states is not appropriate when discussing the tier of states that exist below

[5]cf. Martin (1992); Ikenberry (2001).

the great powers. Multilevel modeling and the structuring ability of larger actors to enforce (or undermine) commitments and provide information, has been important in the civil war literature; however, this same dynamic exists within interstate politics as well.

For Nonproliferation Policy

These essays should also lead policymakers to expand their perception of how to deal with the problem of nuclear proliferation (as well as other international security issues). A majority of recent counterproliferation policy has focused on direct coercive or military instruments.[6] However, the range of tools available to the United States, Russia, and China also extends to the indirect pressures of international structure. Risky behaviors such as nuclear proliferation are undertaken when they are protected from consequences. Undermining these sources of extended deterrence, a diplomatic task that lies outside of the "target" proliferating state, can be sufficient to undermine the process of proliferation. The majority of states that have given up the pursuit of nuclear weapons have done so through their own loss of political will, rather than direct action. Creating the conditions that lead to that decision are less costly and more effective than preemptive military action will likely be.

[6]cf., for example, Krause and Mallory (2010); Wright (2010).

Chapter 1

Great-Power Nuclear Strategy and the Question of Second-Tier Proliferation

> Some argue... that we are destined to live in a world where more nations and more people possess the ultimate tools of destruction. Such fatalism is a deadly adversary, for if we believe that the spread of nuclear weapons is inevitable, then in some way we are admitting to ourselves that the use of nuclear weapons is inevitable... As the only nuclear power to have used a nuclear weapon, the United States has a moral responsibility to act. We cannot succeed in this endeavor alone, but we can lead it, we can start it. So today, I state clearly and with conviction America's commitment to seek the peace and security of a world without nuclear weapons.
>
> —Barack Obama, Prague, 5 April 2009

Nuclear nonproliferation has been an increasing stumbling block for US foreign policy. In the past fifteen years, two states (Pakistan in 1998 and North Korea in 2006) have joined the ranks of the declared non-treaty nuclear powers, while a third—Iran—is flouting US and UN sanctions in pursuit of a domestic nuclear-weapons capability. In the midst of this failure of coercion to stem the expansion of the nuclear ranks into second-tier states, the Obama Administration's 2010 Nuclear Posture Review (NPR) calls for the United States to lead by example in the nonproliferation regime. "By reducing the role and numbers of U.S. nuclear

weapons—meeting our NPT [Nuclear Nonproliferation Treaty] Article VI obligation to make progress toward nuclear disarmament—we can put ourselves in a much stronger position to persuade our NPT partners to join with us in reinvigorating the non-proliferation regime and secure nuclear materials worldwide" (U.S. Department of Defense 2010*b*: v–vi).[7] A similar message is included in the preamble of New START, the strategic arms reduction treaty negotiated with Russia in early 2010. By taking serious action toward satisfying the United States' Article VI disarmament obligation, the new US nuclear policy aims to induce non-nuclear states to renounce their own nuclear ambitions.

However, the connection between Article VI (disarmament) and Article II (nonproliferation) has not yet been established in practice. This chapter examines the historical record since 1945 in two respects, by evaluating the effect of the size of US and Russian/Soviet nuclear arsenals on states' decisions to initiate nuclear weapons programs and to acquire a nuclear weapons capability through both system- and country-level analysis. The chapter concludes with a discussion of the evolution of nonproliferation strategy and an evaluation of the Obama administration's strategy of linking Article VI and Article II commitments and its consequences for future policy.

Causes of Nuclear Proliferation

The debate over the causes of nuclear proliferation and nonproliferation has long centered on three principal factors: the technological conditions for proliferation, external political considerations, and domestic political incentives, with a fourth factor—the role of international norms and status-seeking—being raised in the constructivist response to this puzzle. The first, dubbed *technological determinism* by Ogilvie-White (1996), centers on the opportunity to acquire nuclear weapons-related technology. This hypothesis argues that if this technology—especially the ability to enrich uranium—is developed, the progression to weaponization is teleological (Kegley 1980; Lavoy 1993). While technological barriers are

[7] cf. also Blair et al. (2010).

important considerations in evaluating the set of possible proliferators,[8] the deterministic perspective has largely been abandoned in favor of the latter two hypotheses, which examine the political and decisionmaking factors that contribute to a state's policy to "go nuclear."

Meyer (1984: 6) argues that "nuclear weapons do not generate spontaneously from stockpiles of fissile material." Rather, some political incentive moves states' leaders to transform the latent technological capacity to develop a nuclear weapon into an active proliferation effort. These incentives can be either external or domestic. Waltz (1990), Davis (1993), and Betts (1993) argue that the logic of rational deterrence theory incentivizes states to pursue nuclear weapons to offset power asymmetries with a conventionally-stronger rival. There also appears to be a proliferation domino effect, as each state that goes nuclear incentivizes its rival states to pursue nuclearization (Bergenas 2010). The participation in an enduring rivalry appears to play heavily into decisions to pursue nuclear weapons, while recognition of a dyadic security interdependence is central to nuclear-capable states' forbearance of weapons (Dunn and Kahn 1976; Paul 2000). Conversely, a state's alignment with a great-power patron, in the form of a security guarantee (most notably the US "nuclear umbrella") is argued to have a dampening effect on nuclear proliferation (Betts 1993). To the extent that allies serve as an imperfect substitute for domestic armament (cf. Morrow 1993), security guarantees can assuage states' sense of insecurity and make the resort to nuclearization less enticing.

Alternatively, characteristics of domestic politics are argued to affect the proliferation decision. Solingen (1994) and Paul (2000) note that democratic states with liberal economies are likely to avoid crossing the threshold from a latent nuclear-weapons ability to an overt arsenal. This is because the democratic leadership likely views economic policy as a more certain path to public welfare (and its own political survival) than the unsanctioned pursuit of nuclear weapons (cf. Bueno de Mesquita et al. 2003). Jalonen (1995) argues that

[8]The discovery of the Abdul Qadeer Khan network and the nuclear proliferation market has lessened this requirement somewhat. As the case of Libya has shown, the current technological environment is much more amenable to diffusion as an alternative to domestic development of nuclear weapons-related technology (Corera 2006).

Ukraine's forbearance of its inherited post-Soviet arsenal and 1994 signing of the NPT were seen as conditions for the new regime's recognition as part of the European core of liberal democracies, with the economic benefits that accompanied that recognition being used as positive incentives for the Kuchma administration. By the same logic, states that are run by an insular or parochial elite have fewer constraints on their ability to support nuclearization efforts (Elworthy and Beyer 1986; Lavoy 1993; Sagan 1997).

A fourth hypothesis, which has grown out of the constructivist framework, argues that international norms and the drive for status have further effects on the likelihood of proliferation. This framework puts a heavy emphasis on the effect of the 1968 Nuclear Nonproliferation Treaty as an international regime that dampens the proliferation incentive (Scheinman 1990; Sagan 1997; Jo and Gartzke 2007; cf. Oye 1985; Wendt 1992 more generally). However, possession of nuclear weapons also produces important status gains for states that acquire them. Great-power status was officially accorded to Communist China shortly after it developed a nuclear-weapons capability, and many second-tier states view nuclearization as an important step toward "regional paramountcy" (Dunn and Kahn 1976).

Singh and Way (2004) and Jo and Gartzke (2007) attempt to quantitatively evaluate the veracity of these four factors. Singh and Way (2004: 873) find that technological capability and external political incentives (participation in an enduring rivalry and recent MID involvement) both have positive effects at all levels of nuclear proliferation, from exploration to pursuit to acquisition. Internal characteristics, such as democracy, are found to have positive effects up to the decision to pursue nuclearization, but do not affect the ultimate acquisition of nuclear weapons. Jo and Gartzke (2007) do not differentiate the proliferation process as finely as do Singh and Way, but generally corroborate these findings, with the addition of positive incentives for regional and global powers to pursue and acquire nuclear weapons and a negative incentive for NPT members attempt nuclearization.[9]

[9]Jo and Gartzke find no systemic effect of the NPT on proliferation decisions, but do not control for possible conditional effects of the NPT era on other variables.

Linking Disarmament and Nonproliferation

Previous studies of nuclearization have tended to look at the factors that directly affect states' pursuit of and acquiring nuclear weapons, without engaging the systemic dynamics that shape the decisions to pursue these weapons. Great powers, which constitute the first generation of nuclear-weapons states, actively attempt to condition less-powerful states' behavior with regard to nuclear proliferation. Neorealists consider these states to be security providers—substitutes for domestic nuclear production—while neoliberals link nonproliferation to economic engagement only as a signaling or typing mechanism. With the exception of the American "nuclear umbrella," possession of nuclear weapons has not been differentiated from these states' status as great powers. By considering the great powers' possession of nuclear weapons as a distinct characteristic of the great powers' participation in the nonproliferation regime, one can evaluate the independent effect of Article VI nuclear disarmament on Article II nonproliferation efforts.

The connection between Article VI and Article II is apparent in the 2010 Nuclear Posture Review, the American government's third-ever comprehensive statement on nuclear strategy, which guides the United States' development, maintenance, and deployment of its nuclear arsenal. The Review states that "[b]y demonstrating that we take seriously our NPT obligation to pursue nuclear disarmament, we strengthen our ability to mobilize broad international support for the measures needed to reinforce the non-proliferation regime" (U.S. Department of Defense 2010*b*: 12). The Review further argues that concrete disarmament steps, including ratification of New START, the Comprehensive Test Ban Treaty, and the reduction of weapons-grade plutonium stockpiles, will provide the political capital necessary to reverse the nuclear ambitions of states such as Iran and North Korea. Former Director of Central Intelligence and Secretary of Defense James Schlesinger similarly noted in hearings on New START that "the principal defect, if the Senate does not ratify [the treaty], lies in the political arena... To wit, for the United States at this juncture to fail to ratify the treaty in the due course of the Senate's deliberation would have a detrimental effect

on our ability to influence others with regard to particularly the nonproliferation issue."[10] Statements linking the reduction of the United States' nuclear arsenal to the success of the nonproliferation regime were made fifty-nine times during Senate debate on New START,[11] and figured into the op-ed signed by five Republican Secretaries of State in support of the treaty.[12]

This argument follows the logic of issue-linkage (cf. Haas 1980; McGinnis 1986; Lohmann 1997), the connection of two issues of negotiation (in this case nuclear proliferation and nuclear disarmament) that are not directly predicated on each other in order to produce cooperation through "horse-trading," or distributing the gains of cooperation from one issue to one group, while distributing the gains of cooperation on the other issue to a second group. Haas (1980: 371–372) argues that issues are linked only when "the process [of cooperation] seemed to pass out of [the dominant group's] control" and a *quid pro quo* is necessary to entice the non-dominant group's participation. As the diffusion of nuclear technology began making its way from the superpowers to other countries (France in 1960, China in 1964), the need to create a nonproliferation regime became more pressing. Placing Article VI in the NPT, therefore linking nonproliferation to the reduction and eventual elimination of nuclear arsenals, provided the promise of gains to those states that forswore nuclear weapons by entering the regime, increasing the appeal of cooperation to the non-dominant group.

President Kennedy saw the need for a regime to limit the diffusion of nuclear weapons early in his term (Allison 2010), although the development of a formal nonproliferation regime did not enter the national discourse until Johnson appointed Roswell Gilpatric to head a task force on the issue in 1964, after both France and (Communist) China detonated their first nuclear bombs. Early attempts at reining in attempts at nuclearization focused on

[10]Testimony given by James Schlesinger before the Committee on Foreign Relations, US Senate, 29 April 2010.

[11]Based on a reading of *The Congressional Record* between the treaty's signing on 8 April 2010 and ratification on 22 December 2010.

[12]Henry A. Kissinger, George P. Schultz, James A. Baker III, Lawrence S. Eagleberger, and Colin L. Powell, "The Republican case for ratifying New START," *The Washington Post*, 2 December 2010.

either direct military action or NATO-based weapons-sharing; treaty-based nonproliferation grew out of the combination of these plans' inadequacies and the practical need to engage the Soviet Union in any counter-proliferation activities—political, diplomatic, or military—that dealt with the emerging class of second-tier nuclear states (Brands 2006). The Soviets' contemporaneous acknowledgment that nuclear weapons proliferation was more of a strategic liability than a military asset made superpower agreement a relatively easy accomplishment for the era (Carranza 2006; Coe and Vaynman 2011).[13]

While the great powers saw the prevention of further proliferation as an appropriate end in its own right, with an aim toward collective security, the non-nuclear states would not agree to unilateral restraint, even as a group. The Non-Aligned Movement (NAM) in particular expected "just recompense" for their concession on nonproliferation, which took the form in negotiations of both eventual disarmament by the nuclear weapons states and assured interim access to civilian nuclear energy (Leslie 2008: 480–483).[14] The idea of a discriminatory regime—one that legitimated the possession of nuclear weapons by some states, while prohibiting them to others—could only be justified in the short-term, as an interim state leading to eventual disarmament.[15] Ultimately, the United States and the other nuclear weapons states acquiesced to a number of the NAM's concerns during the development of the NPT. A promise to negotiate nuclear disarmament was made, and in exchange all states-parties that had not tested nuclear weapons before 1967 agreed to forego their development. Carranza (2006: 490) notes that the "special circumstance" of the Cold War temporarily justified the unequal burdens imposed by the NPT regime, as well as the initial failures by the United States and the Soviet Union to move toward disarmament.[16] Early post-Cold

[13]Gilpatric himself was adamant about the need for a multilateral approach to nonproliferation, calling Soviet cooperation "the 'sine qua non' of U.S. strategy" (Brands 2006: 99).

[14]cf. also statements by Ambassadors Augustine P. Mahiga (Tanzania) and Le Luong Minh (Vietnam) to the United Nations during the 2005 NPT Review Conference (Leslie 2008: fn. 8, 9).

[15]cf. Nye (1981); Singh (1998).

[16]cf. also Nye (1981, 1985). The United States did reduce its total operational stockpile (including both strategic and tactical nuclear weapons) by 27% between 1968 and 1990, although the Soviet Union never decreased its stockpile size from a previous year until 1987; cf. U.S. Department of Defense (2010*a*).

War arms control agreements (including the START series) provided a legitimizing stimulus to the nonproliferation regime at a time when previous systemic constraints had dissolved and India and Pakistan had just crossed the nuclear threshold.[17]

However, the mere assertion of the connection between nuclear disarmament and nonproliferation does not empirically ordain it. Sagan argues that linkages of Article VI and Article II are "merely sops to public opinion in non-nuclear countries. The degree to which the nuclear states follow through on these Article VI commitments will not significantly influence the actual behavior of non-nuclear states, since it will not change their security status" (1997: 62).[18] Former Nuclear Weapons Council Chairman and Director of Central Intelligence John Deutch (2005), however, argues that the double standard enacted by the NPT is harmful to nonproliferation efforts, as failures by the nuclear powers to credibly reduce their arsenals undermines their ability to promote nonproliferation, even if good-faith efforts toward disarmament do not affect prospective proliferators' willingness *in se* to acquire nuclear arms (Cortright and Väyrynen 2009).[19]

Some critics of the grand bargain note that the great powers manipulated the nonproliferation regime's multidimensional approach, transforming "the discourse of nonproliferation found in the NPT [into] a discourse of nondissemination," such that the great powers' own obligations became of minor concern (Keeley 1990: 103). The unequal burden is a prime point of contention among the non-nuclear states, and has been used as a justification by India and Pakistan to remain outside the formal international nuclear regime.[20] Nye argues that "a disdain for the arms control institutions and concerns expressed by nonweapons states can exacerbate the discrimination issue that is the central dilemma in nonproliferation

[17]cf. Blackaby (1996); Carranza (2006).

[18]cf. also Joffe and Davis (2011), who argue that nuclear disarmament is likely to reopen the problems associated with conventional asymmetries, particularly with regard to Israel (vis-à-vis the Arab world) and Pakistan (vis-à-vis India).

[19]Deutch states the United States did not enter into this arrangement in good faith, and has "no intention of pursuing" nuclear disarmament. As a result, he argues that the underlying hypocrisy of the nonproliferation regime must be dealt with in a delicate political balancing act (2005: 51–52).

[20]cf. Singh (1998).

policy" (1981: 35). This indicates that—even if the great powers behind the nonproliferation regime initially failed to enforce this aspect of the grand bargain—the connection has become entrenched in the dialogue between nuclear and non-nuclear states.

To the extent that the NPT regime acts as an equilibrium rather than as a constraining agency (cf. Simmons 2000; Coe and Vaynman 2011), great-power action should increase as non-nuclear states' behavior begins to deviate from the equilibrium.[21] While access to civilian technology could incentivize cooperative behavior among non-nuclear states, that concession alone began to fail in the 1980s. Article VI disarmament then became a more important tool as proliferation events begin to occur at increasing frequency, and as the non-nuclear states began to exercise leverage short of defection in the five-year review conferences.[22] Additionally, the easing of Cold War tensions made this concession by the great powers less costly than it had previously been, lessening the great powers' incentives to defect from the coordination game vis-à-vis the non-nuclear states.[23]

Despite the recent occurrence of proliferation in North Korea and the threat of Iran's acquiring nuclear weapons, the NPT's track record at preventing the dissemination of nuclear weapons cannot be understated in comparison to the dire predictions of the Kennedy and Johnson administrations. Every country that has acquired nuclear weapons since the NPT came into force resulted from "long-standing regional and bilateral political issues that the NPT was not necessarily designed to address," rather than from an intrinsic drive toward nuclearization (du Preez 2006: 6).[24] The presence of the NPT regime and associated safeguards was also central to several countries' decisions to abandon their nuclear weapons programs.[25]

[21] ie. the great powers should make disarmament gestures *in addition to* the preexisting policy of making civilian technology available under Article IV as the risk of proliferation increases.

[22] cf. Paul (2003).

[23] cf. Miller (2007).

[24] North Korea, which performed a nuclear test shortly before du Preez' article was published, behaves similarly to the four prior cases noted by du Preez.

[25] Brazil, Argentina, South Korea, and Egypt are examples of such nuclear reversal. Additionally, the post-Soviet return of nuclear arsenals by Ukraine, Belarus, and Kazakhstan to Russia similarly represents an embrace of the NPT regime and IAEA safeguards.

The grand bargain's demands toward disarmament continued to remain nominally linked to the nonproliferation regime, and remained part of the justification for post-Cold War arms control treaties. This impetus has resulted in a 45% overall decrease in strategic nuclear weapons during the period 1990–2002, corresponding with the longest continuous period since 1945 without a new state entering the nuclear club.

If the link between nuclear disarmament and nonproliferation posited by the NPT and the Nuclear Posture Review does exist, then previous movements by the Nuclear Weapons States (NWS) toward arms reduction should translate into a reduced likelihood that non-Nuclear Weapons States (NNWS) will pursue or acquire nuclear weapons, as measured by the presence of a nuclear weapons program or existing arsenal. This theory presents the following hypotheses relating to nonproliferation effects:

H_1**:** The reduction in nuclear arsenals by a NWS should reduce the probability that a NNWS initiates a nuclear weapons program, *ceteris paribus*.

H_2**:** The reduction in nuclear arsenals by a NWS should reduce the probability that a NNWS acquires nuclear weapons, *ceteris paribus*.

Furthermore, if this issue-linkage resulted from the NPT regime-formation process, this effect should be seen principally in the period after 1968. Conversely, if nonproliferation and nuclear disarmament were linked independently of the NPT, no such change in relationship would be seen.

H_3**:** The correlations described in H_1 and H_2 should be stronger after the adoption of the NPT than prior to the adoption of the NPT, *ceteris paribus*.

An opposing hypothesis promoted by several scholars and policy experts states that nuclear disarmament will incentivize proliferation, as it weakens the United States' ability to deter potential proliferators. This is connected to the role of the great powers as providers of the "nuclear umbrella"—a security guarantee in exchange for states' renouncing a domestic nuclear capability. As nuclear forces are reduced, extended deterrence would be retracted

(Carpenter 1994). In response, states without the support of strong allies are likely to balance against their adversaries through internal military buildup, including nuclearization (Morrow 1993; Conybeare 1994; McNiel 2010; cf. also Quester 1983; Cohen and Miller 2010 regarding Israel's response to the evolution of the US security guarantee.) If it is the nuclear umbrella, and not linkage to nuclear disarmament that is driving nonproliferation, the hypothesized effects would run counter to the above assertions, with stronger great-power arsenals decreasing the likelihood of proliferation, and nuclear disarmament leading to a world of more *de facto* nuclear weapons states.

Analysis

Method & Data

The choice of the appropriate analytical method with which to test these hypotheses is important, and remains highly contested. Nuclear proliferation has long been the domain of qualitative, case-oriented histories, with only a recent strain of research in this field embracing statistical analysis of proliferation. Singh and Way (2004: 860–861) find three reasons to justify moving away from qualitative research in this field (or at least to move toward a more holistic multi-method approach). First, by ignoring the instances of non-events of nuclear proliferation (ie. those states that do not pursue or acquire nuclear weapons), qualitative research runs the risk of erroneous inference. Second, Millian methods are often treated as being deterministic, while statistical models are more explicitly probabilistic in their inferences. Thus, qualitative methods are useful for establishing necessity or sufficiency of a cause, but not for testing probabilistic theories.[26] Third, statistical methods are more suited to multicausal relationships than are comparative analyses.[27] This particular research puzzle adds a fourth justification: by examining the effect of a particular structure on international outcomes, the examination of this relationship cannot properly be reduced to

[26]cf. Bleek (2010).

[27]cf. Ragin (1987); Lieberson (1992, 1994).

individual cases. All potential proliferators inhabit the same system and are affected by the same structure, therefore, a case study must examine the system history and its structural development, which can be accomplished more effectively through quantitative analysis.

The remainder of this chapter analyzes the above hypotheses through a systematic quantitative analysis using data covering the international system between 1951 and 2000. The key independent variables—the size of the great powers' nuclear arsenals—are effectively system-level, in that they are not observed to vary across space, but do vary from year to year. It is therefore logical to first examine the relationship between great-power nuclear arsenals and proliferation at this level of analysis. The analysis is performed on two dependent variables: nuclear weapons programs and nuclear weapons states. At this level of analysis, each yearly observation of the dependent variables represents the total number of states in the international system that are either pursuing or possess nuclear weapons. Increased numbers of great-power nuclear weapons is predicted to positively affect the rate of the diffusion of nuclear weapons throughout the system; all else being equal, there are predicted to be more nuclear weapons programs and more nuclear weapons states when high levels of US and Soviet nuclear arms are observed than when lower levels of arms are observed. Singh and Way (2004) construct a four-tiered variable of proliferation, ranging from nonproliferation to exploration to pursuit to the acquiring of nuclear weapons. This is the most finely-defined operationalization of proliferation activity to date. Reconciling Singh and Way's measures of nuclear program and nuclearization dates with those of Jo and Gartzke (2007) and other qualitative research, Table 1 describes the full universe of nuclear weapons-pursuing states and the periods for which any of these states are *de facto* possessors of nuclear weapons. Because the dependent variables are both counts, a Poisson-style regression is the appropriate method for the analysis (Faraway 2006).[28]

The principal explanatory variables are the number of operational strategic and tacti-

[28]Specifically, a quasi-Poisson model is used. This relaxation parameterizes the factor of difference between the sample mean and variance, whereas a traditional Poisson regression assumes $E(Y) = V(Y)$. These data are substantially underdispersed, rendering the quasi-Poisson specification superior.

Table 1: Nuclear Weapons Programs and States

State	NW Program			NW State		
United States	1942	–	1944	1945	–	2011
Soviet Union/Russia	1943	–	1948	1949	–	2011
United Kingdom	1941	–	1951	1952	–	2011
France	1954	–	1959	1960	–	2011
China (PR)	1955	–	1963	1964	–	2011
Israel	1958	–	1972	1972	–	2011
India	1964	–	1974	1974	–	1974
	1980	–	1987	1988	–	2011
South Africa	1974	–	1978	1979	–	1993
Pakistan	1972	–	1989	1990	–	2011
North Korea	1980	–	2005	2006	–	2011
Germany	1941	–	1945	NA		
Japan	1943	–	1945	NA		
Libya	1970	–	2003	NA		
South Korea	1970	–	1978	NA		
Argentina	1978	–	1990	NA		
Brazil	1978	–	1990	NA		
Iraq	1982	–	2002	NA		
Iran	1985	–	2011	NA		

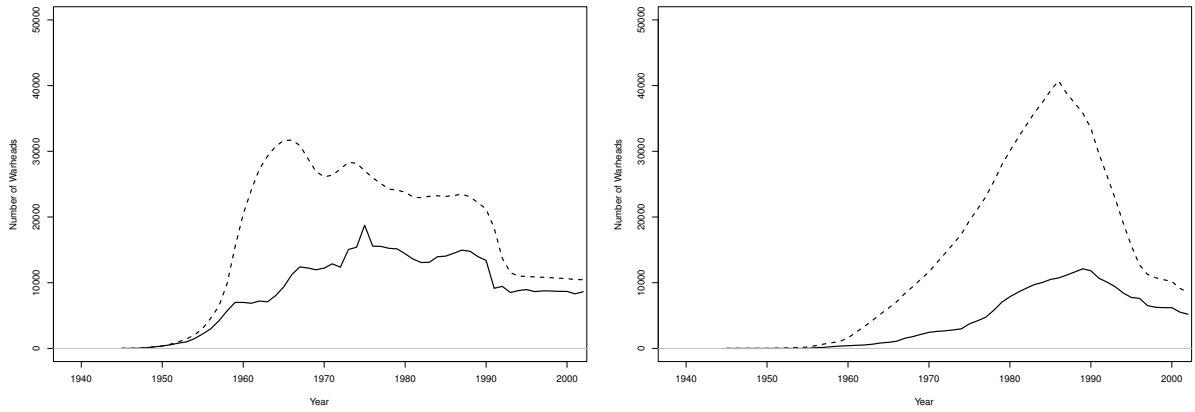
cal nuclear warheads possessed by the United States and the Soviet Union (Russia for the period 1992–2000).[29] The National Defense Research Council has compiled information on nuclear arsenal sizes for both great powers, using Department of Energy and Department of Defense declassifications for US nuclear forces information and the SIPRI Yearbook for Soviet and Russian nuclear forces information.[30] The use of a warhead count, rather than a measure that directly includes delivery systems (such as used by Lieber and Press 2006*a*), is justified by both practical and theoretical concerns. First, the diversification of delivery systems, including the makeup of air-, sea-, and missile-borne nuclear weapons, and their geographic deployment was—and remains—classified, and therefore unavailable with any

[29] Arsenals of other nuclear weapons states are not included, as the United States and Soviet Union together possess the overwhelming majority of nuclear weapons at all times. In 1985, the year with the largest number of nuclear weapons in the international system, the United States and Soviet Union collectively possessed 98% of them—62,565 of 63,632 (Norris and Kristensen 2010: 81).

