Collusion and the Nuclear Nonproliferation Regime*

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Abstract

We develop and test a theory of the origins and enforcement of the nuclear nonproliferation regime, based on a game-theoretic model of proliferation. The theory synthesizes the popular, but incomplete, views of the regime as either a grand bargain or a cartel. Widespread nonproliferation is only possible if the superpowers collude to coerce some states into compliance, as in the cartel view; but this enforcement is only affordable if most states voluntarily comply under a grand bargain. The necessary collusion arises from the superpowers' early experience of proliferation and its disruptive effects on intra-alliance politics. We document explicit collusion in the negotiation and enforcement of the NPT, and find support for the theory's predictions in a dataset of superpower reactions to states' failure to join or comply with the NPT during the Cold War. Our theory implies that the regime has substantially reduced proliferation, in contrast to previous studies' findings.

Keywords: nuclear weapons, proliferation, nonproliferation, NPT, superpowers

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The Treaty on the Non-Proliferation of Nuclear Weapons (NPT) requires of most of its members a remarkable concession of sovereignty: they must eschew a highly effective means of self-defense, in exchange for relatively modest benefits. And yet more than 190 states have signed the treaty, only one has left it despite an article enabling states to do so, and almost all have abided by it. What accounts for this apparent success? Why was the treaty created, and how was it enforced?

We develop and test a theory of the origins and enforcement of the nonproliferation regime, and the roles of the NPT within it, based on our analysis of a game-theoretic model of proliferation that is tailored to the Cold War context in which the regime was born. Our model implies that widespread nonproliferation could only be possible if the superpowers colluded to enforce it. Their enforcement would be effective because of the power and influence they possessed over most other states; collusion would be necessary because otherwise one superpower might exploit and undermine the other's attempt to stop an aspirant.[1]

Despite the ability of the superpowers to enforce nonproliferation, we show that their *willingness* to do so depends critically on their perceptions of the consequences of proliferation. The origins of the regime can then be traced to a shift in these perceptions documented by historians. Initially, each superpower saw the spread of nuclear weapons to certain of its own clients as a way to strengthen its side against the other's. Our model demonstrates that the superpowers cannot collude to enforce nonproliferation while they hold these views. In time, experience taught the superpowers that states could also substitute nuclear weapons for their patronage, and subsequently gain autonomy. We show that, under the right conditions, this revised conception can motivate the superpowers to jointly try to stop proliferation.

These conditions are that the necessary enforcement cannot be too expensive for the

[1]We use "collusion" rather than "cooperation" because, as we document, the superpowers came to this understanding in private and sometimes acted to disguise it, and their cooperation came at the expense of certain states.

superpowers, and that the monitoring of states' nuclear programs and of the superpowers' own fidelity to collusion must be reliable enough. We argue that enforcement is affordable only if many states support nonproliferation and so do not have to be coerced into compliance. Under this theory, the NPT's roles are to bolster monitoring, to signal that the needed enforcement will be modest, and to coordinate states' expectations and behavior on nonproliferation, rather than the widespread proliferation that might otherwise result.

We proceed to test three observable implications of our theory. First, we should actually observe the superpowers colluding with each other on nonproliferation concerns, and pressing each other to uphold their side of collusion. We examine the declassified record of private superpower interactions, both during the NPT negotiations and on occasions when a new nuclear aspirant surfaced, and find ample evidence of this collusion. Second, the superpowers should apply pressure as needed to induce states to join the NPT. To test this, we present a new dataset of all those states judged by the superpowers to be at risk of pursuing nuclear weapons, with information on the measures (if any) the superpowers used to pressure these states to join the treaty. Consistent with the theory, we find that though the superpowers' efforts were not always successful, they generally applied pressure when states did not join the treaty, and we found no evidence of any attempt by either superpower to undermine the other's pressure. Third, upon discovering a state's nuclear weapons program, the superpowers should attempt to coerce that state back into compliance. We present data on all known cases in which a state's possible transgression was detected, measure the superpowers' responses to these cases, and also assess instances in which a superpower assisted such a nuclear aspirant state or exploited the other's pressure. The data generally support the theory: in most cases, the superpowers intervened forcefully to correct errant states. In no case did a superpower assist a state with a nuclear weapons program, and we again found no evidence of any attempt by either superpower to undermine the other's pressure.