[30] See `http://www.nrdc.org/nuclear/nudb/datainx.asp` for these data. The US figures are statistically consistent with data released directly by the Department of Defense on 3 May 2010, cf. `http://www.defense.gov/npr/docs/10-05-03_fact_sheet_us_nuclear_transparency__final_w_date.pdf`.

Figure 1: US and Russian Nuclear Arsenals, 1939–2002

(a) United States (b) Soviet Union/Russia



Solid line represents strategic warheads, while dotted line represents total operational stockpile.

degree of precision or thoroughness. Second, the hypotheses depend on an issue linkage between disarmament and nonproliferation. Warhead count has been the measuring stick of nuclear disarmament since START I, and played an important role in the earlier Strategic Arms Limitation Talks. The data are also widely available. Even before formal declassification, informed observers (such as the *Bulletin of the Atomic Scientists*) were able to estimate the number of American and Soviet nuclear warheads with a substantial degree of accuracy (Norris and Arkin 1999*a*,*b*; Norris and Kristensen 2009). Different models consider the effects of arsenal movement independently (as individual state effects on the system structure) and jointly (as a collective great-power effect). Lastly, the levels are transformed by a base-2 logarithm. (Thus, an increase of one in the variable's value represents a doubling of arsenal size, while a decrease of one represents halving the arsenal.) This is done in order to weaken the anticipated effect of movements around a large base value while increasing the anticipated effect of movement around a smaller base: eliminating the last thousand weapons in an arsenal ought to have a much stronger effect on nonproliferation than should eliminating one thousand weapons from a base of 40,000.

To address the concerns in the third hypothesis, a dummy variable representing the presence of the Nuclear Nonproliferation Treaty is included for all years from 1969 onwards.

This variable is interacted with the arsenal size variables in order to determine changes in the linear relationship between nuclear arsenal size and proliferation resulting from the formalization of the nonproliferation norm. Additionally, early versions of the research design also included a number of atheoretic temporal lags (Cranmer, Rice and Siverson 2011) to account for lagged effects, as well as controls for diffusion and contagion effects (cf. Oatley 2011); however, none of these provided sufficient explanatory power to justify their inclusion in the system-level analysis. However, a cubic spline (cf. Marsh and Cormier 2002) is included to compensate for temporal autoregression.

Results of System-Level Analysis

Table 2 shows the results of the quasi-Poisson regression. Models 1A and 2A analyze the effects of the size of American and Russian nuclear arsenals separately on the pursuit and acquisition of nuclear weapons, respectively, while Models 1B and 2B examine a joint effect on the dependent variables. As expected, *NPT Era* has significant and negative effects throughout all models, indicating that the formalization of the nonproliferation regime in 1968 has deterred some potential proliferants, and that the baseline of nuclear weapons aspirants and *de facto* nuclear weapons states would have been higher had the NPT not come into existence. However, the nonproliferation regime has also effected an empirical relationship due to the "grand bargain" of nonproliferation and disarmament.

Prior to the implementation of the NPT, there did exist a small, yet significant positive relationship between nuclear arsenal size and the likelihood of proliferation. This effect, which was present during the period immediately following great-power nuclearization and during the strong expansion of both US and Russian nuclear arsenals, showed that doubling of the US nuclear weapons would result in a 113% increase in the number of states pursuing nuclear weapons, *ceteris paribus*. This effect would be seen much more strongly in the 1950s, when the United States was starting from a small baseline, and decrease over time, as the relative baseline of the American arsenal was much higher. The Soviet Union shows no

Table 2: Systemic Effects on Proliferation

	Nuclear Pursuit				Nuclear Acquisition			
Variable	Model 1A		Model 1B		Model 2A		Model 2B	
(Intercept)	–5.174	**	–3.532	*	1.348	**	0.695	
	(1.700)		(1.557)		(0.459)		(0.431)	
NPT Era	–7.657	*	–10.469	**	–2.830	**	–2.469	*
	(3.192)		(3.377)		(0.985)		(1.121)	
log(US Arsenal)	0.752	*			–0.187	*		
	(0.322)				(0.089)			
log(Russian Arsenal)	–0.190				0.138	*		
	0.237				(0.062)			
log(Joint Arsenals)			0.353	*			0.020	
			(0.142)				(0.040)	
NPT Era × log(US Arsenal)	–0.565				0.037			
	(0.442)				(0.133)			
NPT Era × log(Russian Arsenal)	0.920	*			0.183			
	(0.373)				(0.112)			
NPT Era × log(Joint Arsenals)			0.595	*			0.178	*
			(0.231)				(0.074)	
φ	0.246		0.257		0.037		0.044	
n	50		50		50		50	
$\ln(L)$	–6.077		–6.662		–0.788		–0.978	

$^{*}\ p < 0.05$; $^{**}\ p < 0.01$; $^{***}\ p < 0.001$

Coefficients reflect quasi-Poisson count regression (φ = dispersion parameter).
Heteroskedasticity/Autocorrelation-Consistent Robust Standard Errors in parentheses.
Time effects computed with cubic spline (not displayed).

Table 3: Net Effects of Interaction for $NPT\ Era = 1$

	Nuclear Pursuit				Nuclear Acquisition			
Variable	Model 1A		Model 1B		Model 2A		Model 2B	
log(US Arsenal)	0.186				–0.149			
	(0.302)				(0.098)			
log(Russian Arsenal)	0.730	**			0.320	***		
	(0.289)				(0.092)			
log(Joint Arsenals)			0.948	***			0.198	***
			(0.183)				(0.063)	

similar effect prior to 1968 on the likelihood of nuclear weapon pursuit, though the positive effect derived from the US arsenal continues to be seen when the great power arsenals are considered jointly.

When considering these effects against the number of successful nuclear weapons programs, there appears on the surface to be no significant relationship between nuclear arsenal size and the number of nuclear weapons states in the system; however, Model 2A presents more nuanced results. An increase in the size of the American nuclear arsenal, *ceteris paribus*, exerts a negative pressure on the number of nuclear weapons states in the system, while an increase in the size of the Soviet nuclear arsenal exerts a positive pressure of a similar magnitude. This similarly divides the pre-NPT era into two subperiods: the 1950s, when American technological dominance restricted nuclear technology to NATO, and the 1960s, when the Cold War stalemate allowed for a wider range of developing states to bring a nuclear weapons program to fruition.

However, the empirical relationship is markedly different after the implementation of the Nuclear Nonproliferation Treaty. The joint effect of great-power nuclear arsenal size on the number of nuclear weapons aspirants doubles. Whereas halving the number of nuclear weapons among great powers would reduce the number of nuclear aspirants by 30.2% prior to the NPT, after the formalization of the nonproliferation regime that effect would be 61.3%.[31] More interestingly, the originating force behind this effect changes. Whereas prior to the formalization of the nonproliferation regime the United States' arsenal had a significant positive effect on proliferation (and the Soviets did not), Model 1A shows that during the post-NPT era the positive impetus originates from the Soviet Union, and the size of the American nuclear arsenal does not significantly affect the number of ongoing nuclear weapons programs. A 50% reduction in the Russian nuclear arsenal, *ceteris paribus*, creates sufficient political pressure to reduce the number of nuclear aspirants by 51.8%.

This change in the empirical relationship continues with regard to nuclear weapons ac-

[31]For the reader's convenience, Table 3 shows the coefficients and standard errors of all quasi-Poisson models net of their interaction effects for $NPT\ Era = 1$.

quisition. The effect of the Soviet nuclear arsenal size on successful nuclearization increases substantially; a 50% decrease in the Soviet nuclear arsenal correlates with a change in the attrition rate of successful nuclear programs, from 12.9% *ex ante pactum* to 27.4% after 1968. This effect is both significant *in se* and differs significantly from its levels *ex ante pactum*. The United States' arsenal, by contrast, exhibits a negative, yet insignificant correlation. As with the relationship vis-à-vis nuclear pursuit, the Soviet-based effect is controlling when considering the relationship jointly. Both sets of models show that after the formalization of the nonproliferation regime, the relationships between great-power nuclear arsenal size and proliferation outcomes became rationalized, with similar directional effects, originating from the Soviet Union, on both the pursuit and acquisition of nuclear weapons.

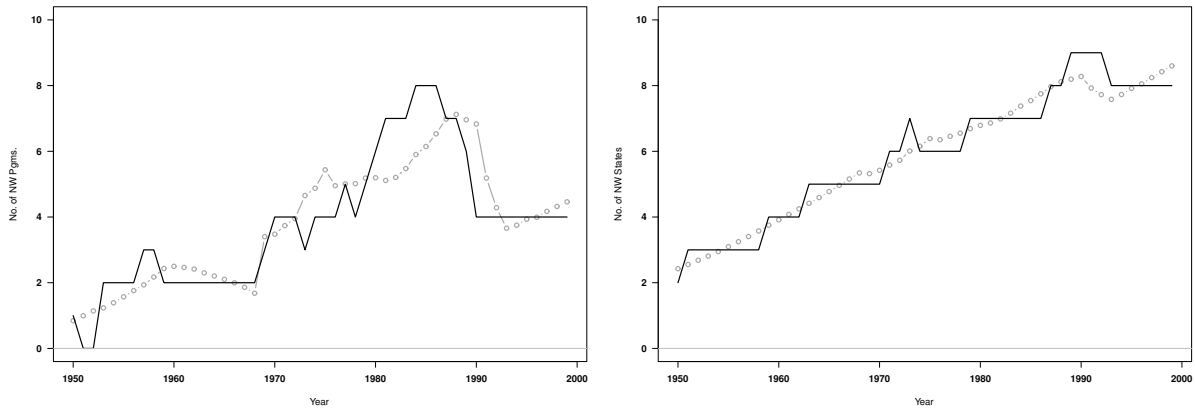
These simple models track the actual growth of both nuclear weapons programs and nuclear weapons states rather well. Figure 2 plots the predicted number of nuclear weapons programs and nuclear weapons states, using the joint nuclear arsenal figures for each year (as well as the cubic spline to control for time effects). The model time series accurately tracks two trends in nuclear pursuit: the relative stagnancy of the 1960s and the expansion of interest in nuclear weapons in the early 1970s. Additionally, the model predicts a second expansion in the 1980s followed by a sharp dropoff in the early 1990s; however, both of these trends trail their actual counterparts by a few years. With regard to successful nuclear proliferation, the model accurately follows the steady climb in nuclearization throughout the Cold War, while predicting a small decrease in the early 1990s (anticipating by a few years South Africa's renunciation of its nuclear arsenal in 1993).

Model Expansion: Country-Level Analysis

The above count models show that—at various times—the United States' and Soviet nuclear arsenals had differing effects on the overall likelihood of nuclear proliferation in the international system. While further proliferation was much less likely to occur after 1968 than before it due to convalescing norms, the connection between great-power intransigence on

Figure 2: Actual and Predicted Diffusion of Nuclear Weapons

(a) Nuclear Weapons Programs (b) Nuclear Weapons States



Gray dots: mean predicted values using coefficients from Models 1B and 2B, respectively.
Black line: actual values (cf. Table 1).

disarmament (particularly on the part of the Soviets) and the expansion of nuclear weapons in the system became much more consistent. However, as an inherent constraint on the statistical methods used to exploit system-level variation, the above models can only provide insight on the overall presence of nuclear weapons in the international system; they provide little leverage on *which* states within the system will be most likely to nuclearize, and how these states in particular react to great-power nuclear disarmament. Previous quantitative studies have focused on the individual country-level incentives for states to pursue nuclear weapons, and the current policy debate is concerned with the expected behaviors of a few specific proliferators.[32] While a system-level understanding of great-power structure is important by itself, augmenting it with an analysis of country-level variation provides greater specificity that can be directly applicable to the current policy environment.

Furthermore, a country-level analysis can assist in determining the differences in how individual countries react to the system-level stimulus of great-power nuclear strategy. Wagner (1988) and Crescenzi (2003, 2007) find that a state's behavior is conditioned on its relative relationships with other actors in the international system, and Oatley (2011) and Oatley et al.

[32]cf. Singh and Way (2004); Jo and Gartzke (2007); Fuhrmann (2009); Bleek (2010).

(2011) find that this behavior is further influenced by state position in the international network, which affects the opportunities to exploit relationships with other states as well as the costs of doing so. This conditioning undergirds contemporary understanding of alliances (cf. Walt 1985; Leeds 2003*a*) and third-party mediation and intervention (cf. Regan 2002; Kydd 2003, 2006; Kathman 2010), as well as conflict origination. A traditional realist argument, such as that proposed by Joffe and Davis (2011), argues that nuclear disarmament by the great powers should increase the likelihood of proliferation both among those states affiliated with great powers (which now doubt the viability of alliance protection) and those states unaffiliated with a great power (which now stand to gain from a weaker adversary). However, the logic at the foundation of New START and the NPR begins from a different assumption: the grand bargain should be most effective among states with close ties to the system leaders (and therefore to the international regime sponsored by the great powers), while its effect should be felt less by those with weaker ties to the great powers.

This relationship is tested by modifying the *Nuclear arsenal* variable by a directed affiliation with each of the great powers, or—when comparing against the *Joint arsenal* of both great powers—with a *Bias* differential that categorizes the net level of affiliation with either of the great powers.[33] With respect to each state's observed alignment with an individual great power, Signorino and Ritter's (1999) S-score is the standard accepted operationalization (Bennett and Stam 2004). The generalized *Bias* variable is constructed using the difference between a state's observed alignment with the United States and its alignment with the Soviet Union in a given year. This measure has a range of [–2, +2], where –2 indicates the greatest possible level of pro-Soviet bias, and +2 indicates the greatest level of pro-American bias. Because the effect of great power behavior should be greatest on those states that are most closely aligned with it, the variable is squared to create a scalar measure of the magnitude of each observation's alignment with one great power patron or the other.

[33]As the United States and Russia represented opposite foreign policy poles during the Cold War, a state in one's sphere of influence would not be aligned with the other. A state could exist, however, disaligned from either great power pole.

The effect of great-power nuclear arsenals on proliferation outcomes, modified by the observed state's bias, is evaluated using a logistic switching model. Unlike a categorical multinomial regression, which analyzes the probability that a country is in a particular outcome state at a particular time, the switching model takes the subset of observations in a state at time $t-1$ (non-nuclear, pursuing, or nuclear-armed) and evaluates the probability that the country in question moves to a different state at time t. Model 3 addresses the likelihood that a non-nuclear state initiates a nuclear weapons program (ie. that the country moves from a state of "non-nuclear" at time $t-1$ to a state of "pursuing" at time t). Model 4 addresses the likelihood that a nuclear weapons program is successfully concluded with the acquisition of weapons (ie. that the country moves from a state of "pursuing" at time $t-1$ to a state of "nuclear-armed" at time t). The subsetted data for each model are analyzed using a traditional logistic regression, as the dependent variable (switching state) is now binary.[34]

The models described below in Table 5 use the modified independent variable, as well as control variables used in prior quantitative analyses of proliferation by Singh and Way (2004) and Jo and Gartzke (2007).[35] Rather than attempt a comprehensive control for all possible explanations, as previous studies have done, Models 3 and 4 are specified for the greatest model fit. Only those variables that provide statistical explanatory power as controls are included; those that do not provide value-added to the explanation are removed to prevent over-specification of the model.[36] The interpretation of the principal variable of interest—the interaction between great-power nuclear arsenal size, the *Bias* or S alignment variable, and the dummy variable for the *NPT Era*—is conducted using the method established by

[34]Model 3 contains a rare-events correction, as the number of switches account for 0.22% of the subsetted population; Model 4, for which 3.72% of the population constitute switches, does not necessitate a rare-events correction. King and Zeng (2001) recommend using a correction for rare-event logits when the number of positive results is less than approximately three percent of the sample size.

[35]Table 4 describes the operationalization of the control variables. Missingness in two of these variables—*Democracy* and *Economic openness*—is corrected for using multiple imputation (cf. Honaker and King 2010).

[36]The models' explanatory power are calculated through an iterative AIC-reduction algorithm (Venables and Ripley 2002).

Table 4: Control Variable Operationalizations

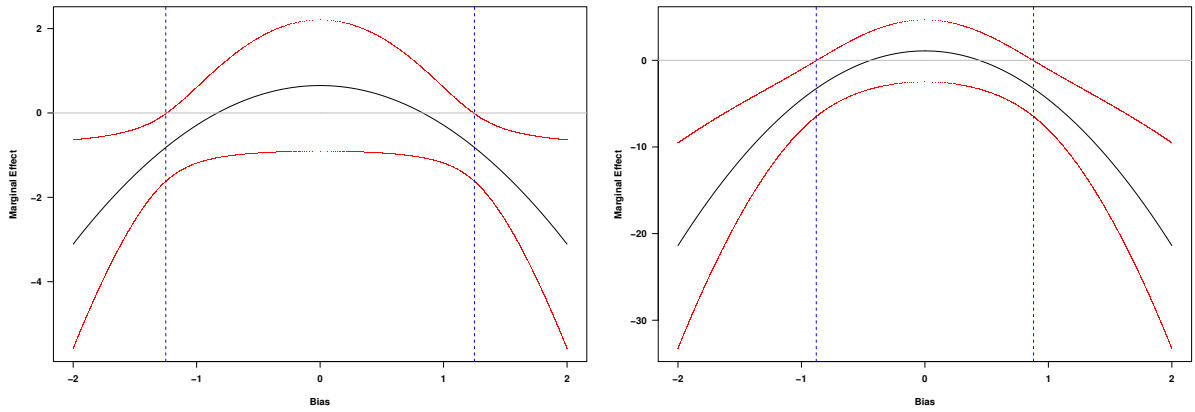
Variable	Operationalization	Source
S Alignment	$S_{i,US}$ or $S_{i,USSR}$, as appropriate	Signorino and Ritter (1999)
Bias^2	$(S_{i,US} - S_{i,USSR})^2$	Signorino and Ritter (1999); Gent and Shannon (2011)
Conventional Threat	Rivalry with a great- or regional-power	Thompson (1999); COW (2008)
Nuclear Threat	Rivalry with a nuclear-armed state	Thompson (1999)
Nuclear Security Guarantee	Defense pact with a nuclear-armed state	Gibler (2009)
Latent Nuclear Capability	0–7 scale of necessary components of a nuclear weapons program, domestically produced	Jo and Gartzke (2007)
National Capability	CINC score	Singer, Bremer and Stuckey (1972)
Democracy	POLITY IV Democracy score	Marshall, Gurr and Jaggers (2009)
Economic Openness	Trade balance as percentage of GDP	Gleditsch (2002); Heston, Summers and Aten (2009)
NPT Member State	Ratified NPT by January 1 of observation year	CNS (2010)

Preacher, Curran and Bauer (2006).

The three-way interactions used in each of these models—which are constituted by seven distinct statistical terms—are not directly interpretable, so the marginal effects of nuclear arsenal size—modified by *Bias* and *NPT Era*—have been displayed graphically in Figures 3 (for Model 3B) and 4 (for Model 4B). (Models 3A and 4A, which break out the effect of nuclear arsenal size by great power, are shown in Figures 8 and 3.)Model 3B shows that, prior to the institution of the nonproliferation regime, great-power nuclear arsenals exhibited a deterrent effect for those states most likely to enjoy a nuclear security guarantee—those exhibiting the greatest *Bias* toward one of the great powers. While the overwhelming majority of states saw no significant effect during this period, the 10% of observations with the greatest level of association with a great power saw a significant negative correlation between nuclear arsenal size and the likelihood of initiating nuclear pursuit. A 10% reduction in nuclear arms by the great powers during the early Cold War would correspond, *ceteris paribus* with a 3.2–6.4% increase in the likelihood of one of these states beginning a nuclear weapons program. However, Model 4B shows there to be no empirical indication of a rela-

Figure 3: Marginal Effects of Nuclear Arsenal Size on Pursuit (Model 3B)

(a) 1950–1968 (b) 1969–2000



Red lines represent 95% confidence interval.

tionship between movements in great-power nuclear arsenals and the likelihood of successful acquisition by a second-tier state, except for a small subset of observations with the greatest balance in their international alignments, which would experience a deterrent effect. Only China, during the period 1960-64, would have experienced pressure to hedge its acquisition strategy in response to nuclear buildup by the United States or Soviet Union. However, the plateauing of the US strategic buildup during this period failed to deter China's first nuclear test in 1964.

The relationship between great power nuclear strategy and proliferation changes markedly after the introduction of the formal nonproliferation regime, which codified the "grand bargain" between nuclear reduction and nonproliferation. The bargain had a dual effect on the empirical record. The stimulative effect of nuclear reduction on the pursuit of nuclear weapons—the realist argument seen in the early Cold War period—is reinforced. Whereas a 10% decrease in great power nuclear arsenals would previously increase the likelihood of initiating a nuclear program by 3.2–6.4%, the effect of a similar decrease after 1968 would increase the likelihood of initiating a nuclear program by between 13.7% and 71.9%, varying only the level of *Bias*. Furthermore, the subset of states affected by this relationship increases from 10% to 24% of the total observed population. This finding indicates that the grand

Table 5: Country-Level Effects on Proliferation

	Nuclear Pursuit		Nuclear Acquisition	
Variable	Model 3A	Model 3B	Model 4A	Model 4B
US Arsenal × S Alignment × NPT Era †	See Figure 8		See Figure 9	
Russian Arsenal × S Alignment × NPT Era †	See Figure 8		See Figure 9	
Joint Arsenals × Bias² × NPT Era †		See Figure 3		See Figure 4
Conventional Threat	–2.216	NR	NR	NR
	(2.255)			
Nuclear Threat	3.790	1.781 *	NR	NR
	(2.377)	(0.837)		
Nuclear Security Guarantee	–2.612	–1.141	NR	NR
	(2.122)	(1.163)		
Latent Nuclear Capability	0.350	0.367 **	NR	NR
	(0.194)	(0.160)		
National Capability	58.109 **	47.023	2.396	147.88
	(26.424)	(26.238)	(28.520)	(78.683)
Democracy	NR	NR	NR	NR
Economic Openness	NR	NR	NR	0.130 *
				(0.061)
NPT Member State	–1.199	–1.214	NR	NR
	(0.915)	(0.887)		
(Intercept)	–31.364 **	–16.198	516.45 **	18.881
	(15.809)	(11.438)	(249.13)	(13.058)
n	6468	6468	188	188
$\ln(L)$	–67.30	–73.13	–17.98	–19.67
AIC	176.60	174.27	66.96	63.34

$^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$; NR: not a relevant control variable.
Heteroskedasticity/Autocorrelation-Consistent Robust Standard Errors in parentheses.
Coefficients reflect logistic regression. Time effects computed with cubic spline (not displayed).
† All seven constituent components of three-way interactions are included in the model, but are not displayed individually for convenience.

bargain reinforces the deterrent nature of great-power nuclear arsenals, and that the promise by the Article IX nuclear weapons states to eventually eliminate their arsenals increases their allies' perception of threat even as the promise of disarmament was formalized.

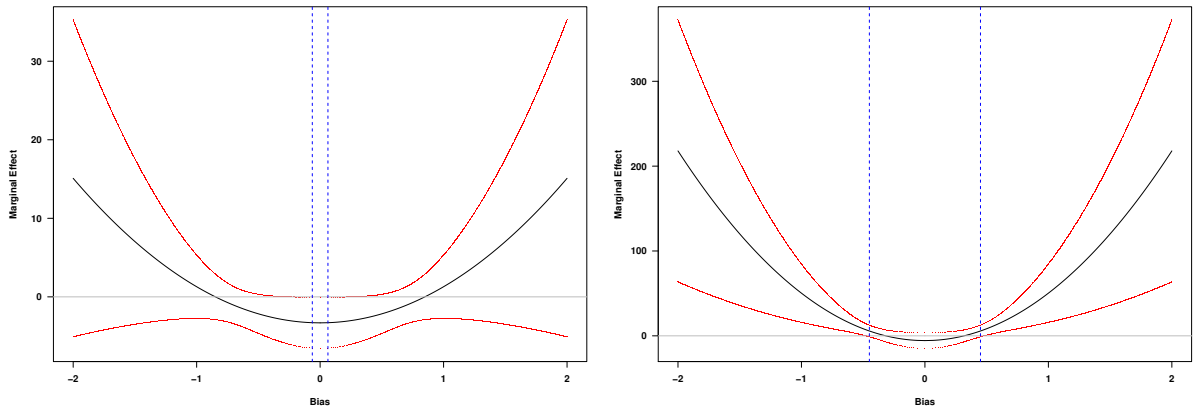
The correlation is different in how those states' likelihood of nuclear acquisition responds to great-power nuclear strategy. Prior to the formalization of the nonproliferation regime in 1968, there is no statistical correlation between the size of great-power nuclear arsenals and the likelihood that a nuclear program is successfully completed. However, the predicted positive relationship exists in the period after the creation of the NPT for a subset of the population. The 17.2% of the observed population with the greatest level of *Bias* (that with a magnitude of *Bias* greater than 0.45) shows a significant positive correlation between the size of great-power nuclear arsenals and the likelihood of successful nuclear acquisition.[37] A 10% reduction in great-power nuclear arsenals, *ceteris paribus*, would decrease the likelihood of successful acquisition of nuclear weapons by between 38.9% and 99.9%, varying only the level of *Bias*. The grand bargain shows evidence of strong returns on investment, as even though reduced great-power arsenals invite the pursuit of nuclear weapons, it radically decreases the likelihood that these programs are successful.

Beside the effect of great-power nuclear arsenals and the grand bargain of the NPT, the likelihood of nuclear proliferation is also affected by other country-level characteristics. Those states most directly threatened by a nuclear weapons state have the strongest incentive to respond in kind: an average state with a nuclear-armed rival has a 44.5% greater likelihood of pursuing a nuclear weapons program than does an equivalent state that lacks such a political impetus. Similarly, a state that has a preexisting latent nuclear capability—whether developed clandestinely or through an overt civilian nuclear program—has a greater likelihood of pursuing nuclear weapons, than does a state that must develop *ex nulla*. A state that already has all necessary prerequisites is 36.2% more likely to pursue nuclear weapons, *ceteris paribus* than is a state that has only two of the seven capabilities, the median level,

[37]The countries that meet this criterion are Argentina, Brazil, Iraq, and Libya.

Figure 4: Marginal Effects of Nuclear Arsenal Size on Acquisition (Model 4B)

(a) 1950–1968 (b) 1969–2000



Red lines represent 95% confidence interval.

and must then develop the remaining prerequisites. Among existing nuclear weapons programs, half of all observed country-years show full latent nuclear capabilities, a figure that jumps to 71% with six of seven prerequisites. Latent nuclear capability has no significant effect on a nuclear program's success, only on its initiation.

However, two important controls that should impede the will to pursue nuclear weapons do not appear to have significant effects. The presence of a formalized nuclear security guarantee (defined as a defense pact—the strongest form of a military alliance—with a nuclear-weapons state) tends toward a lower likelihood of nuclear pursuit, but does not arrive at traditional standards of significance.[38] (This effect does not provide sufficient explanatory power to merit inclusion in the analysis of nuclear acquisition.) Similarly, formal participation in the nonproliferation regime (defined as ratification of the NPT) does not significantly affect the likelihood of nuclear pursuit.

[38]Cooperation in NATO or the Warsaw Pact—the strongest military commitments of the superpowers to allied states and the source of nuclear weapons sharing for on both sides of the Iron Curtain—did not inappropriately bias the outcomes of the logistical switching models. An additional set of models run on the subset of non-NATO, non-Warsaw Pact countries shows results that are statistically-equivalent to the models run on the full international system with regard to nuclear pursuit (Models 3A and 3B). Such restricted analyses cannot be run on the nuclear acquisition dependent variable (Models 4A and 4B) due to issues of multicollinearity. Analysis is therefore confined to the models examining the full international system.

This second set of models, which analyzes the country-level variation in proliferation outcomes, serves as a balancing act between two divergent needs. On the one hand, the structure created by the great powers' nuclear strategy affects the behavior of the international system as a whole, and should rightly be analyzed as a systemic effect. On the other hand, system-level analysis is not effective at explaining the country-level variations that drive the application of political resources to the most-warranted cases. In bringing system-level explanations to a cross-section analysis, we are able to support the hypothesis that a correlation exists between the collective size of great-power nuclear arsenals and the likelihood that further nuclear proliferation occurs.[39] We are also able to see that the target population affected by this relationship changed as a result of the formal nonproliferation regime. Whereas no significant correlation between great-power nuclear arsenals and the likelihood of second-tier acquisition of nuclear arms exists prior to 1968, during the NPT era acquisition is strongly positively-correlated, even as the likelihood of nuclear pursuit is negatively-correlated to great-power nuclear arsenals. A reduction in nuclear arsenals by the United States and Russia will, on average, increase the likelihood that second-tier states pursue nuclear weapons, but decrease the likelihood that such pursuit is successful.

Discussion

Both the systemic- and country-level evaluations show that an empirical correlation between the size of great power nuclear arsenals and the proliferation outcomes of second-tier states exists from 1968 onwards. This provides support for this chapter's hypotheses that the formal nonproliferation regime embodied in the Nuclear Nonproliferation Treaty's "grand bargain" was indeed incorporated into the political discourse. While there is no inherent reason for nuclear disarmament and nuclear nonproliferation to be interdependent, the ex-

[39]However, the cross-sectional models are unable to differentiate the effect between state perceptions of the United States and of the Soviet Union—this is likely due to high multicollinearity within the interaction effects. It appears from this finding that the great powers are best treated collectively with respect to the grand bargain.

pansion of the nuclear club to France and China in the early 1960s, as well as the initiation of programs by Israel and India, forced the reconsideration of the *status quo* by the great powers. A discriminatory regime—one that legitimized their own possession of nuclear weapons while forbidding them to others—would be by itself unacceptable, as both the technology and desire necessary for nuclear weapons had begun to diffuse throughout the international system. As an intermediate step, the non-nuclear states required an incentive, which was provided in the Article VI promise to move toward disarmament, a central condition of the Non-Aligned Movement's negotiations on the NPT.

The need for a formal regime became apparent as the central conditions of the early nuclear age—bipolar stability and nuclear-protected spheres of influence—became less credible. The early Cold War exhibited the prevalence of the great power security substitution effect: heavy investments by the United States and Soviet Union in nuclear and conventional forces were deemed by second-tier states to be equivalent to domestic armament, as a replacement rather than as a threat. Gaullist France and Maoist China developed nuclear weapons only as they found themselves alienated from their respective bloc leaders.[40] The logic of extended deterrence became central to Schelling's (1966) framework, which informed American debate on nuclear strategy through the end of the Cold War. Maintaining a strong American nuclear capability was seen as the best way to eliminate the need for other Western states to pursue an independent option. It was only recently that many former high-level officials acknowledged that this is no longer a valid paradigm in an era of second-tier nuclear proliferation.[41]

By 1968, the threat of second-tier proliferation was clearly felt by the great powers, and extended deterrence was undermined as a tool of nonproliferation. The "grand bargain" became a replacement incentive for second-tier states to forgo nuclearization. This outcome

[40]The United Kingdom has been consistently excluded from this category due to their heavy involvement in the Manhattan Project and World War II-related nuclear research, which predates even the American program.

[41]cf. George P. Schultz, William J. Perry, Henry A. Kissinger, and Sam Nunn, "Deterrence in the Age of Nuclear Proliferation," *The Wall Street Journal*, 7 March 2011.

was a concession granted by great powers as part of the cooperative outcome of the formal nonproliferation regime, an exercise in diplomacy, rather than the exertion of military coercion. As a result of the underlying dynamics that led to this regime, the post-NPT environment showed a strengthening of the incentives that existed during the early Cold War.

In the current NPT regime, great-power nuclear arsenals are less likely to be seen as a form of security, and high levels of American and Soviet nuclear weapons—in violation of the spirit of the NPT—legitimate the nuclear weapons programs of aspirant states. In particular, those states most closely aligned with great powers, and therefore most likely to enjoy a security relationship with such a patron, are most sensitive to their patron's nuclear arsenal and most likely to pursue a domestic nuclear option under the current regime. Nuclear reduction, by adhering to the norms established in the NPT, creates the political capital necessary to coerce compliance by deviant states on nonproliferation issues. By reducing the importance of nuclear weapons in their defense strategies, as New START (as a continuation of the previous START agreements) and the 2010 Nuclear Posture Review have done, the United States and Russia lessen the likelihood that nuclear-aspirant states will successfully acquire such weapons.

With the successful implementation of New START scheduled for 2018, the United States and Russia will be limited to 1,550 nuclear weapons each, from 2,200 in 2010. This represents the remarkable success of arms control since the height of the Cold War. In 1986, the United States and Soviet Union collectively possessed 63,977 operational nuclear warheads (25,204 of them strategic weapons); by 2018 they will possess less than 5% of those levels. Aside from the inherently reduced likelihood of accidental nuclear war, the reductions made over the last twenty-five years provide substantial evidence that the great powers have accepted the necessity of nuclear disarmament as a means of positive security gain.[42] However, the

[42]Despite making the promise to do so in 1968, the Soviet Union never decreased the size of its nuclear arsenal until 1986–87. Early American attempts to bring down nuclear expenditures in 1965 and 1973 stalled, with levels holding at around 23,500 until the late 1980s.

low-hanging fruit may soon be running out. Nuclear officials at the US Air Force believe that unconditional secure second strike requires at least 1,000 warheads; beyond this point, nuclear reduction engenders trade-offs with direct deterrence capabilities.[43] It is principally for this reason that further nuclear reductions beyond New START are unlikely, and that the NPT's "grand bargain" will arrive at an equilibrium state.

Conclusion

This chapter addressed a fundamental assumption underlying the nuclear posture of the Obama Administration, that reducing American reliance on nuclear weapons would strengthen the nonproliferation regime and prevent new entry into the club of nuclear weapons states. Conventional wisdom, based in Cold War thinking about the nuclear guarantee to international security, derided this assumption as a dangerous weakening of American hard power. However, the empirical record shows that the validity of an extended-deterrence model was precarious long before the fall of the Berlin Wall. As soon as nuclear processes slipped out of the control of the great powers, there was need for a new regime to slow the spread of the absolute weapon. For many developing countries, the promise of a nuclear-free world for all was the necessary price for accepting the great powers' demands.

The regime has been successful so far. There are many fewer nuclear weapons in the world today than a generation ago, and the likelihood of nuclear war is limited to the mountains of Kashmir. Only five countries have acquired nuclear weapons since 1968; one of these—South Africa—has subsequently abandoned them: the only country in history to voluntarily give up possession of its nuclear arms. Five more countries have abandoned attempts to develop a nuclear option as a result of international pressure. While it is impossible to know with certainty how many nuclear weapons states would exist had the NPT and subsequent great-power nuclear disarmament not occurred, nine nuclear weapons states is much less than the twenty or more predicted by the Kennedy Administration. On several fronts, the embrace

[43] cf. McNiel (2010); Baylor (2011).

of the "grand bargain" by all sides has created a common framework for lessening nuclear tensions. The exploitation of the reduced US-Russian tensions during the immediate post-Cold War era to implement the early START agreements coincided with the longest period of time without a new nuclear entrant on record: sixteen years between the acquisition of nuclear weapons by Pakistan and North Korea's first test of a fission device.

As the United States continues to redefine its nuclear posture, further research will be necessary to expand on the relationship between great-power nuclear arsenals and proliferation outcomes. Why did the international system change its perception of US and Soviet nuclear weapons? What domestic processes led second-tier states to reject the nuclear umbrella in favor of a domestic nuclear capability? In-depth analysis of particular cases will better understand the perceptions of the great-power contest that led other international actors to change their preferences on nuclearization. Moving forward, how will the other *de iure* and *de facto* nuclear weapons states engage with Washington and Moscow on future reductions, especially as the arsenal sizes of the great powers and those of the other nuclear states begin to converge? How else do the great powers exert soft (and hard) power to undermine others' pursuit of nuclear weapons? While much focus is already being given to the aspiring nuclear states of this decade, the conduct of the current system leaders is similarly important in establishing the environment and rules for second-tier behavior.

Chapter 2

Proliferation, Preemption, and Intervention in the Nuclearization of Second-Tier States

Joy was tangible on the streets of Islamabad in May 1998. Six times in the span of three days, the Pakistani government detonated nuclear weapons in the western Changai Hills. This feat of technological development—the creation of an "Islamic Bomb"—made Pakistan the ninth state to acquire nuclear weapons and overcame the military regime's previous humiliation at the hands of its rival, India. Pakistan's nuclear weapons program was decades in the making, and the 1998 test detonations were a sign and confirmation of the unstable south Asian state's transformation from backwater to development, with the military and political power rightly held by a regional leader.[44]

Nearly twenty-five years earlier, a different nuclear weapons program was abandoned in Egypt. Exasperated by twenty years of investment with few resulting technical or political gains, Anwar Sadat ended Cairo's pursuit of nuclear weapons. The attempt to achieve parity with Israel—its regional rival—had backfired; by 1973 the United States affirmed the indispensability of Israel's regional supremacy and assured Egypt that nuclear aspirations would only bring further rounds of violence to the Middle East.[45] Sadat found greater long-term diplomatic standing through embracing the nonproliferation regime instead, rather

[44]cf. Federation of American Scientists (2002).

[45]cf. Levite (2003); Rublee (2006).

than continuing a militarized approach to the Arab-Israeli conflict.

At face value, these cases have many similarities. Both Pakistan and Egypt were mid-level, regionally-important states aiming to increase their international standing. Both states faced rivals that had superior conventional military capabilities and a preexisting (though undeclared) nuclear option. However, Pakistan was successful at bringing a decades-long nuclear-weapons program to fruition, while Egypt was undermined by the lack of support for nuclearization from either the Americans or the Soviets. Existing research indicates that the pursuit of nuclear weapons—which greatly magnify military power at a relatively low cost—invite preemptive attack from those states that stand to be threatened.[46] This chapter aims to explain the differences in the international system, specifically the role of great power preferences, that allow some states to successfully proliferate while others remain non-nuclear states by outside force. As nuclear proliferation becomes more of an issue among second-tier states—those that have regional, but not global importance and power projection—these states must make their decisions in the shadow of the United States and other great powers. Great powers can either protect members of the second tier, through alliances and support for joint interests, or they can harass smaller states to which they are opposed. Conversely, great powers can also be indifferent to the affairs of a faraway regional actor with whom it has no interests at stake.

The preferences of great powers were central to the first wave of international relations theory (cf. Waltz 1979; Keohane 1984). As research began to broaden its scope, looking at the nature of state-level interactions, great-power preferences became less prominent; however, the literatures on intervention and extended deterrence both preserve the importance of great powers in determining the outcomes of international interactions. Powerful states can shield their clients from the consequences of threatening behavior, but do not similarly protect their enemies or the nonaligned. Enjoying the patronage of the United States, Russia, or China may have been sufficient for Israel, India, and North Korea (respectively) to successfully

[46] cf. Powell (2006); Levy (2008).

acquire a domestic nuclear weapons capability while avoiding a military strike in the interim from their adversaries. This chapter contributes to the development of international relations theory by expanding the perspective of extended deterrence to the consequences of war prevention: when the threat of retaliation or preemption is deterred, what kinds of activities can a protected state pursue?

This chapter is divided into four parts. The first section develops the theoretical background for the role of great-power intervention in protecting or deterring proliferation while placing it within the development of the international relations literature. It connects the substantive issue of nuclear proliferation to the theoretical construct of dynamic commitment, and shows why preemptive war should be expected when states pursue nuclear weapons. The second section presents a theory of international interactions in the shadow of intervention by a more-powerful state and introduces a bargaining model that formally explains the outcomes of these interactions in the context of nuclear proliferation. The third section elaborates the empirical implications that can be drawn from the model. The chapter concludes with an examination of two historical cases, which illustrate the plausibility of the theory's predictions, before addressing the consequences for American nonproliferation strategy.

Literature

Levy (2008) notes several anecdotal cases in which states that pursue nuclear weapons are subject to preventive military strike by their neighbors. Contemporary attempts at nuclear proliferation by Iran and North Korea make the possibility of preventive military action extremely relevant to today's policymakers.[47] Nuclear weapons are inherently valuable for political (especially coercive) purposes, but among less-powerful states their military value directly affects the local balance of power, increasing newly-nuclear states' bargaining leverage vis-à-vis their neighbors. Anticipating this change, those states that stand to lose

[47]cf., for example, Sokolski and Clawson (2005); Posen (2006); ODDNI/A (2009); Bunn (2010); Lindsay and Takeyh (2010).

the most from nuclearization are incentivized to act during the period of time during which their advantage still exists.

The leverage provided by nuclear weapons comes from two complementary characteristics: the direct increase in military capabilities and first-strike incentives[48] and—indirectly—the increased ability to impose unacceptable costs on the adversary *ex ante bellum* through coercion.[49] Nuclear weapons are powerful instruments of war, yet in small numbers they are highly vulnerable. Lieber and Press (2006*a*) note that low levels of nuclear weapons are less survivable than are the larger arsenals associated with mutually-assured destruction. If an adversary can easily disarm such a powerful weapon, there is a greater incentive to use that weapon offensively and earlier in an engagement. Below (2009) argues that a credibly-survivable nuclear arsenal in the contemporary era requires roughly 1000 warheads, and that offensive incentives exist for states that possess fewer than that number.[50]

The second characteristic of nuclear weapons, the "power to hurt," is more well-researched, as is their diplomatic-coercive application. Schelling notes that "[i]t is *latent* violence that can influence someone's choice... The threat of pain tries to structure someone's motives, while brute force tries to overcome his strength" (1966: 3, emphasis in original). Nuclear weapons provide both the capability for latent (interpreted to be threatened countervalue) violence and brute force, although research has shifted focus between the two over time. Early research—such as Brodie (1946)—was focused on the military applications of nuclear weapons, whereas their latent value became the primary focus soon afterwards.[51] However,

[48] cf. Wagner (1991).

[49] cf. Schelling (1966); Wagner (1982).

[50] The exact requirements of survivability are a function both of protective technology (armoring, mobility, diversification) and the military capabilities of any opposing actor. If all states had fewer nuclear weapons, the threshold for survivability would decrease, but 1000 weapons is believed to be sufficient *in se* to maintain a secure second-strike option. Cf. also US Air Force Col David Baylor's (2011) analysis of nuclear deterrence below the 1000-warhead limit. Nonetheless, the absolute threshold level remains controversial and context-dependent, and will certainly play a role in debates on further nuclear arms control negotiations.

[51] cf., for example, Dingman's (1988) reports of the Eisenhower administration's purported use of deterrence in the Korean War. Additionally, Brodie notes that "[if a country] must fear retaliation, the fact that it destroys its opponents cities some hours or even days before its own are destroyed may avail it little... The threat of retaliation does not have to be 100 per cent certain; it is sufficient if there is a good chance of it"

the counterforce and coercive applications of nuclear weapons are not substitutes for one another. Slantchev (2003) notes that increasing an adversary's costs of conflict increases the range of mutually-acceptable bargains, while increasing one's available military capabilities shifts the location of that range.

As the Cold War progressed (especially with the Soviet development of nuclear weapons in 1949) the focus on nuclear weapons grew to encompass the deterrence framework exclusively.[52] The number and force of nuclear weapons possessed by the great powers far outnumbered any military purpose, and the competitive escalation of the balance of terror became the principal effects of the nuclear rivalry (Lerner 1962; Schelling 1966; Huth 1988*b*). However, the continued proliferation of nuclear weapons to rising great powers and into the second-tier states made deterrence arguments less compelling. First, the numbers of nuclear weapons necessary for "secure second-strike" are lacking in newly-nuclear states (Lieber and Press 2006*a*,*b*, 2009). Second, the counterforce value of nuclear weapons is relatively much higher for smaller states—such as Israel (Quester 1983) and attempted proliferators such as Egypt (Levite 2003; Rublee 2006)—than it is for states with large conventional militaries. As stated above, the offensive incentives associated with low levels of nuclear weapons, and the cost-effectiveness of nuclear versus conventional balancing make their use a more rational option for these states than for the great powers. It is for this reason that contemporary nuclear coercion is the domain of the small states, while nuclear blackmail by the great powers is no longer seen as credible. Coercion by Israel, Pakistan, or North Korea is more credible than nuclear coercion by the United States or China, as the former group of states lack conventional alternatives with which to protect their national interests.

Dynamic commitment is an appropriate framework for analyzing this form of nuclear proliferation. In an anarchic environment where states are left to enforce their own agree-

(1946: 73–74). The principles of deterrence were known intuitively long before Schelling's masterpiece.

[52]cf. Ellsberg (1959); Schelling (1966); Lapp (1969); cf. also Stern et al. (1989); Freedman (2003) for retrospective analyses.

ments, the ability to commit to particular arrangements of coexistence is essential to stability (Fearon 1995). In a static arrangement of power—where each party's relative strength is commonly known—it is possible to establish cooperative equilibria based on the underlying distribution of power (Waltz 1979; Axelrod and Keohane 1985). Axelrod (1981, 2006) identifies several ways in which repeated interactions can lead to cooperative commitments even when incentives point toward non-cooperation at any given moment. However, this problem becomes more difficult in environments where states are becoming more or less powerful relative to one another. Organski (1958) first proposed the hypothesis that preemptive war may be a logical strategy for a strong state that sees the rising power of an adversary. Even though war is costly, preemption is preferable when an actor cares sufficiently about its declining future status that it is willing to pay upfront in order to maintain the status quo.[53] Powell notes that "[c]omplete-information bargaining can break down... if the shift in the distribution of power is sufficiently large and rapid" (2006: 181). Thus, not all power transitions are likely to lead to preemptive war. Differential economic growth—the center of Organski's theory—is too gradual a process to cause preemption (Powell 1999, 2004). Rather, technological improvement in military capabilities should be examined when looking at dynamic commitment causes of bargaining failure.

Nuclear proliferation, by drastically increasing the military capabilities of a state (relative to a similar investment in conventional balancing) can succeed in shifting the mutually-acceptable bargaining range to a space that is entirely inconsistent with the prior distribution of power. As a result, anticipation of an adversary states nuclear weapons program should result in preemptive military strikes aimed at decapitating the means of power transition. While unaware of the general causal mechanisms behind bargaining failure, the nuclear proliferation literature has developed one of the more expansive collections of work on rational preventive warfare, especially those focusing on Israel's 1981 attack against the Osirak nu-

[53]The "shadow of the future" is important in bargaining theory for bringing actors together to make an agreement, but also opens the possibility that future benefits will directly influence present decisionmaking (cf. Axelrod 1981, 2006; Rubenstein 1982; Fearon 1995, 1996, 1998, 2007; Powell 2002, 2004, 2006).

clear reactor (cf. Feldman 1982; Snyder 1983; Feaver and Niou 1996; Tamsett 2004).

Matthew Fuhrmann and Sarah Kreps (2010; 2011) address external factors of proliferation with the microfoundations of military prevention specifically in mind. They find that preventive military action against nuclear facilities is most likely when the perpetrator and target have divergent foreign policy views and when there is a history of militarized conflict within the dyad (2010). Furthermore, they find that the risk of international condemnation or direct retaliation from the target are not deterrents to preventive action when the target's acquisition of nuclear weapons is deemed a serious threat to their national security. They do not directly address extradyadic actors, though they do note that military strikes put pressure on international suppliers and collaborators (among other consequences), reducing the material available to the target state (2011).

Given the incentives to militarily preempt the acquisition of nuclear weapons, why have there been so few instances of this type of bargaining failure? Extending the strategic framework to encompass multiple levels of bargaining changes the constraints that states face (Putnam 1988). International actors that are not directly engaged in a dyadic bargaining process nonetheless have interests in the process' outcome, and act (explicitly or implicitly) to influence its end state. This results in a different dynamic than in examining a dyadic interaction in isolation, one that has been most fully developed in the civil war literature (cf. Walter 2002, 2009). Cetinyan argues that "[i]nefficient war due to a commitment problem might be averted, if the group that fears for its future were able to find an ally who, both groups believed, would intervene if the other group reneged on its promise to govern as agreed" (2002: 671). This requires that third-party interveners be strong enough to enforce the dyad's commitments.[54]

Several recent quantitative studies of nuclear proliferation have probed the external

[54]This activity is a function of military and political capabilities and does not require a functional differentiation of the third party from the dyadic partners. Thus, interstate-level intervention as a form of guarantee is consistent even with Waltz' (1959; 1979) assumption of the functional equivalence of states. This conclusion is also consistent with much of the literature on alliance behavior (cf. Altfeld and Bueno de Mesquita 1979; Leeds and Savun 2007) and on extended deterrence (cf. Huth and Russett 1984; Huth 1988*b*).

political considerations that influence proliferation decisions. However, their approach to the power differential at play in contemporary cases is superficial. Singh and Way (2004), Jo and Gartzke (2007), and Fuhrmann (2009) all control for the presence of a great-power security guarantee. Based on Morrow's (1993) interpretation of armament and alliances as substitutive, each of these articles hypothesizes that "[t]he allure of nuclear weapons as an avenue to security may be attenuated by a security guarantee in the form of a defense pact" with a great power (Singh and Way 2004: 869). However, these studies find mixed results, with the average effect of the security guarantee being an insignificant predictor of proliferation outcomes. This confounding result may be due to related methodological and theoretical reasons. By only controlling for cases in which a defense pact—the strongest formal signal of commitment—exists, these models ignore the *de facto* commitment expressed by states' interest alignment. A formal commitment is only as valuable as it is credible: as a patron becomes more invested in its client's well-being, it loses its ability to compel certain behaviors by threatening to end the alliance. Great power protection for nuclear aspirants (as well as for perpetrators of other illicit behaviors) can thus be *induced* through a state's indispensability on other fronts.[55]

It is therefore misleading to think of an impartial arbiter as the paradigm for intervention. Firstly, states intervene in disputes to which they are not direct participants only when it is in their own strategic interest to do so (Walt 1985; Werner 2000; Gent 2007).[56] Leeds (2003*a*) finds that great-power allies are less likely to honor alliance commitments because of reputational costs than are minor powers, lending support to the conclusion that self-interest is a necessary component of credible commitment. Secondly, Kydd (2003, 2005, 2006) finds that impartial mediation—when it is invoked—is less effective than intervention that favors one of the actors. States that mediate disputes with the sole intention of mitigating conflict or

[55]This has been recognized through thirty years of qualitative literature; cf. Quester (1983); Betts (1993); Farr (1999); Garver (2001); Burr (2004, 2008); Cohen and Miller (2010).