There are two other general theories of the nonproliferation regime and the NPT. The

"cartel" theory holds that some of the nuclear haves coerced or bribed the nuclear have-nots into nonproliferation in order to maintain their nuclear oligopoly and preeminence (Swango, 2009; Verdier, 2008). A more common theory holds that the NPT represents a "grand bargain," with two aspects: first, the nuclear haves promise nuclear energy assistance and eventual nuclear disarmament in exchange for the nuclear have-nots eschewing nuclear weapons; and second, each have-not goes without weapons so long as the rest do and accepts international safeguards to assure others of this.[2]

Neither theory is in accord with the evidence we present, and each leaves important questions unanswered. If the cartel theory is right, then the superpowers should have had to coerce many more states than the few in our dataset. Why would so many states willingly go along with an instrument that only served to oppress them? If the benefits of nonproliferation were worth the costs of enforcing it, why did the superpowers not do it sooner, before China and France got nuclear weapons? If the grand bargain theory is right, many more nuclear have-nots should have defected from the regime, since some have-nots got nuclear weapons and the nuclear haves neither disarmed nor conditioned energy assistance on regime membership (Fuhrmann, 2012; Swango, 2014). How exactly would the bargain be enforced, should some have-not decide it favored obtaining nuclear weapons even at the cost of access to nuclear energy assistance and other states following suit once it was detected?

Our theory provides a synthesis of the cartel and grand bargain views that answers these questions and is consistent with the evidence. Most states voluntarily adhered to the regime because they preferred widespread nonproliferation to widespread proliferation, in line with the grand bargain theory. The few that would have risked widespread proliferation in order to get their own nuclear weapons were prevented by the superpowers from "spoiling" the regime, in line with the cartel theory. But the superpowers were willing to collude and

[2]See Weiss (2012) for the first aspect, and Dai (2007) for the role of safeguards in the second. Dai explains why the NPT has centralized monitoring, but not how or why it is enforced.

bear the costs of enforcement only because there were relatively few spoilers that had to be coerced, and only belatedly, once the superpowers realized that widespread proliferation would be injurious to their interests.

The principal contribution of our work is to show how the constellation of states' interests in nuclear weapons and expectations about the extent and consequences of future proliferation gives rise to the regime. By contrast, most prior scholarship has focused on four particular elements within this constellation. First, and most closely related, Kroenig (2009, 2010, 2014) develops a theory of individual states' attitudes toward other states' proliferation, in which a state disfavors proliferation to other states over which it can project power. While this theory implies that the superpowers will see benefits to nonproliferation, it does not recognize the necessity of collusion to their ability to enforce it or the importance of other states' voluntary compliance to the superpowers' willingness to enforce it. It also does not explain why the regime's establishment was delayed. A second body of work analyzes the efficacy of various means of enforcing nonproliferation, including safeguards (Fuhrmann, 2012), supply controls (Fuhrmann, 2009*a*, 2012; Kroenig, 2009, 2010; Montgomery, 2005), economic sanctions (Miller, 2014*a*; Solingen, 2012), preventive attack (Bas and Coe, 2012; Debs and Monteiro, 2014; Fuhrmann and Kreps, 2010), and security guarantees (Monteiro and Debs, 2014). However, these studies do not elucidate how expectations about the extent and effects of future proliferation influence the superpowers' willingness to undertake these costly measures. Third, historians have documented the supepowers' collusion on nonproliferation, the shift toward it in the mid-1960s, and the effect this had on negotiations for the NPT, but cannot explain why this shift enabled the regime's creation (Brands, 2006, 2007; Gavin, 2004, 2010; Popp, 2014). Finally, recent research examining individual states' interests in nuclear weapons and capacities for obtaining them appears to take for granted states' expectation that proliferation will be rare (Hymans, 2006, 2012; Paul, 2000; Solingen,

2007).[3] Many of these studies conclude that the regime has had little effect on nonproliferation (Sagan, 2011). However, as we will explain, our theory gives rise to an alternative interpretation of this evidence, in which the regime substantially reduced proliferation.