[56]Disaggregating the unitary state, one finds that intervention occurs when it is in the leader's strategic interest, which may or may not differ from that of the unitary state; cf. Fearon (1994); Smith (1998); Bueno de Mesquita et al. (2003).

that "have no policy preferences at all over the issue in dispute" are not seen as trustworthy, and their actions will be ignored (*Ibid.* 2003: 598). A threat of intervention by such an actor represents a static commitment problem, and is seen by other actors not to be credible.[57]

Intervention also creates a moral hazard that does not exist in isolated dyadic bargaining. Bapat (2010) notes that, because intervention bolsters the position of one actor vis-à-vis its adversary, that actor is likely to demand greater concessions. The end result of this is not only a further squeezing of the adversary state, but the entrapment of the intervener. Likewise, Smith (1996) finds that moral hazard extends to conflict initiation; when allied states are believed to be reliable, actors may seek out opportunities to provoke favorable intervention. Any intervention that has the possibility of meaningfully impacting the outcome of a bargaining process can also be exploited to create outcomes that are unfavorable to the intervener. How and when the external actor commits itself to certain behaviors (and how it communicates this commitment) becomes an integral part of the strategic calculations of the states that are directly involved in the bargaining process.

Theory

While commitment problems as a source of bargaining failure have been examined thoroughly within a dyadic framework, there is little analysis outside of the civil war literature[58] that deals with the influence of external actors on these bargains. The interstate system allows for more powerful states to impress their will on less-powerful states, a dynamic that is central to understanding the practical limits of the dynamic commitment problem in leading to interstate bargaining failure. Furthermore, an understanding of dynamic commitment with a specific focus on the empirical question of nuclear proliferation allows a critical evaluation of the role that current great powers can play in shaping or controlling the expansion of nuclear weapons into the second tier of states and the effects that proliferation will have

[57] cf. Fearon (1995).

[58] cf. Fearon (1998); Walter (2002); Kydd (2003); Gent (2007, 2008); Bapat (2010).

on international stability.

This section introduces a game-theoretic framework to analyze this problem. First, a two-stage dyadic bargaining model based on Powell's (1999; 2006) bargaining model is introduced. The bargaining framework of the isolated dyad—so often used in international relations literature—is appropriate for bargaining among the "first tier" of states: the great powers, which are sufficiently powerful that no other state exists that can meaningfully alter the bargaining relationship.[59] Currently, the United States and China occupy the first tier; during the Cold War, the Soviet Union was also a first-tier state.[60] Bargaining among these states is *de facto* isolated from external actors because no state has the capability necessary to effect change within their bargaining dynamics.

However, this is not the case with the majority of states, who exist in a system that is structured by the first-tier actors. Current nuclear aspirants (and their adversaries) must negotiate in the shadow of great-power intervention. Therefore, the bargaining model is expanded to include a strategic, "dictatorial" actor who can (at a cost to itself) fix the distribution of benefits within the second-tier dyad in the event of bargaining failure. This model more accurately reflects the bargaining undertaken by second-tier states, which must account not only for their peers' preferences and capabilities, but also for those of the system leaders. In comparing the dyadic and triadic games, it becomes clear that the threat of external intervention opens the possibility of extreme changes in the distribution of power without the occurrence of bargaining failure; this becomes more likely as the change is desired by the great power. However, a deviation of the great-power preference from the *status quo ante* is necessary for the other actors to alter their strategies from those of the isolated dyadic interaction.

[59]The alliance literature (cf., for example, Morrow 1991, 1993; Conybeare 1994; Leeds 2003*a*,*b*) notes that capability is an essential characteristic of third parties' (allies') effect on the bargaining process. Junior partners provide less capability to an alliance, but gain greater benefits from its existence. Conversely, senior partners feel little gain in capability from participating in an alliance with smaller states.

[60]Using Singer, Bremer and Stuckey's (1972) CINC scores, these states reach at least half of the system's maximum observed levels of military power. The data's power-law distribution provides for a natural cut-off point between these states and the second tier.

Dyadic Bargaining in Isolation

Model Introduction

The models in this chapter draw heavily on the dyadic bargaining model developed by Powell (1999, 2006). The dyadic model (termed Γ_0) is played between unitary rational actors, defined as the Defender (D) and the Challenger (C).[61] The actors are engaged in a repeated interaction in which they must divide a set of benefits—normalized to the interval $[0, 1]$—between them during each period. The actors have linearly-increasing preference for the benefits and are either risk-neutral or risk-averse,[62] characterized by $\rho \in (0, 1]$. At the start of the game, and for each period in which an agreement is not reached, the benefits are divided according to a *status quo ante* of $(q, 1-q)$ to C and D, respectively. Future gains are discounted by a commonly-held discount factor $\delta \in (0, 1)$. The actors also have an exogenously pre-defined distribution of power $(p, 1-p)$, where $p \equiv p_0$ at the commencement of the game.[63]

The game is played in two periods. Prior to the initiation of the game, C decides whether or not to nuclearize. If C chooses to nuclearize, it sets in motion a process such that, in between $t = 1$ and $t = 2$, $p \equiv p' > p_0$, unless the bargaining process is settled via the exit option. Additionally, D's costs associated with the inefficiency of war c_d increase to $c'_d > c_d$. If C does not nuclearize, p and c_d remain at their prior values for both periods. After this decision is made, the actors enter into the two-round bargaining game.

[61] These actors are defined as by Waltz (1979), who suppressed the conditions of domestic politics in determining state behavior. While unpacking the unitary state would later become standard practice (cf. Fearon 1994; Schultz 1998, 1999), it is inappropriate to do so in this case for two reasons. First, nuclear programs tend to be highly centralized and compartmentalized operations, focusing on a need-to-know principle that minimizes public oversight or control (Levite 2003). Second, these programs show a tendency toward partisan continuity (George 1980); while there are instances of domestic regime change that result in "nuclear reversal," Paul (2000), Paul, Harknett and Wirtz (2000), and Levite (2003) find reason to subordinate domestic causes to systemic conditions and constraints. Therefore, activities related to nuclear weapons are undertaken by a homogeneous national-level elite analogous for modeling purposes to the unitary state.

[62] Risk-acceptance is considered both theoretically-implausible, as it renders war an efficient outcome (Fearon 1995, 1996) and empirically difficult to justify (Huth, Bennett and Gelpi 1992; Moravcsik 1997), and is therefore excluded from discussion.

[63] p is defined by $p \equiv \frac{\beta m_c}{\beta m_c + m_d}$ and can be conceived of as the challenger's share of the overall military capabilities in the dyad, weighted by the offensive dominance or "first-strike advantage" (β, cf. Powell 1999).

Table 6: Descriptions of Parameters

Parameter	Description
$p_t = \{p_0,\ p'\}$	Challenger's share of power distribution
$c_c,\ c_d$	Costs of war to Challenger and Defender
q	*Status quo* distribution of benefits to Challenger
x_t	Defender's offer to Challenger at time t
$\rho_c,\ \rho_d$	Level of risk-aversion for Challenger and Defender
δ	Discount factor
x_g	Great power's ideal point *
c_g	Cost to great power of intervention *

* Only used for Γ_1, the three-player model.

In each period t, D offers some $x \in [0, 1]$. C has the option of either accepting (A) or rejecting (R) x. If it accepts x, the distribution of benefits is redefined $(x, 1-x)$ at that period. If C accepts x at $t = 1$, that value becomes the *status quo* level q in the following round. If C rejects x, the distribution of benefits remains unchanged at the *status quo* level $(q, 1-q)$. After C makes its decision, both players receive their payoffs for the round, and they enter into the second round. After repeating the exchange for $t = 2$, the game ends.

However, both D and C have recourse to an exit option, war (W). By choosing this strategy, an actor permanently suspends the bargaining framework. The distribution of benefits is fixed at the *ex post* inefficient outcome $(p_t - c_c, 1 - p_t - c_d)$ for all t moving forward.[64]

Solution

The solution to this game can be found through the subgame-perfect equilibrium (SGPE), a refinement of the Nash equilibrium that requires that actors' strategies represent Nash equilibria at every subgame level of the overall game (Selten 1975). Because the game is played

[64]This outcome can be considered either as a lottery over all-or-nothing outcomes, or as an eventual distribution of benefits reflecting the underlying distribution of power. The inclusion of the great-power intervener in Γ_1 makes greater intuitive sense if war is seen as a continuation of the bargaining process (cf. Wagner 2000; Wolford, Reiter and Carrubba 2011) because of the ability of the great power to enforce commitments, therefore ending the cause of bargaining failure, prior to the imposition of inefficiency costs. However, for simplicity, the process of war absent intervention will be condensed into the lottery.

Figure 5: First-Round Interaction for Two-Player Game (Γ_0)

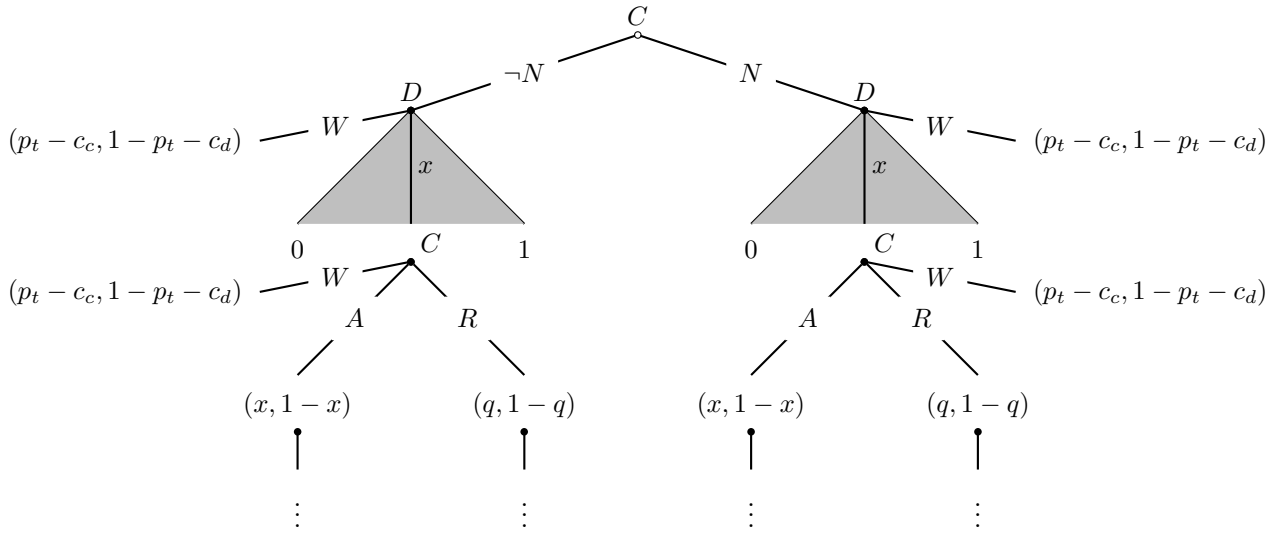


Table 7: Move Order for Two-Player Game (Γ_0)

t	Player	Move
0	Challenger	Chooses to nuclearize (N) or not nuclearize ($\neg\ N$)
1	Defender	Offers Challenger $x \in [0, 1]$ or War* (W)
	Challenger	– If offered x, Accepts (A) or Rejects (R) or War* (W)
2	Defender	Offers Challenger $x \in [0, 1]$ or War* (W)
	Challenger	– If offered x, Accepts (A) or Rejects (R) or War* (W)
		Game Ends

* If either player chooses War (W), the game ends immediately.

in complete information, the process of backward induction allows for the identification of the SGPE (Gibbons 1992). Separating at C's initial decision over nuclearization, there are two parallel subgames that must be analyzed: one in which no nuclearization occurs, and one in which the process of nuclearization does occur.

Rational-choice literature has long held that the inefficient outcome of war should not occur in situations of complete information—the presence of such wars led to the initial evaluation of commitment problems (Fearon 1995). Dynamic commitment problems exist as a consequence of changes in the distribution of power that are "sufficiently large and rapid" (Powell 2006: 181); however, an equivalent *static* commitment problem does not exist. Where the distribution of power is both stable and common knowledge, and where the distribution of benefits is sufficiently continuous (ie. bargaining does not suffer from indivisibility problems), there should always exist a range of acceptable bargains, and—given the decision rules posited above regarding offer-making—the range condenses to a unique equilibrium bargain.

Lemma 1 *In an environment of static power (ie. when p does not change), there exists an equilibrium bargain to the dyadic subgame at* $x_t^* = (p_t - c_c)^{1/\rho_c}$.

The proofs for this and other theorems are found in the appendix. Because D has the power to make the offer x, it is rational for the offer to make the maximum utility for D, and—by complementarity—make C indifferent between accepting the offer and going to war.[65] That is, D receives all of the gains from an efficient settlement of the bargaining process.

However, in situations of dynamic distribution of power, the option of preventive war becomes a viable option. C has every incentive to keep the bargaining process alive—at $t = 2$ the distribution of power shifts in its favor, and a non-null range of acceptable bargains is open as in the static case described above. However, prior to the power transition,

[65] cf. Powell (1999: chap. 3).

Table 8: Comparative Statics for Critical Level of Power (p_c') in Two-Player Game (Γ_0)

Variable	Symbol	$\partial(\Delta p_c)$
Challenger's initial share of power distribution	p_0	+
Challenger's costs of war	c_c	+
Defender's costs of war	c_d	+
Challenger's risk-aversion	ρ_c	*
Defender's risk-aversion	ρ_d	*
Discount factor	δ	–

* See Figure 6.

D must calculate the expected benefits that it will lose to C as a result of C's acquiring nuclear weapons (and the resulting change in the distribution of power). This expected loss is calculated relative to if D were to engage in preventive war, resulting in an *ex post* inefficient end state.[66] If the expected change in the distribution of power is sufficiently large, D's expected loss from the power transition is greater than the costs of inefficiency, preventive war becomes personally-rational for D. This holds even though the option is inefficient at the dyad level.

Theorem 2 (Preemption Condition) *In an environment of dynamic power, there does not exist an equilibrium bargain to the dyadic subgame when the change in the distribution of power between* $t = 1$ *and* $t = 2$ *exceeds* $p_c' - p_0$*, and there does exist an equilibrium bargain to the dyadic subgame at* $x_t^* = (p_t - c_c)^{1/\rho_c}$ *for each period when the change in the distribution of power does not exceed* $p_c' - p_0$*.*

Once C has decided to pursue nuclear weapons, there are two possible end states. If the change in the distribution of power (represented by $p' - p_0$) is sufficiently small, the change is absorbed by the bargaining process, and D is able to offer mutually-acceptable levels of x in both rounds of the game, resulting in some shift of benefits away from D and to C's advantage, that is nonetheless still preferable to war for both actors. However, if the expected

[66]Because D captures all gains from the efficient outcome, it also stands to lose all of these gains in a war. C is indifferent between the two outcomes on a per-period basis, but prefers to allow the power transition to occur than for it not to occur.

change in power resulting from nuclearization is sufficiently large, D is unable to provide an offer at $t = 2$ that provides it with more long-term utility than would war under the terms of the initial power distribution. Faced with this prospective outcome, D's rational strategy is to suspend the bargaining process up front through preventive military action. Power transition theorists, such as Organski (1958) and Van Evera (1999), argue that a variety of factors, including differential economic growth, conventional armament, and even tactical advantages can be sufficient to result in bargaining failure. However, Fearon (1995) and Powell (2004, 2006) argue that future changes in power must be both extreme and sudden in order to frustrate the creation of a Pareto-superior negotiated settlement.

The formal model provides for a critical value p'_c, which determines, based on initial conditions, at which point the dynamic commitment problem exists for D. The critical value is defined as

$$p'_c \equiv \left[1 - \left[\frac{(1+\delta)(1-p_0-c_d) - [1-(p_0-c_c)^{1/\rho_c}]^{\rho_d}}{\delta}\right]^{1/\rho_d}\right]^{\rho_c} + c_c$$

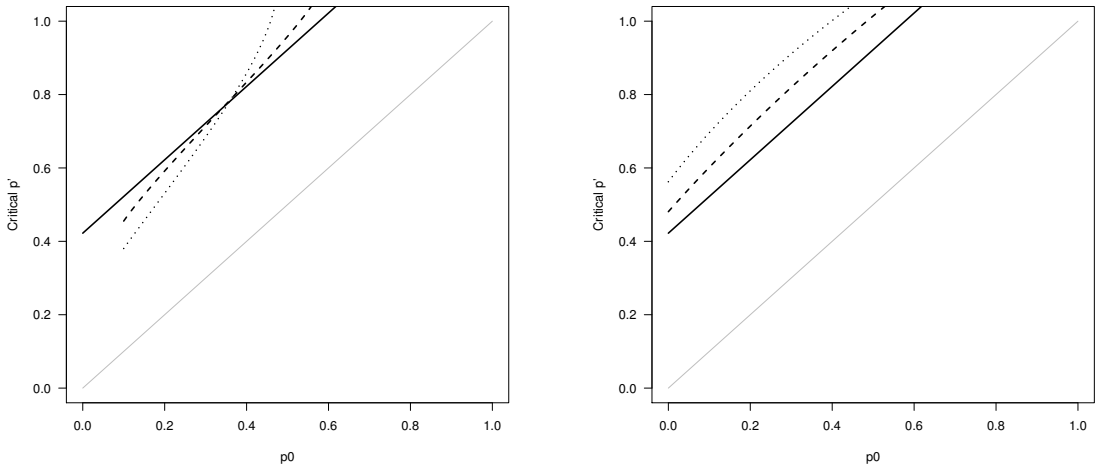
When changes in the distribution of power resulting from nuclearization exceed $p'_c - p_0$, the power transition induces bargaining failure; when the change is less than this value, the defender rationally accepts an unfavorable revision of the *status quo* while maintaining an efficient bargaining process. Figure 6 shows that—even under liberal grants of the cost of war and the actors' risk-aversion—the required increase in power necessary to justify preemption is extraordinarily high.[67] Instead, a technological change that increases offensive incentives is necessary to to reach the threshold for military action.

This critical level is linearly dependent on the initial distribution of power for risk-neutral actors. The absolute level of change in the distribution of power is the same relative to the

[67]Using Van Evera's (1999: 78–79) example of various Egypt–Israel conflicts, changes in conventional military capabilities led Israel from 20% of the dyad's power capabilities in 1956 (measured as an unweighted percentage of dyadic CINC) to 25% in 1967, to 27.3% in 1973. Barring extreme risk preferences, it is highly unlikely that the prospect of conventional armament alone induced a commitment problem generative to these three conflicts.

Figure 6: Effect of Starting Distribution and Risk-Aversion on Critical Level of Power

(a) $p'_c = f(p_0;\ \rho_c)$ (b) $p'_c = f(p_0;\ \rho_d)$



Solid Line: $\rho = 1$; Dashed Line: $\rho = 0.8$; Dotted Line: $\rho = 0.6$
Assumes $c_c = c_d = 0.1;\ \delta = 0.9;\ \rho_{-i} = 1$

initial level of the distribution regardless of whether the challenger is more, less, or equally powerful relative to the defender in the *status quo ante*. Because this critical value is so high, states that exceed a certain level of initial power $p_0 > 1-(p'_c - p_0)$ will be theoretically unable to induce a dynamic commitment problem. In order to do so, their share of the distribution of power after the transition would require exceeding the total distribution. States that are conventionally powerful before they nuclearize are not likely to prompt bargaining failure vis-à-vis their weaker rivals; however, the dynamic commitment problem is a distinct possibility for challengers that are conventionally weaker than their rivals.

However, this linear relationship does not hold for risk-averse actors. Either the challenger or the defender acting in a risk-averse fashion changes the marginal effect of the initial distribution of power on the threshold level of the dynamic commitment problem. As the challenger's risk-aversion increases, the marginal effect of p_0 on the critical change in the distribution of power increases, and the domain for which a dynamic commitment problem is possible becomes bounded. When the challenger is risk-averse, the dynamic commitment

problem does not exist if the challenger is either too weak ($p_0 < 0.1$) or too strong (an increasing bound that is a function of ρ_c). As the defender becomes more risk-averse, in contrast, the bounds of p_0 do not change, but the critical value of p'_c increases at a curvilinear rate.[68] Figure 6 shows the threshold values of p'_c as a function of the initial distribution of power for various levels of challenger and defender risk-aversion.

The effect of p_0 on p'_c shows that the dynamic commitment problem is theoretically possible only for second-tier states. Because great powers—such as the first-generation proliferators—held a majority of the distribution of power vis-à-vis their rivals, it was impossible for any of these states to achieve the necessary leap forward in the distribution of power sufficient to prompt bargaining failure. The relative effect of nuclearization on their power was broadly accepted by less-powerful states, which did not have the ability to reverse the new *status quo*. However, states that are weaker than their adversaries initially can prompt bargaining failure through the anticipated expansion of their power that nuclearization provides.

The inefficiency costs of war for both C and D have a positive effect on the critical value of p'_c. This comes from the condition that D captures all of the gains from an efficient settlement, which is equal to $c_c + c_d$. As either of these increases, D has to suffer a greater loss of utility by engaging in preventive war vis-à-vis accepting the peaceful transition of power. It therefore requires that the expected loss resulting from the latter scenario increase respectively in order to make preemption personally-rational.

A final effect is seen by the discount factor (δ) on the threshold. As to be expected, placing a lower value on future gains relative to present utility increases exponentially the critical expected change in the distribution of power necessary to induce the dynamic commitment problem. Where a state is sufficiently concerned with its present well-being relative to the future, it will not regard the consequences of future developments as pressing.[69] The effect

[68]This is with the exception of levels of p_0 very close to 1, at which point risk-aversion decreases the critical level of p'_c. However, due to constraints on the bounds of $p \in [0, 1]$, this level of p'_c can never be obtained from such a high level of p_0.

[69]Powell (1999) notes that states tend to have long shadows of the future and are concerned for continued streams of utility, but that existential crises such as war may focus their attention on immediate matters.

of this is that a state that is sufficiently concerned its utility in the present period will not intentionally suffer the inefficiencies of war—even at a favorable distribution of power—in order to avoid an unfavorable revision of the *status quo* in the future. Conversely, a defender that expects to have a long-term political relationship with the challenger is going to weight the post-transition environment more heavily than will a state with a short shadow of the future. This type of defender will therefore require less of an expected change from nuclearization to make bargaining failure the personally-rational strategy.

The two subgames can be compared to one another directly, informing the challenger's decision whether or not to pursue nuclear weapons in the first place. Initially, the challenger is indifferent between accepting the defender's offer and going to war.[70] If nuclear weapons are not pursued, the static environment of the *status quo ante* remains undisturbed. Conversely, by pursuing nuclear weapons, one of two outcomes is possible. If the expected change in the distribution of power Δp is sufficiently high, this will provoke bargaining failure—the defender will preemptively attack the challenger before the power transition occurs. The challenger is indifferent between these two outcomes. However, if Δp is low, the defender accepts that nuclearization will occur, and continues the bargaining process while taking into account the new power that nuclear weapons bestow on the challenger. The resulting gain $(p' - c_c)^{1/\rho_c} - (p_0 - c_c)^{1/\rho_c}$ is transferred from the defender to the challenger. As a result of these possible outcomes, dyadic bargaining in isolation results in a consistent preference for pursuing nuclearization.

Theorem 3 (Nuclear Preference in Dyadic Games) *For Γ_0, C has a weak preference to nuclearize for all Δp.*

Despite the possibility of a dynamic commitment problem, in the isolated dyadic inter-

Bueno de Mesquita et al. (2003) posit that a similar dynamic may work at the substate level, where leaders concerned with their own political survival may not extend their interest to affairs beyond the length of their tenure.

[70]This is a function of the defender exploiting its ability to make the offer in order to itself capture all gains from the efficient bargaining process.

action common to international relations literature, it is always part of the SGPE for the challenger to pursue nuclear weapons. The process of nuclearization is a calculated gamble by the challenger that it will be able to achieve this new military technology—and the added bargaining leverage that it entails—without inviting preemptive warfare to maintain the *status quo ante*. Success in achieving nuclear weapons is a function of the perceived effect of nuclearization (and the resulting threat) on the dyadic relationship. The result, as Debs and Monteiro (2010) show, is that nuclear proliferation is successful when its effect on the balance of power is relatively low, and either bargaining failure (prevention) or nuclear abstention occur when the effect of nuclearization is sufficiently high.

However, dyadic interaction is rarely in isolation from the remainder of the international system, and it is imprudent to ignore systemic impositions on the bargaining process. Great powers have their own interests over the stability of and distribution of power within the second tier of international powers. Even though these states may not overtly intervene in second-tier dyadic negotiations, their presence and the shadow of great-power intervention affect the strategic calculations of the challenger and defender, and may upset the equilibrium behavior of the dyadic interaction.

Bargaining in the Shadow of a Single Intervener

Model Introduction

The literature on civil wars has discussed at length the effects of intervention on dyadic negotiation (Werner 2000; Cetinyan 2002; Gent 2007). When another actor has the ability to "dictatorially" interfere (cf. von Glahn 1992: 171) externally in a dyadic bargaining process—by means of the application of outside reserves of power—the strategic logic of the initial dyad is altered. Actors must now consider not only how their strategies affect the behavior of their adversary, but also the intervener's decision whether or not to involve itself in the dyadic bargain, and how intervention—if it occurs—affects the overall preferences of the initial actors.

The remainder of this chapter examines several conditions under which the presence of a great-power intervener affects the likelihood of bargaining failure in the context of the dynamic commitment problem of nuclearization. Γ_1 introduces the player G, which has the ability to unilaterally correct for bargaining failures that may occur in Γ_0. G is assumed to be risk-neutral and has linear preferences over the distribution of the benefits between C and D. However, because G is not receiving the benefits itself, its preference is over the possible distributions between C and D relative to some exogenously-defined ideal point x_g; G has lower utility for bargains that are settled at greater distances from x_g, and higher utility for bargains that are settled at lesser distances from the ideal point. This is represented by the negative absolute-value distance of the bargain, such that $U_G(x) = -|x - x_g|$ (Hotelling 1929).

Γ_1 differs from Γ_0 in that G has the ability to intervene in the dyadic bargain in the event of bargaining failure. When either C or D chooses the option of war, G may either intervene or not intervene. If G does not intervene, no change occurs to the outcome of Γ_0. If G does intervene, a dyadic bargain is enforced such that the division of benefits between C and D is set at $(x_g, 1 - x_g)$ for that period. Because intervention is costly to G, it pays $c_g > 0$ whenever it intervenes.[71] G does not have the option of intervening if C and D agree to an outcome through the bargaining process.

Solution

The inclusion of G in the bargaining process serves as a fail-safe in case of C and D's failure to achieve an efficient outcome on their own. However, because intervention is costly, G will not always affect the strategic dynamic in the second-tier dyad. It will only do so when the benefit to be gained from intervention (ie. its preferred outcome) outweighs the costs of achieving that outcome. Werner and Yuen (2005) note that the costs of intervention are

[71] Γ_0 can be treated as a special case of Γ_1, in which G's cost of intervention is so high that it is unwilling under any conditions to influence the bargaining framework. Thus, bargaining among the first tier is *de facto* isolated from the system, rather than subject to a formal separation.

Figure 7: First-Round Interaction for Three-Player Game (Γ_1)

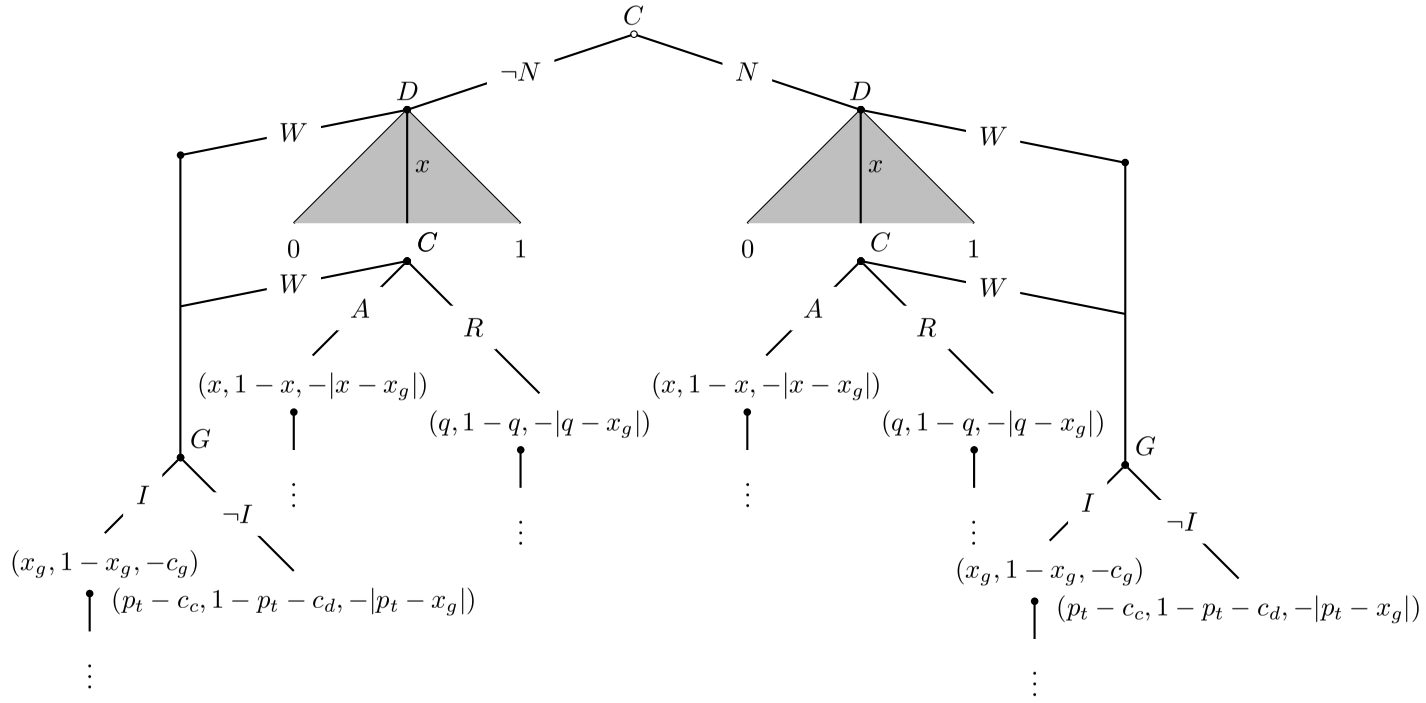


Table 9: Move Order for Three-Player Game (Γ_1)

t	Player	Move
0	Challenger	Chooses to Nuclearize (N) or not nuclearize ($\neg\ N$)
1	Defender	Offers Challenger $x \in [0,1]$ or War† (W)
	Challenger	– If offered x, Accepts (A) or Rejects (R) or War† (W)
2	Defender	Offers Challenger $x \in [0,1]$ or War† (W)
	Challenger	– If offered x, Accepts (A) or Rejects (R) or War† (W)
		Game Ends
$\dagger$	Great power	If either player chooses War (W), chooses to Intervene (I) or not to intervene ($\neg\ I$)*

* If either player chooses War (W) and the Great power does not intervene ($\neg\ I$), the game ends immediately.

related to the stability of the desirerd outcome. Where the great power's preferred outcome is within the bargaining range (or can be within the bargaining range after a power transition), intervention can be limited in duration, fixing the commitment problem until the agreement becomes self-enforcing. However, if the outcome is non-self-enforcing, the intervention must be unlimited in scope and duration in order to maintain its stability (cf. also Bapat 2010).

In evaluation of a "hard case" of intervention, G must maintain an indefinite commitment to the stability of the second-tier dyad. That is, G must be willing to pay the costs of intervention c_g indefinitely in order to achieve its ideal outcome, or chooses not to involve itself at all in case of war. Thus, there exists a range of possible outcomes around the war outcome p_0 where it costs more for G to affect the outcome of bargaining failure than the utility it receives from moving to an ideal outcome from the natural one. Outside of this range, G is willing to remain committed to intervention for the full duration of the game.

Theorem 4 (Intervention Condition) *G credibly threatens to intervene in a degenerate bargaining scenario when $x_g \notin p_0 \pm c_g$.*

Simply put, G can influence the strategic dynamics of the second-tier dyad when its ideal distribution of benefits differs from the initial distribution of power by at least as much as the cost expended in fixing the distribution of benefits. However, if the great power's preferred outcome is eventually self-enforcing, an indefinite commitment is not necessary.

Rather, G must only expend effort to fix the distribution of benefits until the power transition occurs. Because the great power only needs to pay immediate costs, rather than a discounted stream of costs into future periods, the range G's preferences that are credible threats of non-intervention is reduced.[72]

Corollary 5 *G credibly threatens to intervene in a degenerate bargaining scenario when $x_g \in [p_0 + \frac{c_g}{1+\delta}, p_0 + c_g]$ and when $x_g \geq (p' - c_c)^{1/\rho_c}$.*

This can be interpreted as great-power patronage or protection for its protégé's nuclear weapons program. Whereas the "hard case" of intervention assumes the conditions under which G will interfere in the dyadic bargaining process based on its own interests and irrespective of the stability of such an outcome, the range of possible interventions is increased when the great power seeks—implicitly or explicitly—to improve the challenger's standing relative to the defender. Being amenable in principle to a pro-challenger change in the distribution of power, G is able to extend the range of its influence toward more balanced outcomes. However, if the great power's preferred outcome is not within the acceptable bargaining range after the power transition, G will only be able to intervene under the conditions of the "hard case."

Corresponding with Theorem 4 and Corollary 5, great-power intervention is posited on G's ideal point being sufficiently different from the initial distribution of power (and the anchoring point of initial bargaining outcomes). If the great power's preference is sufficiently close to this distribution of power, G is willing to accept "natural" outcomes from the dyadic bargaining process, without becoming directly involved. Great power capabilities are not a sufficient factor by itself to influence external outcomes—the shadow of intervention must also display a preference for change from the *status quo* in order to be relevant. Where this is not so, the dyadic interaction plays out as if it were in isolation.

[72]Though the range constraint is symmetric around p_0, the self-enforcing constraint $x_g \geq (p' - c_c)^{1/\rho_c}$ limits this outcome to at most the upper range. $x_g \in [p_0 - c_g,\ p_0 - \frac{c_g}{1+\delta}]$ cannot credibly threaten intervention.

Corollary 6 *The inclusion of G does not affect the equilibrium path of play of Γ_1 away from that of Γ_0 if $x_g \in [p_0 - c_g, p_0 + \frac{c_g}{1+\delta}]$.*

Where the difference between x_g and p_0 is sufficiently large, the interaction between C and D in the shadow of intervention is not identical to the isolated dyadic interaction. The credible threat of intervention creates a deterrent effect when G is sufficiently in favor of the challenger. However, when G's preference is inverted—being sufficiently in favor of the defender—G's presence creates a moral hazard.[73] In the isolated dyadic interaction, D chooses to suspend the bargaining process through war only as a result of the dynamic commitment problem; however, each period, when self-contained, has a range of acceptable bargains $x \in [(p_t - c_c)^{1/\rho_c},\ 1 - (1 - p_t - c_{d,t})^{1/\rho_d}]$ from which D may choose. By providing a credible threat of intervention when $x_g \notin p_0 \pm c_g$, D is presented with an alternative exit option from the bargaining process with a known and efficient value.[74] When that utility is greater than the maximum that can be derived from the bargaining process, D provokes bargaining failure irrespective of the presence of a dynamic commitment problem or a nominally-acceptable bargaining range.

Theorem 7 (Moral Hazard) *If $x_g < p_0 - c_g$ and $x_g < (p_0 - c_c)^{1/\rho_c}$, D induces bargaining failure and provokes intervention regardless of C's decision whether or not to nuclearize.*

The scenario of moral hazard is not of direct interest to this research, but it is a necessary consequence of the shadow of great-power intervention. Whenever an actor has the ability to provide protection to one side in a bargaining process, it can induce riskier behavior on the part of the protected actor. When x_g is high, that protection allows C to strictly prefer a strategy of pursuing nuclear weapons. The challenger is protected from the possibility of

[73]Moral hazard results from the creation of insurance policies against non-preferred outcomes (cf. Arrow 1963; Pauly 1968). In this scenario, G is providing insurance against bargaining failure when it can credibly threaten to intervene. The provision of insurance is welfare-improving for the second-tier dyad (as it results in the efficient outcome); however, the presence of this insurance against inefficient outcomes may induce riskier behavior—and therefore a greater use of the insurance—than is strictly necessary given the rate of bargaining failure in the absence of the insurance policy.

[74]In a situation of complete information, $U_D(x_g) = (1 - x_g)^{\rho_d}$.

preemptive warfare by the threat of favorable intervention. However, this effect works in both directions. When x_g is low, it is the defender who is protected both from the effects of its adversary's power transition and from the bargaining process more generally. The same dynamic that allows the challenger to escape the dynamic commitment problem allows the defender to exploit the great power's static commitment.

Examining the intervention conditions described above, great-power intervention is an off-equilibrium behavior. By credibly threatening to affect the dyadic bargaining process in C's favor, G can successfully deter any attempt at preemption by D. When G can intervene, D receives greater utility from preserving the bargaining process and allowing C to successfully pursue nuclear weapons—and the additional bargaining leverage they provide—than by inducing G's intervention. This holds regardless of the advantage Δp that C receives as a result of the nuclear power transition. In contrast, viewing the bargaining process in dyadic isolation shows that nuclearization is only successfully completed when $\Delta p < p'_c - p_0$, when the challenger is already sufficiently powerful. Smaller states are able to successfully acquire nuclear weapons not because of their relative inutility, but because the shadow of great-power intervention deters any countermanding by the threatened defender.

Theorem 8 (Nuclearization Condition) *If $x_g \geq p_0 + c_g$, C will successfully nuclearize.*

Corollary 9 *If $x_g \geq p_0 + \frac{c_g}{1+\delta}$ and $x_g \geq (p' - c_c)^{1/\rho_c}$, C will successfully nuclearize.*

As can be seen from Table 10, the inclusion of G shifts C's preferences over the initial act of nuclearization. In Γ_0 C exhibits a weak preference for nuclearization under all conditions of the initial distribution of power (and a strict preference for values of $\Delta p < p'_c - p_0$). However, once the dictatorial intervener is allowed to alter the strategic considerations within the dyad, C exhibits this same preference only for the range $x_g \geq p_0 + c_g$ (or $x_g \geq p_0 + \frac{c_g}{1+\delta}$ if $x_g \geq (p' - c_c)^{1/\rho_c}$), where the great power is sufficiently biased in favor of the challenger vis-à-vis the *status quo ante* that it deters any form of preventive attack on the challenger's

Table 10: Three-Player Nuclearization SGPE as a Function of Great-Power Ideal Point

$x_g \in$	Outcome
$[p_0 + c_g,\ 1]$	Challenger nuclearizes
	Challenger strictly prefers N to $\neg N$
$[p_0 + \frac{c_g}{1+\delta},\ p_0 + c_g)$	Challenger nuclearizes if $x_g \geq (p' - c_c)^{1/\rho_c}$
	Bargaining failure if $x_g < (p' - c_c)^{1/\rho_c}$
	Challenger weakly prefers N to $\neg N$
$[p_0 - c_g,\ p_0 + \frac{c_g}{1+\delta})$	Bargaining failure at $t = 1$
	Challenger is indifferent between N and $\neg N$
$[0, p_0 - c_g)$	Moral Hazard if $x_g < (p_0 - c_c)^{1/\rho_c}$
	Challenger is indifferent between N and $\neg N$

For $\Delta p < p'_c - p_0$, bargaining failure never occurs for $x_g \in p_0 \pm c_g$, leaving the Challenger with a weak preference for N over $\neg N$ in these domains.

nuclear program. This is the only condition under which nuclearization should be observed empirically.

For the subset of domains $x_g \in [p_0 - c_g,\ p_0 + \frac{c_g}{1+\delta}]$, there is no meaningful intervention, as G prefers to allow bargaining failure fix the distribution of benefits rather than pay the cost itself of doing so. As a result, for values of x_g in this domain, the shadow of great-power intervention does not affect the bargaining process away from the dyadic game in isolation.

Lastly, for sufficiently low values of $x_g < p_0 - c_g$, a moral hazard exists. Whereas sufficient bias toward the challenger deters any preemption, sufficient bias toward the defender induces this form of aggression. The apparent promise of support from the great power allows D to provoke bargaining failure at the earliest possible opportunity in order to move the distribution of benefits from $q = (p_0 - c_c)^{1/\rho_c}$ to x_g.[75] Again, this moral hazard exists irrespective of a future dynamic commitment problem, and so C's decision to nuclearize is moot in determining the equilibrium state here.

[75] If $x_g > q$, this scenario does not characterize moral hazard, but rather the previous condition of failure in the absence of intervention.

Empirical Implications

The dyadic and triadic models provide two different perspectives on the behavior of states in anticipation of a change to the distribution of power. While simplifications of reality, theoretical models provide powerful explanations of the causal logic behind behavior—both observed and unobserved—and provide expectations of behavior by rational states. Three implications are derived from the dyadic model Γ_0.

Implication 1 War should not occur between two states given a static distribution of power.

Implication 2 Preemptive war should occur in anticipation of an event that changes the distribution of power in a sufficiently large and rapid manner, but should not occur for sufficiently small or gradual changes in the distribution of power.

Implication 3 States are naturally incentivized to pursue nuclear weapons under all possible changes to the distribution of power.

The first two implications are consistent with the existent literature on bargaining theory and commitment problems (cf. Debs and Monteiro 2010), while Implication 3 is drawn from a comparative analysis of subgames varying the challenger's decision to pursue nuclear weapons. If bargaining were indeed conducted in dyadic isolation, all states that have the ability to pursue nuclear weapons should take that strategic choice. However, very few states have attempted to pursue nuclear weapons, and even fewer have succeeded in acquiring them.

The refinement described in Γ_1 conditions dyadic behavior on the shadow of great-power intervention in the bargaining process. This splits the challenger's incentives over nuclearization. When great-power preferences are sufficiently biased in favor of the challenger, nuclearization can be successful, and the challenger's strict preference for nuclear weapons is carried over from the dyadic into the triadic bargaining process. However, where that bias does not exist, second-tier states are indifferent over the possible outcomes of the bargaining process. This results in the following implications:

Implication 4 Nuclearization will not occur if the great power's preferred distribution of

benefits is sufficiently similar to the *status quo*.

Implication 5 Nuclearization is less likely to occur when the costs of intervention are high or when the great power's shadow of the future is sufficiently short.

Implication 6 A state is more likely to procure nuclear weapons without incident when the great power is sufficiently biased in its favor.

Nuclearization—especially successful acquiring of nuclear weapons—should be seen most often among the second tier of states where the challenger is under the patronage of a great power that is relatively unencumbered in its dealings with the international community. As the great power becomes more constrained through higher costs of intervention, the range of protégé states whose nuclear weapons programs can remain under its protection decreases. However, extreme bias in favor of a challenger should be sufficient to shield its domestic pursuit of nuclear weapons from external challenge.

This finding runs contrary to the conventional wisdom that alignment with a much stronger state should exert a deterrent effect on nuclearization. While armament and alliances are substitutes for each other, the patron's ability to deter its client's domestic armament. When the patronage is *de facto* (based on natural alignment between the patron and client) rather than *de iure* (based on a formal alliance), the patron cannot credibly threaten to separate itself from the client, removing a key means of compellence (cf. Leeds 2003*b*). Additionally, increased client capabilities reduces the expectation of direct support from the patron. This serves as an incentive for the patron to acquiesce to domestic armament by its clients. Having induced the protection necessary to succeed in nuclearization, the client state is less likely to demur from increasing its own capabilities.

Strategic interactions rarely take place in isolation from external factors. This chapter explains how the dynamic commitment problem resulting from the pursuit of nuclear weapons can be "resolved" through the shadow of great-power intervention. Extended deterrence prevents retaliation against a protégé, providing sufficient protection to bring a nuclear-weapons program to completion. However, in the absence of this protection, attempts at nucleariza-

tion are met by direct action when the perceived costs of tolerating proliferation are too high. The absence of the dynamic commitment problem in a large number of second-tier attempts at nuclearization is a function of this great-power patronage, while the few cases that resulted in military action reveal attempts at undermining the nonproliferation regime without the support of a larger state.

Historical Illustrations

While there are few historical cases of middle-power nuclearization that have come to fruition, they provide concrete support for overcoming the commitment problem by way of great-power deterrence. Israel, India, Pakistan, South Africa, and North Korea have all developed nuclear weapons capacities, in part dependent on the protective shadow of great-power intervention. However, seventeen other states (cf. Levite 2003) have had serious attempts at nuclear-weapons or dual-use research, but have not attempted to cross the threshold of nuclearization because of a lack of great-power support. The cases of Pakistan and Egypt help to illustrate the two deterrent effects of the shadow of great-power intervention on the commitment problem of nuclearization.

Pakistan: A Case of Preemption Deterred

Pakistan's interest in a nuclear program began shortly after its independence, with the 1954 US-sponsored "Atoms for Peace" program. While the program (and Pakistan's newly-formed Atomic Energy Commission) did have a legitimate interest in augmenting the country's insufficient conventional energy sector, the government remained ambiguous on its official policy vis-à-vis weaponization. While the military government initially vetoed the pursuit of a domestic nuclear weapons program, concerns about India (already the conventionally-superior military force in the region) led to a deterrence orientation by the

late 1960s (Kapur 1987). Constrained by immediate military concerns in Kashmir, Pakistan did not make nuclearization a national priority until after the *Smiling Buddha* nuclear test in 1974 (Marwah 1981; Ahmed 1999). "After the Indian explosion, however, the nascent Pakistani weapons program had to move forward according to the realist view: facing a recently hostile neighbor with both nuclear weapons and conventional military superiority, it was inevitable that the government in Islamabad would seek to produce a nuclear weapon as quickly as possible" (Sagan 1997: 59).

The first signs of Pakistan's move toward weaponization came in 1977, as the United States and IAEA became aware of Pakistani reprocessing and enrichment activities.[76] By 1983, Pakistan was sufficiently-close to a weapons capability, which it probably acquired shortly thereafter. (Pakistan maintained a position of strategic ambiguity about its nuclear capability until it conducted test explosions in 1998, so it is uncertain when exactly it acquired its nuclear weapons capability.) This was achieved largely with the assistance of China, itself a nuclear weapons state and—like Pakistan—an adversary of India.[77] Since then, Pakistan has developed an arsenal of approximately sixty nuclear weapons with regional range, which is believed to be a larger arsenal than India's at approximately fifty weapons.[78]

Why then did India, which had achieved its first nuclear capacity at least ten years prior, not preempt the Pakistani nuclear program? According to Kapur (1987), India had sufficient conventional capabilities to suppress the Pakistani military, as it had in earlier conflicts (cf. also Arquilla 1997). However, it could not overcome the Chinese, who had aligned with Pakistan against India since the Sino-Soviet split in the 1960s. The 1962 Sino-Indian border war helped to confirm Pakistan's acknowledgment of China's aversion to

[76]U.S. Embassy, Vienna, "[SECRET] Pakistan Nuclear Issue: Briefing of IAEA Director General Eklund." 9 July 1977. `http://www.gwu.edu/~nsarchiv/NSAEBB/NSAEBB114/chipak-4.pdf`. Government documents for this subsection are found in Burr (2004).

[77]U.S. Department of State, "[SECRET] The Pakistani Nuclear Program." 22 June 1983. `http://www.gwu.edu/~nsarchiv/NSAEBB/NSAEBB114/chipak-11.pdf`.

[78]Federation of American Scientists, "Status of Nuclear Weapons States and their Nuclear Capabilities." `http://www.fas.org/nuke/guide/summary.htm`.

the pro-Russian regime in Delhi.[79] Over the following twenty years, China provided both technical and material assistance to the Pakistani nuclear program, consisting of transfers of highly-enriched uranium and enrichment infrastructure, in the attempt to balance against India (Ahmed 1999).[80] China's position clearly indicated that Pakistani nuclearization would be beneficial for the regional alliance as well as for the furtherance of "revolutionary change that would work to the benefit of the Third World."[81] While Pakistan could not entice China to collaborate on the 1965 or 1971 Indo-Pakistani conflicts, the possibility of regional destabilization meant that the Chinese provided a latent deterrent while Pakistan developed its own nuclear capability (Arquilla 1997). Despite India's dyadic superiority, it was unable to overcome Pakistan's alliance with the superior Chinese forces.

Factions within the Indian political establishment—while recognizing Pakistan as an enduring rival—were most concerned about the expansionist role of China in South Asia (Hedrick 1999; Karnard 2002; Bajpai 2007). China and India had been involved in a rivalry for regional dominance since 1949, as the only two large states in south and south-east Asia. The Indo-Pakistani conflict, derived from the 1947 partition, was initially unrelated to the Sino-Indian rivalry; however, the two became linked in the context of regional balancing: China's assistance to and cover for the Pakistani nuclear program is, in hindsight, a clear sign of that intent. Given the intimate connection between the Pakistani nuclear program and China's patronage, India could not disentangle its two rivals. To risk preemptive action against the nascent Pakistani program would entail bringing the Sino-Pakistani relationship to the conflict's front (Garver 2001). As a result, India largely conceded to Pakistan the development of a nuclear arsenal. The one time that India did threaten action (the 1987 ex-

[79] [SECRET] Letter from Thomas Hughes, Director of Intelligence and Research, U.S. State Department, to William F. Raborn, Director of Central Intelligence. 21 July 1965. `http://www.gwu.edu/~nsarchiv/NSAEBB/NSAEBB114/chipak-1.pdf`.

[80] See also U.S. Embassy, Beijing, "[SECRET] Cable to Secretary of State." 18 December 1982. `http://www.gwu.edu/~nsarchiv/NSAEBB/NSAEBB114/chipak-9.pdf`.

[81] U.S. Department of State, "[SECRET] Classified Report to Congress on the Non-Proliferation Policies and Practices of the People's Republic of China." 18 September 1997. `http://www.gwu.edu/~nsarchiv/NSAEBB/NSAEBB114/chipak-26.pdf`.

ercise named "Brasstacks," the largest military maneuver since World War II), it was too late to effect change. Through both diplomatic channels and public media, Pakistan acknowledged its nuclear weapons capability, a shocking response to the Indian strategy of regional intimidation (Ahmed 1999).[82] This news brought Brasstacks to an abrupt conclusion—the window of opportunity had passed India by.

The Pakistani case provides illustration that pressure by a great power can deter attempts to preempt middle-power nuclear programs. Whereas Pakistan had been militarily inferior to India since the partition of the former British colony, China had a clear interest in expanding Pakistan's power vis-à-vis their common enemy. This interest manifested itself not only in the assistance provided to the Pakistani nuclear program, but in the protection that China gave to its client, via the threat of intervention in an Indo-Pakistani conflict. Unable to resolve the realignment by use of overwhelming force, India was forced to accept a degree of increased Pakistani influence in the region. Though it had been dominant in the first forty years of their dyadic relationship, since 1987 India has been forced into a scenario that more closely resembles the mutual nuclear deterrence of the great powers.

Egypt: A Case of Nuclearization Deterred

Egypt also developed its interest in nuclear energy through its participation in the "Atoms for Peace" program during the 1950s, toward the beginning of the Nasser regime. However, military applications were not Egypt's principal concern until 1960, when the regime became aware of Israel's Dimona reactor and the military direction of its neighbor and rival's nuclear program (Quester 1983; Rublee 2006). The Egyptian nuclear weapons program was therefore a direct challenge to that of the Israelis, who had bested the combined Arab armies during the 1948 war. The defeat of the Egyptians—who were for centuries the political center of the Muslim world—moved the regime toward a militarized perspective on nuclear energy in

[82]Kuldip Nayyar, "Pakistan Has the Bomb," *The Tribune* (1 March 1987).

an attempt to reclaim the mantle of political importance (Gerges 1995; Levite 2003; Rublee 2006).

However, the Egyptian nuclear weapons program was plagued by early failures. By the 1967 war, Cairo was no closer to developing a weapon than it was seven years earlier (Rublee 2006). The Israelis, on the other hand, were believed to have already created a number of nuclear weapons and had solidified the domestic production of such weapons.[83] Furthermore, the United States came to ally itself with Israel only in the aftermath of the 1967 war (Ben-Zvi 2007). As the CENTO initiative to contain Soviet influence in the Middle East fell through, the United States came to focus more on its alliances with Israel and Iran, while fearing the revolutionary pan-Arabism of the Nasser regime.

The traditional framework of mutual deterrence would indicate that Egypt would further expand its nuclear weapons program, given its inability to defeat the Israelis conventionally. However, American involvement in the Middle East—biased as it was in the context of Cold War containment—led the Sadat regime to renounce its militarized nuclear program (Siler 1992; Levite 2003). While the United States was biased toward the Israelis, it had hoped to resolve the regional conflict so as to turn its attention toward the Soviet Union. Bar-Joseph (1982) argues that the Soviet Union was similarly not interested in escalating the Arab-Israeli conflict toward nuclear war. "Sadat knew that any alliance with the United States would require complete abandonment of the nuclear program. *The expectations and diplomacy of global powers can make a difference*, if the state in question values the alliance more than the nuclear weapons program" (Rublee 2006: 561, emphasis added). Through the use of selective incentives, both positive (a security guarantee vis-à-vis Israel) and negative (threats to withhold economic assistance, as well as technological embargoes), the United States was able to deter Egypt from the escalatory path of nuclearization (Levite 2003).

[83]Special National Intelligence Estimate 4-1-74, "[TOP SECRET] Prospects for Further Proliferation of Nuclear Weapons." 23 August 1974. `http://www.gwu.edu/~nsarchiv/NSAEBB/NSAEBB240/snie.pdf`. This document is found in Burr (2008).

The 1973 war was the final blow to Egypt's designs for a nuclear weapons program. During this war, the United States came to the support of Israel despite the threat of Soviet escalation and an Arab oil embargo. This show of resolve to keep Israel at the top of the Middle Eastern hierarchy led Sadat to view the nuclear program as a one-time bargaining chip rather than as an instrument for increasing Egypt's share of the dyadic distribution of power (Rublee 2006). The lengths to which the United States risked its own interests to support Israel (cf. Blechman and Hart 1982) made it clear that the (highly-difficult) process of nuclearization would not result in concessions from Israel, but in further violence. After losses in 1967 and 1973, as well as the "war of attrition" in 1970, the cumulative costs of war and the observance of direct US assistance to Israel led Egypt to abandon this method of technological growth. Rublee notes:

> Sadat decided that it was in Egypt's best interest to give up the nuclear program and used it as a tool to bargain with the United States after the 1973 war with Israel. Sadat promised to ratify the NPT and give up Egypt's nuclear ambition for good if the United States would aid Egypt—a deal that Washington accepted. From 1974 to the present, Egypt has remained true to its promise, embracing the nuclear nonproliferation regime and energetically participating in it, hoping to force Israeli movement on the nuclear issue (2006: 556).

While unable to reverse the distribution of power entirely, Sadat was able to garner enough American support through this diplomacy to regain the Sinai peninsula from Israel in 1979, and to cement Egypt's position as the leader of the Arab negotiating bloc vis-à-vis Israel for a generation.

The theory of great-power intervention provides support for why Egypt ended its nuclear weapons program after thirteen years. As the United States moved from Egyptian ally during the 1950s to an aloof observer in the 1960s to the advocate of Egypt's regional enemy from 1967 onwards, the opportunities to revise the distribution of power away from Israel began to falter. Part of this was due to direct interdiction efforts (cf. Gregory 1995); however,

the political intent to nuclearize was clearly present until the United States had signaled its willingness to absorb costs to maintain a pro-Israel *status quo*. Having suffered severe costs during each attempted revision, Egypt was rationally incentivized to avoid provocation and accept the distribution of power as it was, while exploiting available opportunities to marginally alter the distribution of benefits.

Conclusion

The technological shock of nuclear proliferation drastically changes the distribution of power among second-tier states, with consequences for the division of benefits among them in the international system. This chapter has shown that—when treated in dyadic isolation—the appropriate response to second-tier nuclearization is preemptive military action, which preserves the *status quo ante*. However, military action is not a dominant strategy when a proliferating state is under the protective shadow of a great power. In cases where a great power is biased in favor of the potential proliferator, the threat of intervention may be sufficient to overcome the dynamic commitment problem. States facing a relative decline opt for the "lesser of two evils" resulting from their adversary's acquiring nuclear weapons.

Policymakers should be particularly attentive to the role of great power preferences in incentivizing nuclear proliferation. As potential proliferators are more closely-aligned with a great power patron, they ensconce themselves in their patron's rationally-extended deterrence, becoming more insulated from the consequences of the dynamic commitment problem. Conversely, as great powers are more neutral in their approach to second-tier interactions, endorsing a *realpolitik* distribution of benefits in line with the underlying distribution of military capabilities, the benefits of nuclearization to a potential proliferator become less apparent. This same effect occurs as the great power becomes less capable of providing protection to its clients (through increased costs of intervention). While focusing nonproliferation efforts directly at the state pursuing nuclear weapons has been a common-sense approach for the last forty years, this chapter shows that the behavior of proliferators' adver-

saries and protectors are intimately related to the success of any nuclearization effort, and that a more comprehensive and inclusive approach to nonproliferation is needed to address the causes of nuclearization success.

Several characteristics of this relationship remain to be elaborated. The model presented in this chapter accounts for a single great power with defined interests that are commonly-known. However, there are several states capable of intervening in the second tier that comprises current and future cases of nuclear proliferation. These states will not always have similar interests, and the aggregation of multiple opposing interveners may lead to an escalation of regional conflicts (as was the case during the Cold War) or mutual deterrence, which would allow second-tier interactions to play out as if in isolation. This latter case is possible even when there is not a conflict of interest, as Gent (2007) describes. Additionally, information problems resulting from this aggregation may lead to other forms of bargaining failure.[84] Even with a single great power, how its preferences on multiple issue areas are translated over a second-tier dyad is an unresolved question.

This chapter provides a first attempt to bring the bargaining dynamic of nuclear proliferation out of the dyadic context. The world in which superpowers negotiate in isolation over the structure of the international system is gone; however, the great powers play an important role in structuring the interactions of the second-tier, where the proliferation battle is being played out and will continue in the future. Multilevel strategic interactions are not well-examined in contemporary research, but will become more necessary as the number and types of important actors continues to multiply in the international system.

[84]cf. Wolford, Reiter and Carrubba (2011).

Chapter 3

Great-Power Protection and Nuclearization Outcomes

Attempts at nuclear proliferation have led to varied results over the past forty years, with eight states successfully acquiring nuclear weapons since 1950 out of twenty-two attempts: a success rate of 36%. The previous chapter of this dissertation has explained the variation in this success as a result of great power preference, which shields potential proliferators from the dynamic-commitment effects of nuclearization. As nuclear weapons increase the military capabilities of a state, rivals seek to exploit the momentary advantage in conventional capabilities to prevent nuclearization through preemptive action; this behavior should be the equilibrium in isolation. However, when larger states credibly threaten to intervene on behalf of proliferators, this extended deterrence prevents preemption, allowing for the eventual successful weaponization of nuclear technology.

Nuclear weapons are of fundamental concern for the international community less for their *sui generis* radiological characteristics than for the sheer, concentrated firepower delivered by each individual weapon. Brodie notes that nuclear weaponry operates on an entirely different plane than do conventional weapons:

> It should be obvious that there is much more than a logistic difference involved between a situation where a single plane sortie can cause the destruction of a city like Hiroshima and one in which at least 500 bomber sorties are required to do the same job... [T]he 500 or more bombers needed to do the job under those circumstances would if they were loaded with atomic bombs be physically

> capable of destroying 500 or more Hiroshimas in the same interval of time (1946: 27).

Given that nuclear weapons—while cheaper than a conventional equivalent—are expensive and technologically-sophisticated creations, they require substantial investment prior to a state's establishing a domestic production capability. This leaves adversaries with an important political decision: knowing that nuclear research eventually leads to a dramatic shift in relative power, does one take military action in the present to prevent the shift from occurring? Preemptive war, while expensive, may be preferable to allowing an adversary to acquire new means of power. Organski (1958) argues that anticipation of relative decline could be a sufficient cause of war, and Powell (2004, 2006) found such behavior to be rational when the shift in power would be sudden, as technology-driven nuclearization would be.

Why then do some states acquire nuclear weapons without difficulty (though perhaps in perilous diplomatic environments) while three states have collectively suffered a dozen instances of preemptive counterproliferation?[85] Preemptive war is not solely due to anticipating nuclearization, but is conditional on the context in which nuclearization is to occur. The first nuclear states acquired their weapons in short succession during the early Cold War, at a point in history when neither had a taste for military conflict (Gaddis 1972; Craig and Radchenko 2008). More importantly, there was no other state that had the capability to prevent the United States or the Soviet Union from acquiring nuclear weapons.[86] The superpowers were the undisputed leaders and architects of the post-war international system. However, each additional state to pursue nuclear weapons came from a tier of less-powerful states that was forced to operate in a system dominated by these (and, later in the Cold-War era, other) great powers. Instead of the anarchic system of 1945 and 1949, later nuclear states contended with an international environment influenced by the first tier of powerful states.

[85] cf. Table 11.

[86] Combined, the United States and Soviet Union possessed half of the world's military capability between 1945–1949; cf. Singer, Bremer and Stuckey (1972).

In such an environment, states must take into consideration the possible actions of these great powers when determining their own interactions. When great powers have both a stake in the outcome of an external dispute and the capability to influence its outcome, they can intervene meaningfully (Werner 2000; Gent 2007). The decision to do so is a function of both the great power's preferences over a dispute outcome and the costs associated with intervention. First, preference structure determines whether a second-tier state's acquisition of nuclear weapons would serve or undermine the interests of the great power.[87] If a client state is overvalued—that is, less powerful than it is important—nuclear weapons technology can provide capabilities matching the great power's level of interest. Second, the costs of intervention reflect the level to which a powerful state can impose its will on external political processes. Low-cost interveners are more sensitive to outcomes, *ceteris paribus*, and more willing to overtly support their clients. Conversely, high-cost interveners are willing to tolerate a larger range of suboptimal outcomes, but will nonetheless involve themselves when core interests are at stake. The continuous dimension of great-power patronage can be evaluated as a binary categorization: those states that are *protected* by a great power, and those that are *unprotected* by a first-tier state.

The first category, that of a *protected* client state, is an example of extended deterrence.[88] When a client state's interests are sufficiently aligned with that of its patron great power, it can be expected that the patron will take action to protect their shared interests. This is possible even without risk manipulation; Danilovic (2001) shows that "intrinsic [foreign policy] interests," such as the maintenance of client or bloc position in the system, lead to inherently credible extensions of the great power's commitment. Client states that remain within the embrace of extended deterrence can leverage their patron's power in order to extract concessions from adversaries—something that could not occur in isolation—and can result in either temporary or permanent gains. The acquisition of nuclear weapons, a

[87]Coe and Vaynman (2011) argue that allies' nuclearization was considered a military advantage until the 1960s, at which point proliferation became seen *in se* as a strategic liability.

[88]cf. Huth (1988*a*).

military game-changing transformation, can occur without preemption when done by such a protected state. The moral hazard inherent in extended deterrence regimes may induce nuclearization even if that specific activity is grounds for disagreement between patron and client (Snyder 1984). While great powers no longer see nuclear proliferation to clients as a strategic advantage, a sufficiently-strong foreign policy alignment may lead to proliferation being overlooked.[89]

The second category, that of an *unprotected* state, includes both those second-tier states that are opposed by great powers and those that fall through the cracks of great-power politics. In the former case, great-power pressure can be applied against a potential proliferator. Schelling (1960, 1966) notes that the threat of coercive force may be sufficient to prevent an offending action from being taken; therefore, cases of unprotected proliferation in opposition to a great power are most likely to appear as "non-events." Without the initial pursuit of nuclear weapons, later bargaining problems related to power transition will not occur. In the latter case, a great power is unwilling to exert pressure either in favor of the proliferator or against it. As described above, two mechanisms can render the threat of great-power intervention non-credible: actual indifference and expense. To the extent that the great power is actually indifferent over the outcome of a power transition, the less likely it will desire naturally to become involved in a conflict to which it is external. Similarly, the more expensive that exerting such pressure would be, the less likely the great power will desire to exert pressure to resolve the conflict (that is, relative to the opportunity cost of exerting pressure elsewhere). These two mechanisms are at odds with one another. The less expensive a potential intervention would be, the more a great power can engage in conflicts to which it has little stake. Conversely, the more expensive a potential intervention would be, the greater the stake necessary to justify involvement. In both cases of attempted proliferation by an unprotected state, the same outcome is likely to be observed: the proliferation process will be frustrated by the threatened or actual use of preemptive force.

[89]cf. Coe and Vaynman (2011).

Second-tier states conduct their strategic calculus within the context of their relationships with the great powers. Potential nuclear proliferators can achieve success only when the deterrence extended by a great-power patron protects the proliferator from preemptive military action by other rivals. Without this protection, the natural anticipation of changes to the distribution of power not only make preemptive war possible, but a rational choice by any state that stands to lose from this successful instance of proliferation. The states most likely to be successful at pursuing and acquiring nuclear weapons are therefore those positioned closely within the alliance structure of one of the great powers.

Table 11 presents the four categories of potential cases that can be used to examine this theory. The first column, comprising twenty-eight states, includes all states that possess the technological capabilities for domestic production of a nuclear weapon, but choose not to do so for political reasons (Jo and Gartzke 2007).[90] The second category contains seventeen states that at some point considered or pursued a domestic nuclear option. Two of these states—Iran and Syria—still have active nuclear weapons programs as of 2011. The third category includes the twelve instances in which pursuit has led to a direct military strike against nuclear weapons facilities by an external actor—eight instances during the Iran-Iraq War, the Osirak (Iraq) bombing by Israel in 1981, two instances during US operations against Iraq in the early 1990s, and the Deir ez-Zour (Syria) bombing by Israel in 2007 (Kreps and Fuhrmann 2011).[91] The last column includes the successful instances of nuclearization.

The theory of great power protection is most helpful in understanding the cases of nuclear preemption and successful nuclearization. In these categories, the proliferator's commitment to nuclear pursuit is consistent throughout the program's duration. (Conversely, cases of

[90]Trachtenberg (1999) and Richter (2002) note that many states in Western Europe received physical possession of American nuclear weapons as part of NATO, and that nuclear sharing activities bordered on explicit proliferation in some cases. However, by 1970 at the latest, all NATO nuclear sharing states were capable of domestic production as well.

[91]This excludes several confirmed cases of nuclear preemption during World War II— prior to any awareness or understanding of the political ramifications of nuclear weapons on the international system.

Table 11: List of Potential Nuclearization Cases, 1950–Present

Nuclear-Capable, No Pursuit		Explore or Pursue		Preemption		Nuclear Weapons States	
Canada	1947–1980	Norway	1946–1947†	Iraq (Iran)	1980	United Kingdom	1952–Pres.
Belgium	1958–1993	Switzerland	1946–1969†	Iraq (Israel)	1981	France	1960–Pres.
E. Germany	1959–1990	Brazil	1953–1990	Iran (Iraq)	1984	China	1964–Pres.
Czechoslovakia	1959–1992	Yugoslavia (1^{st})	1954–1965†	Iran (Iraq)	1985	Israel	1972–Pres.
F.R. Germany	1959–2001*	Sweden	1954–1969	Iran (Iraq)	1985	India	1974–Pres.
Poland	1960–2001*	Australia	1956–1973†	Iran (Iraq)	1986	South Africa	1979–1993
Spain	1960–2001*	S. Korea	1959–1978	Iran (Iraq)	1987	Pakistan	1990–Pres.
Hungary	1961–2001*	Egypt	1960–1974†	Iran (Iraq)	1987	North Korea	2006–Pres.
Italy	1963–2001*	Taiwan	1967–1977	Iran (Iraq)	1988		
Japan	1963–2001*	Argentina	1968–1990	Iraq (USA)	1991		
Finland	1964–2001*	Libya	1970–2003	Iraq (USA)	1993		
Portugal	1964–2001*	Yugoslavia (2^{d})	1974–1992†	Syria (Israel)	2007		
Turkey	1964–2001*	Iraq	1976–2003				
Denmark	1967–1985	Algeria	1983–Pres.†				
Bulgaria	1967–1997	Iran	1984–Pres.				
Colombia	1967–1999	Romania	1985–1989†				
Austria	1970–1984	Taiwan	1987–Pres.†				
Greece	1970–1986	Syria	2001–Pres.				
Mexico	1970–1996						
Chile	1977–1989						
Philippines	1980						
Peru	1985–1990						
Thailand	1985–1991						
Indonesia	1989–1999						
Kazakhstan	1992–2001*						
Ukraine	1992–2001*						
Czech Republic	1993–2001*						
Uzbekistan	1995–2001*						

* Right-censored at 2001.

† Never formally pursued a nuclear weapons program, but "seriously considered... developing nuclear weapons without following through with their plans" (Singh and Way 2004: 867). These states are included as "borderline" cases.

abandoned pursuit indicate that cost-benefit calculations in themselves undermined government commitment, without necessitating external direct action. Cases where no pursuit occurs indicate that these calculations occurred even earlier in the nuclearization process.)[92] Domestic decisionmaking is central to these early-term outcomes; however, once a state's policy on nuclearization is internally (domestically) consistent, external factors will drive the program's eventual success or failure.

Many long-running nuclear weapons programs were incentivized by enduring conventional rivalries. Sagan (1997) notes that proliferation tends to follow a "snaking" domino effect: pursuit is a response to an adversary's acquisition, and therefore exhibits a contagious effect. Pakistan developed its nuclear arsenal in response to India's own nuclear weapons (Ahmed 1999). Brazil and Argentina escalated their regional rivalry by pursuing nuclear weapons (Gorman 1979). Israel developed nuclear weapons to counter massive Arab armies in the 1960s; since then, many Arab states (as well as Iran) justify their own interest by the Israelis' undeclared arsenal (Jouejati 2009; Mukhatzhanova 2010). However, some of these rivalries result in preventive military action against nuclear programs, while others do not. The dyadic level is insufficient for explaining the divergence of late-term outcomes. In isolation, rivals ought to prevent any sufficiently-large change in the distribution of power.

Instead, the dyadic relationship is conditioned by its position within a great-power-led system. Proliferators that operate under the protection of a great power are insulated from many of the consequences of their actions. Extended deterrence is thought to be a substitute for armament: the comparison of external versus internal balancing.[93] This argument finds mixed support in the quantitative and historical literature.[94] However, this argument ignores the moral hazard presented by extending a deterrent umbrella over third parties.[95] Where

[92]cf. Siler (1992); Cole (1996); Forland (1997); Rublee (2006).

[93]cf. Powell (1999); Bajema (2010).

[94]For quantitative analyses of the causes of nuclear proliferation, see Singh and Way (2004); Jo and Gartzke (2007); Fuhrmann (2009); Bleek (2010). Excellent historical case studies include Cole (1996); Forland (1997); Rublee (2006); as well as the compilation edited by Potter and Mukhatzhanova (2010).

[95]Arrow (1963); Pauly (1968); cf. also Bunn and Timerbaev (1993); Kydd (2010).

a state enjoys credible external protection (and when there is no credible mechanism to end that protection), actions that would normally encompass a higher risk of war—such as nuclear proliferation—may be insured against possible negative consequences. Feaver and Niou (1996) note that great powers will support (or at least acquiesce to) proliferation when doing so maximizes their own national interests. Conversely, where there is no great-power interest in the proliferating state, nuclear pursuit is frustrated by either domestic or international political processes (including military action).

The cases of India and Syria help to illuminate the role of great-power preferences in affecting nuclearization outcomes. Both states were mid-level, regional powers, engaged in an extended rivalry with a neighboring state. However, their placement within the international system differed substantially. After the Sino-Soviet split in the early 1960s, India became increasingly connected to the Soviet Union, which provided both technical assistance and political cover to its new client in Asia. As a result, New Delhi was able to acquire a nuclear weapons capability within fifteen years without suffering significant escalation from its regional adversary, China. India's nuclear weapons program served as a complement to its military alliance with the Soviet Union. As it became closer to a technological coup that would change the regional balance of power, a greater political and military relationship with its great-power patron extended a deterrent against preemptive military action, protecting this power transition from an anticipatory strike. Syria, another state within the Soviet sphere of influence, found itself grasping for assistance in the early 1990s, during the post-Soviet retraction. Unable to acquire substantial support from either Russia or China due to the geopolitical conditions of the period, Damascus turned to the nuclear black market, acquiring technology from both the Abdul Qadeer Khan network[96] and North Korea. Neither of these could provide political protection, leaving Syria vulnerable to military attack by its

[96]Abdul Qadeer Khan, the father of Pakistan's nuclear weapons program, later turned to underground sales of sensitive nuclear technology. With his assistance, Iran, Iraq, Libya, North Korea, Syria, and Saudi Arabia—and possibly other states—acquired technological skills and matériel necessary to support a nuclear weapons program. Khan's network was dismantled in 2004–06 by US intelligence activities, but the full extent of its proliferation activities are not yet known (cf. Clary 2004; Corera 2006).

regional adversary, Israel. Damascus' treatment of nuclear weapons as a substitute for great-power patronage undermined their development. Absent the political cover provided by a strong ally, Syria could not prevent Israel from anticipating the sudden power transition and preempting it with military force. In each case, the presence or absence of great-power patronage was critical to understanding dyadic behavior, including whether or not nuclearization was preempted by neighboring states that stood most to lose.

India: A Case of Protected Nuclearization

India had an advanced civilian nuclear program long before it began thinking of weaponization.[97] However, security concerns related to the 1962 Sino-Indian War and the following 1964 Chinese nuclear tests had an indelible effect on Indian security calculations, by exacerbating already-existing perceptions of the threat posed by China (OSD 1996). Perkovich (1999) considers domestic and moral considerations to be preeminent in India's decisions since the 1960s. The latter served primarily to retard India's full deployment of a nuclear capability, while the former very much incentivized a strong response to the Chinese tests.[98] External security considerations vis-à-vis China (and, to a lesser extent, Pakistan) prompted India to develop nuclear weapons.[99] Despite considerable international concern that India was pursuing nuclear weapons—furthered by its refusal to join the nonproliferation regime—no state took military action against New Delhi's pursuit (Richelson 2006). By 1974, India had conclusively proven its capacity to field a nuclear weapon, although it did not attempt in earnest to create a substantial arsenal until the late 1980s (Jo and Gartzke 2007).

Two events in the early 1960s created the necessary incentives for India to pursue nuclear weapons. The first was the tactical disaster that befell the Indians in the 1962 Sino-Indian

[97]Central Intelligence Agency, "Indian Government Policy on Development of Nuclear Weapon," Intelligence Information Cable, DB-315/01148-64 (24 October 1964), in Richelson (2006).

[98]cf. National Security Council, "The Indian Nuclear Weapons Problem: Current Issues" (9 June 1966), in Battle (2001).

[99]cf. Conley (2001); Bajpai (2003, 2007).

border war (Ye 2003). India's relationship with Maoist China had never been particularly friendly. Border disputes during the 1950s, mostly related to China's territorial claim on greater Tibet, ensured that relations between the two states were dominated by military distrust. China began the 1962 conflict with specific, minimal territorial objectives, and unilaterally ceased hostilities as soon as they were achieved. While the territorial losses were not substantial, the conflict revealed severe Indian military incompetence, and the ceasefire agreement revealed China's gradual alignment with India's other principal rival, Pakistan (Perkovich 1999). Occurring at the same time as the Cuban missile crisis, the 1962 war initially played out without great power involvement; however, both the United States and the Soviet Union eventually provided military equipment to India, which was nonetheless insufficient to change the outcome of the conflict (Ray 1973; Conley 2001).[100] The defeat prompted a great deal of reflection within the Indian military establishment, which decided that both technology and training needed to be augmented in order to prevent a second Chinese victory (Ganguly 1999; Perkovich 1999).

The second event was the 1964 Chinese nuclear test (Bajpai 2003). In the wake of the 1962 defeat and long-time leader Jawaharal Nehru's death, the Chinese nuclear detonation provided a note of urgency to the disorganized Indian government.[101] There was strong popular and media pressure in the aftermath of the test for India to respond in kind, with nearly seventy percent of Indians supporting overt nuclearization after the Chinese test (Chakma 2004).[102] This position was reinforced by Atomic Energy Commissioner Homi

[100]The United States' continued military support to Pakistan during this period further increased India's skeptical reception of American aid, as Washington was seen to be playing both sides of the region; cf. Perkovich (1999).

[101]Nehru, a leader of the Indian National Congress since before independence, was prime minister from 1947 until his death in 1964, five months before China's first nuclear test. Nehru's dominance of early post-independence politics allowed him to impress a moralistic perspective on India's foreign policy (derived from his being a protégé of Mohandas Gandhi), focused on disarmament and Cold war neutrality. However, Nehru also believed in the necessity of a strong and secure state, especially vis-à-vis Pakistan and China (Perkovich 1999).

[102]cf. also Central Intelligence Agency, "India's Nuclear Weapons Policy," Special National Intelligence Estimate, 31-1-65 (21 October 1965), and Central Intelligence Agency, "The Indian Nuclear Weapons Program and Delivery Capabilities," *Scientific Intelligence Digest* (December 1965), both in Richelson (2006).

Table 12: Chronology of India's Nuclear Weapons Program

Sep 1962	Parliament brings nuclear research under central government control, opening door to weaponization research
Oct–Nov 1964	India responds to Chinese nuclear test, initiates move toward "peaceful nuclear explosion"
1966–68	Indira Gandhi formally suspends nuclear weapons research
Early 1968	Indian scientists begin covert work on nuclear weapon construction
12 Jun 1968	India refuses to ratify Nuclear Nonproliferation Treaty
7 Aug 1971	Soviet Union openly declares military alliance with India
18 May 1974	*Smiling Buddha* nuclear test

Bhabha's assertion that India had sufficient technological prowess to make an atomic bomb within eighteen months.[103] Jones notes that Sino-Indian rivalry was founded both in cultural and geopolitical contexts. The ease of China's nuclearization procecss, as well as Beijing's alliance with Pakistan, provided justification for balancing behavior "both in Kautilyan [traditional Indian] and modern [ie. Western] balance of power terms," and posed significant cultural implications if India could not match China's technological leap forward (2009: 131).

These conditions laid the groundwork for India and the Soviet Union to develop a close political and military relationship. The Soviet Union quickly provided security assurances to India after the Chinese nuclear test.[104] While the Soviet Union had provided considerable support to the early Chinese nuclear program, the schism within the Communist *Internationale* led to the abrogation of all prior agreements and the beginning of the Soviet Union's search for a new ally in Asia (Norris, Burrows and Fieldhouse 1994; Perkovich 1999). Kissinger determines that—as a result of the Sino-Soviet split—the vitriol between the Soviet Union's "institutionalized" Communism and China's "revolutionary" brand ensured a race

[103] "Bhabha: India Can Make Atom Bomb in 18 Months," *National Herald*, 5 October 1964, cited in Chakma (2004). This timeframe was similar to that estimated by the United States (twelve months); cf. Central Intelligence Agency, "The Likelihood of Further Nuclear Proliferation," National Intelligence Estimate, 4-66 (20 January 1966), in Burr (2005).

[104] cf. Curtis E. LeMay, "The Indian Nuclear Problem: Proposed Course of Action," Memorandum for the Secretary of Defense, JCSM-900-64 (23 October 1964), especially paragraphs 3 and 4, and "Rough translation of the revised Russian Draft" in US Department of State, Memorandum of Conversation (19 April 1967), both in Battle (2001).

to establish respective spheres of influence in Asia (1974: 38). Moscow's previous hesitation in arming India—a result of New Delhi's non-alignment in the Cold War—was set aside as its relations with Beijing diminished. Within two years of the Sino-Indian border war, the Soviet Union had helped construct military aircraft factories, transferred armor, artillery, and missile technology to India, and concluded several agreements to "solidify its position as India's chief arms supplier," three facts that accompanied a doubling of India's military spending against 1960 levels (Conley 2001: 19).[105] This support, which continued uninterrupted through the 1965 Kashmir War, would reinforce the reliability of the newly-formed Indo-Soviet alliance and cemented India's position within Moscow's embrace (Singh 1984). Over the next ten years, India would procure 75% of its foreign military equipment from the Soviet Union (a total of $1.6 billion), grossly outweighing its purchases from all other international suppliers (ACDA 1975: 71; cf. also Frankel 1986). India would remain the only nonsocialist state to receive military assistance from the Soviet Union during the Cold War (Conley 2001).

The United States' relationship with India during this period can best be described as "estranged" (cf. Kux 1992), and did not factor greatly into the politics of Indian nuclearization. The United States' early move to align with Pakistan after the partition alienated the Indian leadership, and successive US presidents would spend decades trying to extract themselves from that *status quo*. Beginning with the National Security Council's Report 5701 in January 1957, the United States attempted to increase its governmental and military ties with India, only to retreat in the face of Pakistani outrage (Perkovich 1999).[106] However, the cold rapport between Washington and New Delhi did not prevent private sector exchanges; Perkovich notes that "[a]lthough American experts recognized India's capacity to divert its nuclear program into military applications, nonproliferation was a secondary concern [in the early 1960s] to winning nuclear industry 'markets' and containing communist influence in

[105]cf. also Siegel (1968); Ray (1973).

[106]This middling strategy by the United States eventually drove Pakistan to negotiate an agreement with China in 1971.

South Asia" (1999: 49). Parallel to the unfruitful discussions about a security guarantee were technical negotiations between the Atomic Energy Commission and American counterparts to allow the transfer of nuclear knowledge to India under the cover of studying "peaceful nuclear explosions."[107] These diplomatic failures highlighted the difficulties facing the United States of coordinating a global nuclear-nondissemination policy with the economic imperatives of engaging in the civilian nuclear market.

In the face of its relations with the great powers—American ambivalence and a growing Soviet support—there was nonetheless significant hesitation among Indian elites as to whether to complement their internal balancing against China with the pursuit of nuclear weapons.[108] The moral legacy of Mahatma Gandhi and former Prime Minister Nehru's foreign policy—centered on disarmament—provided strong disincentives regarding nuclear proliferation by India (Singh 1971). However, Nehru's death left a policy opening that was filled by conservatives within the ruling Congress Party after the Chinese test; the recent military history between the two countries created an embedded sense of mistrust and the desire to develop nuclear weapons as a counterbalance to China (Chakma 2004).[109] India consistently felt that separate security guarantees proffered by the United States and Soviet Union were inadequate to defend its interests against a nuclear-armed China, although the peculiarities of its foreign policy alignment made a joint declaration by the great powers a nonstarter (Conley 2001).[110]

Prime Minister Shastri's replacement by Indira Gandhi led to the scrapping of nuclear research for a period of four years from 1966–70. However, after failure to gain explicit

[107]US Atomic Energy Commission, "Discussion Paper on Prospects of Intensifying Atomic Cooperation with India," (23 November 1964), and US Department of Defense, "U.S. Nuclear Assistance to Pacific-Asian Countries," Staff Study (4 December 1964), both cited in Perkovich (1999).

[108]US Department of State, "Possible Indian Nuclear Weapons Development," Cable to Embassy New Delhi (29 March 1966), and Central Intelligence Agency, "Indian Nuclear Plans," *Scientific Intelligence Digest* (April 1966), both in Richelson (2006).

[109]cf. also predictions to this effect in Central Intelligence Agency, "Nuclear Weapons and Delivery Capabilities of Free World Countries Other than the US and UK," National Intelligence Estimate, 4-3-61 (21 September 1961), in Burr (2005).

[110]cf. also "India's Nuclear Weapons Policy," *op. cit.*, pgph. 7.

security guarantees led to India's refusal to sign the Nuclear Nonproliferation Treaty, Gandhi reauthorized research toward a nuclear weapon option. This occurred in conjunction with China's first satellite test, accused of being a cover to test ballistic missile technology that could be used against India (Singh 1971; Perkovich 1999). The aftermath of the 1971 Indo-Pakistani war led the Soviet Union to openly declare its alliance with India; a "friendship and cooperation" treaty was signed later that year. While Indian leaders remained wary of shifting great power interests—a legacy of its nonalignment—overt Soviet support was sufficient to crystallize the triangular relationship with China, providing the political cover necessary to move toward weaponization and India's first nuclear tests at Pokhram.

While China was aware of India's pursuit of a nuclear option, it did not take direct action against New Delhi during the first half of the 1970s. Much to the consternation of Pakistan, China's involvement in the war was solely rhetorical (Dutt 1984; Perkovich 1999). Garver (1996) notes that China's *realpolitik* balancing between India and Pakistan was to blame for this. While allied with Pakistan, China did not desire to further aggravate its relationship with India over what was essentially a purely Indo-Pakistani dispute. However, the deterrent value of the Soviet alliance should not be understated. Frankel notes that "[e]mbracing the Soviets was viewed as a necessity to help forestall the possibility of a two-front war with Pakistan and China" (1986: 157). Had the possibility of Soviet intervention in the conflict not existed, China may very well have overtly exploited the Bangladesh crisis in order to preserve its regional dominance (Kapur 1972; Kux 2001).[111] The exclusion of China from the 1971 dispute was furthered by the United States' "nuclear coercion," expressed in deploying the *USS Enterprise* off the shores of Bangladesh during the war (Ladwig 2009). While the United States' actions were directly focused against India vis-à-vis Pakistan, they also served to preempt China's performing this function, which could have been more destabilizing than the American deployment (cf. Kux 1992; Conley 2001).[112]

[111]cf. also Defense Intelligence Agency, "Communist China's Capability to Support Pakistan," Intelligence Appraisal (9 December 1971), in Gandhi (2002).

[112]While the United States was beginning to engage China at this time, it was still wary of any unilateral

Ultimately, a combination of factors led China to accept Indian nuclearization. "[T]he 1971 treaty between Delhi and Moscow [was] seen in Beijing as a serious threat." Additionally, years of technology transfers and military training that led to India's success in the 1971 Indo-Pakistani War had produced a transformed and now-formidable adversary. China could not afford to take offensive action against India under these circumstances, and instead "saw the need to improve relations with its key neighbors," conceding to the reality of the power transition (Sidhu and Yuan 2003: 116–118).[113] While India would remain inferior to China on the nuclear front, its proliferation experience was sufficient to satisfice on security balancing vis-à-vis the Chinese. (India continued to maintain the region's preeminent conventional military force.) This was a direct factor in leading to the normalization of relations between the two states in the 1980s on a parity basis, in conjunction with India's gradual accumulation of a small nuclear arsenal (Garver 1992).

In conclusion, while India faced two rivals throughout the 1960s and 1970s, it was the northern one—China—that incentivized India's nuclearization. Fearing encroachment after a humbling military defeat in 1962 and Chinese nuclear testing only two years later, India forged its nuclear program in fits and starts, struggling with the moral dimensions of nuclear proliferation. However, India was fully aware of the political dimensions of this move, and saw their program as an invitation for further conflict with the conventionally-superior Chinese forces. To neutralize this threat, India pursued and achieved a military defense pact with the Soviet Union as Moscow was shedding its relationship with its ideological cohabitant. It was an alliance of convenience, rather than necessity, but provided each with a needed good: the Soviets once again had a sphere of influence in Asia, while the Indians acquired their shield against Chinese adventurism. This alignment between the Soviet Union and India was sufficient to keep China on the sidelines during the 1971 war—its best opportunity to engage in direct military action against India—and gave sufficient technological and political cover

actions, and was still strongly distrustful of Beijing's motives.

[113]cf. also Sutter (2005).

to New Delhi until the point of its "peaceful nuclear explosion" in 1974.

Syria: A Case of Preempted Nuclearization

Syria's pursuit of a nuclear capability originated in the late 1970s, though technological progress did not take off until after the end of the Cold War. Nonetheless, American concerns about the weaponization of nuclear technology were apparent as early as Damascus' first reactor agreements in the early 1990s (Feldman 1997; Fields 2003). It was this concern for overt nuclearization that undermined early technological gains, such that—when the al-Kibar reactor was bombed in late 2007—Syria had not yet begun domestic enrichment of uranium when the al-Kibar reactor was bombed in late 2007 (NTI 2011*b*). The damage done during the preemptive military strike, as well as the difficulties in regenerating a domestic weaponization program and the international scrutiny resulting from *Operation Orchard* (Israel's military operation to disable the al-Kibar reactor), have likely led the Syrians to abandon or scale back serious weaponization efforts as of present (Kreps and Fuhrmann 2011).

The motivation for Syria to develop nuclear weapons came from three levels: its long-standing competition with neighboring Israel, its broadly-unfavorable position vis-à-vis other regional actors, and its antagonistic relationship with the United States. In the first thirty-five years of their mutual existence, Syria lost three major military campaigns against Israel; the 1967 war resulted in the loss of the strategically-important Golan Heights. Additionally, Syria failed in its proxy war against Israel during the Black September campaign of 1970 (Seale 1988; Ben-Zvi 2007). Thus, Syria could compete with Israel neither directly nor indirectly, and was in need of a technological change to upset the established *status quo*. Jouejati notes that

> Syria's sense of threat springs from Israel's territorial aggrandizement that has been sustained by Israel's U.S.-backed superior conventional military power. That sense of threat is heightened by Israel's nuclear power [since circa 1970]...

> Furthermore, Israel has an active chemical weapons program, including the production of mustard and nerve agents, and a biological warfare capability (2009: 159).[114]

Furthermore, Syria's historical relationships with its other neighbors have been strained to varying degrees throughout the past forty years. Turkey and Jordan are both close allies of the United States. To its east, Iraq presents a different challenge, with both "personal animus" between Hafez al-Asad and Saddam Hussein, as well as "the ideological competition that pitted the two factions of the [Ba'th Party]... in a classic geopolitical rivalry" (*Ibid.*). Lebanon, which provided Syria with a pliable client state, was the only friendly state in the region, until the events of the 2005 Cedar Revolution.

This perception of threat greatly influenced Syria's strategic decisionmaking during the 1970s. The Asad regime saw the Israeli threat as the greatest problem in terms of capability and intent, and saw non-conventional weapons as providing the most efficient means of achieving "strategic parity" with Israel (Tertrais 2008). The Soviet Union was fully aware of the losing environment, and conceded to Asad that Moscow was unable to provide meaningful conventional support (*Ibid.*: 166–167). Left without the protection of its great-power patron, Syria began to depend even more heavily on chemical weapons and missile technology as part of a regional deterrent, and the costs of developing a nuclear option became more palatable (Laipson 2004; cf. also Spector and Berman 2010).

Syria's embrace of nuclear energy was late-coming by regional standards. The Scientific Studies and Research Center—an advanced research office associated with the Syrian military—was established in the early 1970s, and an overt nuclear energy program was established in 1976.[115] Laipson (2004) argues that Syria's unconventional weapons programs in general, and nuclear program in specific, may have developed as a hedging strategy. Syria was

[114]cf. also United States Congress, Office of Technology Assessment, "Proliferation of Weapons of Mass Destruction: Assessing the Risks," OTA-ISC-559 (August 1993): 65, `http://www.princeton.edu/~ota/disk1/1993/9341/9341.pdf`.

[115]cf. NTI (2011*b*).

Table 13: Chronology of Syria's Nuclear Weapons Program

Sep 1969	Syria ratifies Nuclear Nonproliferation Treaty
13 Nov 1970	Hafez al-Asad deposes Atassi-Jadid government
1976	Syrian Atomic Energy Commission established
1980s	Syrian attempts to acquire nuclear reactors from various vendors frustrated by US- and IAEA-led efforts
Dec 1991	Syria purchases 30-kW research reactor from China
1997	North Korea begins clandestine nuclear cooperation with Syria
Jun–Jul 2000	Bashar al-Asad succeeds his father as President of Syria
2001	Al-Kibar site begins construction outside Dar ez-Zour with North Korean assistance
2001–04	A.Q. Khan network provides assistance to Syria
6 Sep 2007	Israeli Air Force bombs al-Kibar, destroying the reactor before it could begin operation
9 Jun 2011	IAEA finds Syria to be in noncompliance with safeguard agreements regarding al-Kibar

heavily dependent on the Soviet Union for conventional military support, and after less than expected levels of assistance from its patron during the 1967 and 1973 Arab-Israeli conflicts, as well as its 1970 failure in Jordan and its increasingly strained relationship with Hussein's Iraq, Damascus determined that diversification was necessary (cf. Seale 1988). Early development was slow, and beset by underinvestment, both financially and technically.[116] The IAEA assisted Syria in basic nuclear research and technology acquisition beginning in 1982. However, Damascus' prior research in chemical and biological weapons dampened international enthusiasm; the United States in particular was wary of allowing Syria domestic control of sensitive technology. Syria negotiated agreements to construct nuclear power reactors with several states during the 1980s; however, all were eventually abandoned due to concerns about IAEA safeguards. Cordesman (2008) describes one of the most high-profile diplomatic attacks against Syria's nuclear development: in 1990, the United States coerced Argentina into abrogating an already-contracted sale of a 10 megawatt reactor.[117]

[116]Central Intelligence Agency, "Middle East–South Asia: Nuclear Handbook," NESA 88-10027X (May 1988), in CIA FOIA Electronic Reading Room.

[117]cf. also Laipson (2004).

Syria succeeded in acquiring its first reactor, a relatively small 30 kilowatt research reactor, from China in 1991. This accord was negotiated under IAEA auspices and included standard safeguards necessary to prevent the diversion of uranium toward military purposes.[118] However, evidence indicates that, shortly thereafter, Syria initiated relationships with illicit providers of nuclear weapons technology, including North Korea[119] and the Abdul Qadeer Khan network in Pakistan.[120] This began a fifteen-year trend of parallel nuclear exploration: an overt interest in civilian research, conducted under IAEA safeguards, and a covert relationship with rogue actors that aimed to subvert those same safeguards and acquire a nuclear deterrent.[121]

The Chinese reactor sale was likely part of Beijing's effort to extend its influence in the aftermath of the Soviet collapse. China's embrace of Syria was short-lived, occurring during the period of broad international isolation after the Tiananmen Square crackdown. A CIA memorandum from 1992 notes that

> [w]hereas many industrialized states kept contacts with China to a minimum for two years [after the Tiananmen Square crackdown],... international pariahs like Iran, Syria, Libya, and Iraq, were willing to exchange diplomatic delegations... [Beijing] sees an opportunity to increase its own influence and augment its economic presence—particularly through lucrative defense-industrial deals.[122]

China was willing to use its nuclear weapons technology—at the time its principal export

[118]Central Intelligence Agency, "China Proliferation Watch," EA M 92-20063 (5 May 1992), in CIA FOIA Electronic Reading Room.

[119]Office of the Director of National Intelligence, "Background Briefing with Senior U.S. Officials on Syria's Covert Nuclear Reactor and North Korean Involvement" (24 April 2008), `http://www.dni.gov/interviews/20080424_interview.pdf`.

[120]Cordesman (2008); cf. also testimony given by Leonard Weiss and Andrew Koch before the Subcommittee on International Terrorism and Nonproliferation, Committee on International Relations, US House of Representatives (25 May 2006).

[121]The paradigm of parallel exploration is well-established in the literature, as civilian research provides both the tangible and intangible technologies necessary for the eventual creation of a nuclear bomb; cf. MacKenzie and Spinardi (1995); Bunn (2001); Fuhrmann (2009).

[122]Central Intelligence Agency, "China's Motives for Dealing With States of International Concern," EA M 92-92-20109 (19 August 1992), in CIA FOIA Electronic Reading Room.

of value—to buy the leadership of the remaining post-Soviet bloc (at least those states that refused to enter the Western bloc). This same report notes that "China refused to accept full-scope safeguards as a condition of supplying nuclear technology" to Middle Eastern client states. However, Beijing continually balanced its decision to provide sensitive technology to Syria against a desire for greater engagement with the United States and Europe, and gradually downgraded its technological assistance as the West reestablished political and economic ties with China (NTI 2011*a*). An attempt to replace Chinese patronage with a return to Moscow in 1998 proved similarly ineffective (Eisenstadt 2003).

Left without acceptable overt sources of nuclear assistance, Syria turned to the nuclear black market for help. Two suppliers in particular engaged with the Asad regime: the Pakistani network of Abdul Qadeer (A.Q.) Khan, and North Korea's state-sponsored nuclear smuggling operation (Spector and Berman 2010). The A.Q. Khan network was notorious for providing sensitive nuclear technology to a variety of rogue regimes throughout the 1990s, before it was unraveled in 2004 by American intelligence (Corera 2006). During this period, Khan traveled on several occasions to Syria, meeting with high-ranking officials in the Asad regime (Levy and Scott-Clark 2007).[123] However, the extent of technology transferred by the A.Q. Khan network has never been fully established; as late as 2006, there was no firm proof that the Khan network had engaged with Syria or that a military interest in nuclear weapons had even existed (Yilmaz 2006; Fitzpatrick 2007; Tertrais 2008).[124]

The other covert patron of the Syrian nuclear program had much more direct ties. Syria's relationship with North Korea dates to 1990, when Pyongyang began selling ballistic missile technology to Damascus (Delpech 2008). Syria began receiving technological assistance from North Korea for the al-Kibar site—built outside of the IAEA framework that encompassed

[123]cf. also Peter Slevin, John Lancaster, and Kamran Khan, "At Least 7 Nations Tied to Pakistani Nuclear Ring," *The Washington Post*, 4 February 2004.

[124]cf. also Office of the Director of National Intelligence, "Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions, 1 January–31 December 2004" (16 November 2004), `http://www.dni.gov/reports/2004_unclass_report_to_NIC_DO_16Nov04.pdf`.

other Syrian nuclear activity—in 2001, with possible contacts reaching back as far as 1997 (Tertrais 2008; Kroenig 2009). US intelligence tracked North Korean cargo shipments to the site in 2006, and North Korean nuclear technicians worked side-by-side with their Syrian counterparts to establish domestic capabilities.[125] Following American accusations (*post factum* in 2008) of Pyongyang's complicity, North Korea avoided a public response. This reflected a tacit admission by Pyongyang that the US understanding was accurate, despite Syrian protests to the contrary (Crail 2008).

Throughout this period of nuclear pursuit, Syria's international condition was marked by a lack of strong positive relationships with great powers.[126] Russia, in the aftermath of 1991, abandoned several of its military commitments, leaving Syria among the post-Soviet bloc states without a sponsor. China attempted to replace the Soviet patron, yet exploited political support as a bargaining chip with which to open the West. Regardless, limitations in China's military power projection would have made extended conventional deterrence difficult, if not impossible, for the rising Asian power. The United States, which during the 1990s and early 2000s enjoyed its unipolar moment and was the only state with the ability to materially influence Syria's international situation, found its relationship with Damascus at its absolute lowest during the Bush administration. Tertrais (2008) implies that construction at the al-Kibar site was accelerated in response to American hostility in the early war on terror. Pressures resulting from the invasion of Iraq (2003) increased regime perceptions of being under siege, increasing the need for a deterrent force (cf. Rabil 2006). However, absent political protection against its adversaries, there was no way to nurture Syria's technological developments. Ultimately Syria pushed toward its nuclear objectives in a condition of responding to the international system, rather than directing it.

Syria's nuclear ambitions were dealt a severe blow on 6 September 2007, when the Israeli

[125]ODNI, "Background Briefing," *op. cit.*

[126]However, Syria did succeed at limiting the effects of its negative relationships. Cooperation with the American coalition during the first Gulf War and economic engagement with the Gulf Cooperation Council show that Syria was not completely isolated within the international system during this period; however, it could not count on any state to provide extended deterrence in its favor; cf. also Rabil (2006).

Air Force decimated the nearly-completed al-Kibar reactor in a nighttime raid. In contrast to the reaction to Israel's 1981 Osirak bombing, the international community was mute for several months, until the United States released intelligence connecting al-Kibar to a possible nuclear weapons program (Delpech 2008).[127] In his memoirs, former US President George W. Bush notes that he was aware of a likely Israeli strike on the al-Kibar reactor prior to its occurrence. During the summer of 2007, Israeli Prime Minister Ehud Olmert requested American intervention against the Syrian program; however, Bush demurred, with the CIA unable to support a finding at the time that activities at the al-Kibar reactor were being directed toward weaponization. Understanding that the Americans would not intervene, Israel began preparations for direct action on its own behalf (Bush 2010: 421–422). Only after the fact could the available information point conclusively to illicit nuclear activity. In 2011, the IAEA determined that the al-Kibar site was indeed a nuclear reactor constructed outside the safeguards regime, and constituted material noncompliance with international agreements.[128] While no direct proof of weaponization was found, the circumstantial evidence related to illicit use of nuclear technology was sufficient to recommend Syria to the United Nations Security Council.

While early research was conducted under the protection of Russia and China (as well as the IAEA), Damascus' nuclear program became more isolated from great-power patronage as it became more technologically sophisticated, and therefore more dangerous. Syria's failure to pair the technological development of its nuclear pursuit with a parallel political strategy left it vulnerable to preemption by Israel. The destruction of the al-Kibar site does not necessitate a complete upending of Syria's nuclear capabilities, as three undeclared, suspected nuclear sites remain active as of present.[129] However, the resulting political and diplomatic

[127]cf., for example, Feldman (1982); D'Amato (1983); and Snyder (1983) for a discussion of the Osirak bombing and its international fallout; cf. instead ODNI, "Background Briefing," *op. cit.*, with respect to the 2007 al-Kibar bombing in Syria, which resulted in almost no diplomatic backlash.

[128]International Atomic Energy Agency, "Implementation of the NPT Safeguards Agreement in the Syrian Arab Republic," Resolution GOV/2011/41 (9 June 2011), `http://www.iaea.org/Publications/Documents/Board/2011/gov2011-41.pdf`.

[129]David Albright and Paul Brannan, "Satellite Image Shows Syrian Site Functionally Related to Al Kibar

fallout has focused international attention on Syria's nuclear ambitions, pressuring its suppliers and decreasing its access to fundamental resources and technologies (Spector and Berman 2010; Kreps and Fuhrmann 2011). As a result, the likelihood that Syria's nuclear program advances toward weaponization in the near future is substantially lower than it was prior to the al-Kibar bombing.

Comparing Nuclearization Outcomes

India and Syria are exemplars of alternative paths of nuclear pursuit. Whereas India—supported by the Soviet Union in a mid-Cold War realignment—was able to achieve strategic parity with its regional adversary (China), Syria—bereft of great-power patronage—became victim of a preemptive military attack that all but ended its chances of acquiring nuclear weapons. The role of great-power interests (or lack thereof) is central in understanding the differing outcomes of these states' nuclearization. India's success was predicated on the nuclearization process complementing an increasingly-close political and military relationship with its sponsor, so that great-power extended deterrence protected the nuclear weapons program as it came closer to fruition. Conversely, Syria treated its nuclearization process as a substitution for great-power patronage. While the military capabilities entailed in such a replacement may have been equivalent, the political vulnerabilities created by such behavior would ultimately lead to its undoing.

India and Syria show the importance of separating a nuclear weapons program into its political and technological dimensions. The latter, which involves the knowledge necessary to physically create a nuclear weapon, has received substantial attention.[130] Technological development is also intrinsically dual-use, as much of the knowledge and matériel needed to produce a nuclear weapon are also legitimate aspects of civilian nuclear-energy development. Technological development is a necessary condition for the domestic production of nuclear

Reactor," Imagery Brief, Institute for Science and International Security (1 December 2010), `http://www.isis-online.org/uploads/isis-reports/documents/Syria_Masyaf_Report_1Dec2010_1.pdf`.

[130]cf. Ogilvie-White (1996).

weapons, though the presence of the nuclear black market now makes it possible to acquire a weapon through purchase, not production.

However, technological development must be paired with the political development of a nuclear weapons program, which is itself subdivided into domestic and international conditions. Previous literature discusses exclusively the factors leading to domestic commitment to nuclearization (ie. those factors that lead a government to pursue nuclear weapons).[131] Strategic culture, perception of threat, and institutions all condition a state's domestic capability to exploit technological means toward a political instrument. India struggled with its political commitment to nuclearization, with Indira Gandhi explicitly banning weaponization research from 1966–1970. However, once India returned to its pursuit of nuclear weapons, the program was better-funded and more effectively administered. Syria under both Hafez and Bashar al-Asad appears to have had a consistent internal commitment to nuclearization, though Damascus' program was delayed principally by technological shortcomings.

With both technological and domestic-political development, a nuclear weapons program can prosper. However, success requires these to grow in line with the program's international-political condition. Actors external to the proliferator must be willing to accept, or at a minimum tolerate the acquisition of nuclear weapons. Given that the introduction of nuclear weapons greatly alters the balance of power, the international system must exhibit certain conditions to concede to nuclearization. Proliferators that are already sufficiently powerful are unlikely to suffer backlash, as they can directly deter preventive military action with conventional capabilities. This was the experience of the first-generation proliferators. Conversely, proliferators that would normally be victim to preemption can avoid this fate by ingratiating themselves with a sufficiently strong and interested patron state. By appropriating the deterrent power of an allied state, a proliferator can insulate itself from the natural consequences of a change in the distribution of power, protected from preemption until it can complete the nuclearization process.

[131] cf. Meyer (1984); Waltz (1990); Paul (2000).

Great-power patronage exercises a *de facto* form of extended deterrence. India's move into the Soviet sphere of influence in the 1960s, culminating in the "friendship and cooperation" treaty of 1971, provides evidence of a coalescing of Indian and Soviet foreign policy interests, specifically their mutual aversion China's revolutionary brand of Communism. Kapur (1972), Frankel (1986), and Sidhu and Yuan (2003) all find that the Indo-Soviet alliance was a crucial factor in keeping Beijing on the sidelines of the 1971 Bangladesh war. This degree of protection from a conventionally-superior rival (one that had humiliated the Indian military in 1962) allowed India to push forward freely with its nuclear weapon program. It took New Delhi only four years from Gandhi's reauthorization to the "peaceful" nuclear explosion in May 1974. The Soviet response to this instance of proliferation was muted: arms transfers to India increased by 13% during the following three years, and sensitive technology (such as ballistic missile designs) continued to be shared (Conley 2001). Indian nuclear proliferation served a Soviet objective—the containment of Maoist China—and therefore received the shield of Soviet political protection.

India's early nuclear development (1962–1970) occurred in a relatively neutral environment, with both the United States and Soviet Union having no discernable policy bias either toward India or in favor of other Asian states. With the signing of the "friendship and cooperation" treaty, the Soviet Union expressed a shift in its preferences toward India and away from China (and Pakistan). Conversely, Syria operated in an environment where the three great powers (including China in the post-Cold War period) substantially favored other regional actors over Damascus. While the Asad regime was able to overcome the technological impediments of a hostile international environment by turning to the A.Q. Khan network and North Korea, the nuclear black market was unable to repair the international-political context of Syria's nuclear weapons program. In September 2007 there was no concrete impediment to Israel's attacking the al-Kibar reactor.

The Syrian nuclear weapons program shows evidence of being a replacement in Syrian

strategic culture for great-power protection.[132] Threatened by an American-led regional environment, and with weak (and deteriorating) support from the Soviet Union, Syria was confined to a strategy of internal balancing against its regional rivals. Hafez al-Asad supported robust chemical weapons and ballistic missile programs during the 1980s in order to achieve strategic parity with its regional neighbors. Damascus' nuclear weapons program served as a continuation of this trend in Syria's strategic calculations, aiming to make up for the erosion of external support from Russia and China's lackluster investments.

Conversely, India's nuclear weapons program acted as a complement to its international-political environment.[133] New Delhi was under-developed, non-aligned, and militarily decimated in 1962. It evolved into a leading regional actor by the mid-1970s by pairing strategies of internal and external balancing. Understanding that it was operating from a position of military inferiority, India developed closer ties with the Soviet Union as a way of providing immediate political leverage against China. This approach insured India's extensive nuclear weapons program against preemption from China, until the point at which India could oppose its regional rival directly and on equal footing. Soviet patronage was an essential prerequisite for the success of the Indian nuclear program; in insulating the program from the natural consequences of the international environment during its vulnerable, developmental stages, the Soviet Union facilitated a substantial change in the regional distribution of power in Asia, ensuring the containment of Maoist China.

Conclusion

This chapter casts doubt on one of the fundamental assumptions of contemporary non-proliferation. The idea of an external guarantee for a state's security has been understood to be a credible substitute for nuclear proliferation since the 1970s. Betts argued that alliance guarantees can "assuage insecurity" and that "backing vulnerable states with U.S. power

[132] cf. Jouejati (2009).

[133] cf. Perkovich (1999).

or aid" can dissuade states from acquiring nuclear weapons (1977: 167). This assumption has also underpinned NATO defense policy explicitly and other American bilateral security relationships implicitly since the height of the Cold War. However, too much emphasis has been placed on the fungibility of external and internal balancing, with little emphasis on the changes to the strategic environment that occur when patronage relationships are brought into play.

The case of India shows that—despite a clear security rivalry between New Delhi and Beijing—a nuclear weapons program can flourish under the shadow of great-power patronage. Increasing levels of Soviet protection did not dissuade India from pursuing nuclear weapons. In fact, Soviet military ties included the transfer of sensitive technology that would later be used for the weaponization of India's nuclear program.[134] More important than the technology transfers, though, was the political cover provided to India's process of nuclear armament. An extension of Soviet military defenses, rather than substituting for domestic armament, protected India from the likely consequence of an internal military buildup by deterring Chinese preemption.

This finding, which can easily be extrapolated to explain nuclear proliferation by Pakistan and North Korea (both under the protection of China) as well as earlier cases such as the United Kingdom and France (under the American/NATO nuclear umbrella), should provoke greater caution among policymakers who rush to counter Iranian moves toward regional supremacy.[135] An extension of the American nuclear umbrella as a tool of nonproliferation may not be effective. If credible, such an extension of American deterrence will only ensure that further proliferation of nuclear weapons will be peaceful, but will neither assure an end to the spread of nuclear weapons or the preservation of an amenable international environment for American interests. If it is deemed non-credible, the American nuclear umbrella will

[134]American technology, sold ostensibly for civilian purposes, had also been used toward that end; cf. testimony given by Leonard S. Spector before the Subcommittee on International Security, Proliferation, and Federal Services, Committee on Governmental Affairs, US Senate (6 June 2002).

[135]cf. Posen (2006); Lindsay and Takeyh (2010).

be discounted in international politics, and the events of Osirak and Dar ez-Zour may be repeated in other cases.

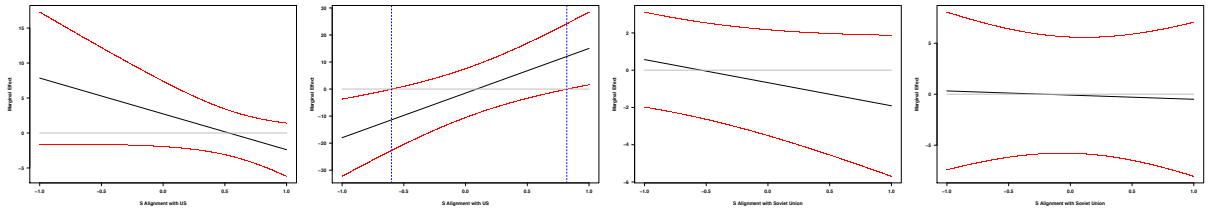
Nonproliferation policy should instead be focused toward establishing a secure international environment without creating the moral hazards that would lead to further armament. Additionally, weakening domestic-political incentives for nuclearization and strengthening control over technological diffusion should be addressed with greater urgency. Eleven states that entertained nuclearization abandoned their programs through internal political processes; the use of both positive and negative incentives can structure nuclear decisionmaking before it becomes an issue of power transition. Once a proliferator's domestic-political decision to move forward with a nuclear weapons program is firmly concluded, the ability of international actors to reverse that decision is limited, absent direct military preemption, an option for those most threatened by a change in the distribution of power. Compared to steps that can be taken earlier in the proliferation process, preemption is costly and destabilizing. Great powers structure the international system, but do not completely control it. They must be careful not to aggravate the problem of nuclear weapons through a misuse of their structural capabilities. Rather, they must use their ability to create disincentives to proliferation while maintaining the peace and stability of the contemporary era.

APPENDIX A

ADDITIONAL GRAPHICS FOR CHAPTER 1

Figure 8: Marginal Effects of Nuclear Arsenal Size on Pursuit (Model 3A)

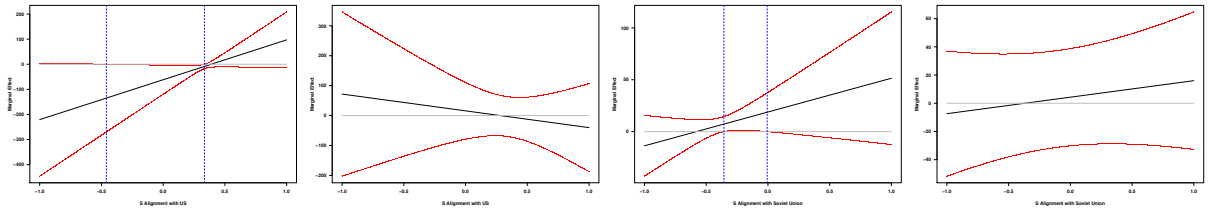
(a) US: 1950–1968 (b) US: 1969–2000 (c) USSR: 1950–1968 (d) USSR: 1969–2000



Red lines represent 95% confidence interval.

Figure 9: Marginal Effects of Nuclear Arsenal Size on Acquisition (Model 4A)

(a) US: 1950–1968 (b) US: 1969–2000 (c) USSR: 1950–1968 (d) USSR: 1969–2000



Red lines represent 95% confidence interval.

APPENDIX B

DERIVATION OF THE FORMAL MODEL IN CHAPTER 2

Proof *(Lemma 1)* The utility to C of taking its various strategy options is defined by the present value of the stream of period utilities. In a two-period game, the strategy at $t = 1$ takes into account both the full value of that period's payoff, and the value of the payoff in $t = 2$ discounted by the factor δ. The possible responses lead to C's utility functions as defined per-period:

$$U_C(\text{War}) = p_t - c_c$$
$$U_C(\text{Accept } x) = x^{\rho_c}$$
$$U_C(\text{Reject } x) = q^{\rho_c}$$

Assume that $U_C(q) = U_C(\text{War})$ (ie. that the bargain is initially in equilibrium). This leaves C with the following strategy, based on utility maximization:

$$s_C = \begin{cases} \text{Accept} & \text{if } x \geq (p_t - c_c)^{1/\rho_c} \\ \text{Reject} & \text{if } x < (p_t - c_c)^{1/\rho_c} \text{ and } x \geq q \\ \text{War} & \text{if } x < (p_t - c_c)^{1/\rho_c} \text{ and } x < q \end{cases}$$

D's utility functions are defined similarly to C's:

$$U_D(\text{War}) = 1 - p_t - c_{d,t}$$
$$U_D(x|\text{Accept}) = (1 - x)^{\rho_d}$$
$$U_D(x|\text{Reject}) = (1 - q)^{\rho_d}$$

Irrespective of the *status quo ante* q, D can eliminate C's option of war by offering $x \geq (p_t - c_c)^{1/\rho_c}$. This is personally-rational for D, because a Pareto-efficient outcome results in

all gains going to D. Therefore, D's offer is defined by:

$$\begin{aligned} s_D &= \arg\max_x 1 - x | x \in [(p_t - c_c)^{1/\rho_c},\ 1 - (1 - p_t - c_{d,t})^{1/\rho_d}] \\ &= (p_t - c_c)^{1/\rho_c} \end{aligned}$$

D's range of possible acceptable offers x is bounded by the threshold to war for each state. Because D has the power of initiative, it offers the minimum value x which maximizes its utility $(1 - x)^{\rho_d}$. This is equal to the minimum value that C (weakly) prefers to its exit option. Conversely, D's strategy would be War if there did not exist any x that satisfies the above argument (ie. the set is null).

At $t = 2$, D is the only one who stands to lose from an unraveled bargaining process. D therefore offers $x_2 = (p - c_c)^{1/\rho_c}$, which is the minimum value of x_2 that C will accept. (Given the static distribution of power, p refers to the same value at both $t = 1$ and $t = 2$.) Thus, in equilibrium, at $t = 2$ C is indifferent between the outcome resulting from war and the bargain proposed by D. Retrogressing to $t = 1$, C is indifferent between the expected utility of its future payoffs: suspending the bargaining process or continuing it each results in an expected utility of $(p - c_c)$. Therefore, C's action at $t = 1$ is based on the offer x_1 according to the same decision rule s_C described above. Again, D maximizes its utility by offering $x_1 = (p - c_c)^{1/\rho_c}$, which C accepts, thus ensuring the continuation of the bargaining process (and the accrual of bargaining gains to D). ∎

Proof *(Theorem 2)* Given a change in p occurring at $t = 2$, each actor's strategy in $t = 1$ will be conditioned on the present value of the full stream of payoffs. Given $p_{t=2} = p'$, the

equilibrium behavior after the power transition is

$$s_C^2 = \begin{cases} \text{Accept} & \text{if } x \geq (p' - c_c)^{1/\rho_c} \\ \text{War} & \text{if } x < (p' - c_c)^{1/\rho_c} \end{cases}$$

$$\begin{aligned} s_D^2 =& \arg\max_x 1 - x | x \in [(p' - c_c)^{1/\rho_c},\ 1 - (1 - p' - c_d')^{1/\rho_d}] \\ =& (p' - c_c)^{1/\rho_c} \end{aligned}$$

Thus, if the bargaining continues after the change in the distribution of power, there exists an equilibrium bargain for $t = 2$ at $x_2 = (p' - c_c)^{1/\rho_c}$, which C accepts (cf. Lemma 1). Continuing backward to $t = 1$, C's utility functions are defined as such:

$$\begin{aligned} U_C(\text{Accept } x_1,\ \text{Accept } x_2) =& x_1^{\rho_c} + \delta x_2^{\rho_c} \\ U_C(\text{Reject } x_1,\ \text{Accept } x_2) =& q^{\rho_c} + \delta x_2^{\rho_c} \\ U_C(\text{War},\ \text{Accept } x_2) =& p_0 - c_c + \delta(p_0 - c_c) \end{aligned}$$

Assuming $q = (p_0 - c_c)^{1/\rho_c}$ at $t = 1$ (ie. that the bargain is initially in equilibrium), C excludes the option of war by being indifferent in $t = 1$ between rejecting x_1 and war, and preferring the former outcome in $t = 2$ to that of war. Therefore, C's strategy in $t = 1$ is defined by

$$s_C^1 = \begin{cases} \text{Accept} & \text{if } x \geq (p_0 - c_c)^{1/\rho_c} \\ \text{Reject} & \text{if } x < (p_0 - c_c)^{1/\rho_c} \end{cases}$$

There exists an equilibrium bargain at $t = 1$ if and only if there exists a value x_1 that D prefers to war. Anticipating that x_2 exists in equilibrium, D's utility functions at $t = 1$ are defined as follows:

$$\begin{aligned} U_D(x_1,\ x_2 | s_C) =& (1 - x_1)^{\rho_d} + \delta(1 - x_2)^{\rho_d} \\ U_D(\text{War},\ x_2 | s_C) =& 1 - p_0 - c_d + \delta(1 - p_0 - c_d) \end{aligned}$$

A dynamic commitment problem exists when D's utility to war—which is *ex post* inefficient, results in a greater personal utility to D. Conversely, an equilibrium bargain exists when D's utility to war is less than the utility of some bargain x_1 for $t = 1$. Given $x_2 = (p' - c_c)^{1/\rho_c}$, the dynamic commitment problem does not exist for any x_1 such that

$$(1 - x_1)^{\rho_d} + \delta(1 - (p' - c_c)^{1/\rho_c})^{\rho_d} \geq (1 - p_0 - c_d)(1 + \delta)$$

Simplifying for x_1, there is an equilibrium bargain when

$$x_1 \leq 1 - [(1 + \delta)(1 - p_0 - c_d) - \delta(1 - (p' - c_c)^{1/\rho_c})^{\rho_d}]^{1/\rho_d}$$

x_1 is effectively bounded at the minimum by $q = (p_0 - c_c)^{1/\rho_c}$.[136] As this threshold level of x_1 is a function of both the expected future distribution of power p' and the current distribution of power p_0. Solving for the unknown value p' shows that, for a given level of initial conditions $p_0,\ c_d,\ c_c,\ \rho_d,\ \rho_c,$ and δ, there exists an equilibrium bargain in the shadow of shifting power when

$$p' < \left[1 - \left[\frac{(1 + \delta)(1 - p_0 - c_d) - [1 - (p_0 - c_c)^{1/\rho_c}]^{\rho_d}}{\delta}\right]^{1/\rho_d}\right]^{\rho_c} + c_c$$

Let p'_c be defined as the minimum level of p'_c for which an equilibrium bargain no longer exists.

For all changes in the distribution of power $\Delta p < p'_c - p_0$, D may offer $x_1 = (p_0 - c_c)^{1/\rho_c}$, which is accepted by C, and the bargaining process remains efficient. However, for all $\Delta p \geq p'_c - p_0$ there is no x_1 that D can offer that results in a utility stream greater than that of war. ∎

Proof *(Theorem 3)* In the subgame of Γ_0 that begins with C's choice $\neg N$, C has an expected

[136] If D offers $x_1 < q$, C rejects the offer; this bound represents the maximum utility that D can gain at $t = 1$ through the bargaining process.

utility of $(p_0 - c_c)(1+\delta)$ (cf. Lemma 1). In the subgame that begins with C's choice of N, C has an expected utility of $(p_0 - c_c)(1+\delta)$ when $\Delta p \geq p'_c - p_0$ (which results in immediate bargaining failure) or $(p_0 - c_c) + \delta(p' - c_c)$ when $\Delta p < p'_c - p_0$ (where Δp does not trigger a dynamic commitment problem). Given these outcomes, C is indifferent between N and $\neg N$ for $\Delta p \geq p'_c - p_0$, and strictly prefers N to $\neg N$ for $\Delta p < p'_c - p_0$, indicating a weak preference for nuclearization for all Δp. ∎

Proof *(Theorem 4; Corollary 5)* In the event of bargaining failure, G intervenes if the benefits in achieved utility outweigh the costs of intervention. G's utility to war at $t = 1$ is defined as follows:

$$U_G(\text{War}) = -|p_0 - x_g|(1+\delta)$$

The utility to intervention is instead a function of whether intervention is self-enforcing or not.[137]

Case 1: x_g is self-enforcing

x_g is defined self-enforcing when intervention at $t = 1$ does not require a subsequent intervention at $t = 2$ in order to maintain this outcome. x_g must therefore be within the range of acceptable bargains after the power transition, namely $x_g \in [(p' - c_c)^{1/\rho_c},\ 1 - (1 - p' - c'_d)^{1/\rho_d}]$. The utility to G of intervention in this case is therefore

$$U_G(\text{Intervention}) = -c_g + \delta(0) = -c_g$$

G prefers to intervene when it receives a greater utility from doing so, or when

$$-c_g > -|p_0 - x_g|(1+\delta)$$

[137] Werner and Yuen (2005) show how "unnatural" ceasefires and other externally-enforced bargains are generally not stable unless either *a*) the intervener remains engaged in enforcing the dyadic commitment; or *b*) the underlying distribution of power shifts in such a way as to make the bargain self enforcing.

This is true for $x_g \notin p_0 \pm \frac{c_g}{1+\delta}$. Because $x_g \geq (p' - c_c)^{1/\rho_c}$ as a result of the self-enforcing requirement, G does not intervene when its preference is below the *status quo* distribution of power. Rather, G intervenes at $t = 1$ when $x_g \geq p_0 + \frac{c_g}{1+\delta}$ and $x_g \geq (p' - c_c)^{1/\rho_c}$. ∎

Case 2: x_g is not self-enforcing

x_g is not self-enforcing when intervention at $t = 1$ does not set $q_2 = x_g \in [(p' - c_c)^{1/\rho_c},\ 1 - (1 - p' - c'_d)^{1/\rho_d}]$, and G must intervene at both $t = 1$ and $t = 2$ in response to bargaining failure. In this case, the utility to G of intervention is

$$U_G(\text{Intervention}) = -c_g + \delta(-c_g) = -c_g(1 + \delta)$$

G prefers to intervene when it receives a greater utility from doing so, or when

$$-c_g(1 + \delta) > -|p_0 - x_g|(1 + \delta)$$

This is true for $x_g \notin p_0 \pm c_g$. This condition is independent of p' and—for $x_g > p_0 + c_g$—is subsumed within the domain $x_g > p_0 + \frac{c_g}{1+\delta}$ for Case 1, though without that case's other constraint that $x_g > (p' - c_c)^{1/\rho_c}$.

Conversely, for $x_g < p_0 - c_g$, G will also be incentivized to intervene in a scenario of bargaining failure at $t = 1$. When $x_g < (p_0 - c_c)^{1/\rho_c}$ as well, this creates a situation of moral hazard, whereby D is incentivized to provoke bargaining failure independently of the dynamic commitment problem. ∎

Proof *(Corollary 6)* Per Theorem 4 and Corollary 5, G intervenes in bargaining failure at $t = 1$ for $x_g \notin p_0 \pm c_g$, or for $x_g > p_0 + \frac{c_g}{1+\delta}$ when $x_g > (p' - c_c)^{1/\rho_c}$ as well. For $x_g \in p_0 \pm \frac{c_g}{1+\delta}$, G does not receive greater utility from intervening (even in a self-enforcing scenario) than it does for allowing the bargaining process to play out as in the dyadic scenario. Per Corollary 5, $x_g \in [p_0 - c_g,\ p_0 - \frac{c_g}{1+\delta}]$ does not satisfy the self-enforcing condition; therefore, G likewise does not have an incentive to intervene in the dyadic bargaining process. ∎

Proof *(Theorem 7)* Follows directly from Theorem 4 for $x_g < p_0 - c_g$ and $x_g < (p_0 - c_c)^{1/\rho_c}$, cf. Case 2 above. ∎

Proof *(Theorem 8; Corollary 9)* Per Theorem 4, for $x_g > p_0 + c_g$, D prefers not to induce bargaining failure at $t = 1$ due to the shadow of G's threatened intervention. As a result, C strictly prefers N to $\neg N$. Per Corollary 5, this follows for $x_g \in [p_0 + \frac{c_g}{1+\delta},\ p_0 + c_g)$ when $x_g > (p' - c_c)^{1/\rho_c}$. Because G does not need to sustain intervention in both periods when x_g is a self-enforcing equilibrium at $t = 2$, the threat of a single-period intervention is sufficient to provide C with a strict preference for N over $\neg N$. (When $x_g < (p' - c_c)^{1/\rho_c}$, bargaining failure occurs at $t = 1$, and C is indifferent between N and $\neg N$.) ∎

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