The next section describes our theory and elaborates on its synthesis of previous views. We then turn to the empirical evidence and the results of our tests. The final section discusses the broader implications of our results for previous research on the regime.

A Theory of the Nonproliferation Regime

We will first describe the assumptions of the model we use to formalize states' interactions over proliferation. We then establish the conditions for a nonproliferation regime to exist in equilibrium, showing that it must entail the superpowers colluding to stop certain states from getting nuclear weapons. These conditions enable us to synthesize the cartel and grand bargain views of the NPT, to explain why the NPT came about when it did, and finally to elucidate the specific roles it plays in the viability of the nonproliferation regime. Proofs of the propositions can be found in the online appendix.

Model Setup

Two superpowers US and SU and a finite set of other states S, which includes clients of the United States ($S_{US} \subset S$) and of the Soviet Union ($S_{SU} \subset S$), interact repeatedly over time. In the first period, all of the states simultaneously decide whether to initiate a nuclear weapons program, and the period ends. In the next and all future periods, a state's choice to start a program in the last period is revealed with probability σ.[4] Each superpower then

[3] Rublee (2009) is an exception.

[4] We assume that a coalition of states seeking nuclear weapons together would be detected together or not at all, as was the case with the Khan proliferation network (Corera, 2006).

simultaneously decides whether to allow each revealed state (if there is any) to continue its program, paying a cost $c > 0$ for each state it tries to stop. A superpower's choice to allow a state to continue is revealed with probability τ, but is otherwise known only to the superpower and that state. All of the states that do not currently have an ongoing nuclear weapons program then simultaneously decide whether to start one. If any state began a program in the previous period, and it went undetected in this period, or was detected but *either* superpower chose to allow it, then its program now succeeds and that state is observed to acquire nuclear weapons, which it retains permanently. If instead *both* superpowers tried to stop the state, then its program ends and the state loses the value of the resources invested in it, worth $d > 0$. Payoffs are realized and the period ends.

The structure of the game assumes that the superpowers—and only the superpowers—are capable of stopping a state that has chosen to seek nuclear weapons from getting them.[5] This capability derives from the unique power and influence the superpowers wield over other nations. Each can more easily detect and more severely punish a proliferant than any non-superpower or even group of such states, and at lower relative cost. Each is capable of persuading or compelling many other states to support a proliferant's punishment, making it even more severe. This capability would be most formidable when dealing with each superpower's own clients: preferential trade arrangements, diplomatic support, assistance with nuclear technology, transfers of arms, stationing of the superpower's own forces in-country, and even guarantees of security could all be ended as punishment for seeking nuclear weapons. The empirical record of superpower attempts to stop proliferation, described in the next section, shows that the threat of these punishments was usually effective.

However, the game's structure also presumes that neither superpower can stop prolifera-

[5]More realistically, both superpowers' efforts to stop a state might fail. This would raise the temptation of some states to seek nuclear weapons and reduce the willingness of the superpowers to try to stop them, making the conditions for nonproliferation more restrictive.

tion unilaterally. The same power and influence that makes a superpower a superb punisher also renders it uniquely able to *undermine* other states' attempts at punishment. A superpower can replace much of what a state might lose due to other states' attempts to punish it, whether markets for trade, diplomatic recognition, arms transfers, or even a security guarantee. It could assist the proliferant with its nuclear program or even defend it from attack. Even if a state's punishment came at the hands of its patron superpower, the other superpower could offer its own services to the newly-needy state and thereby replace its former patron. Thus, the superpowers must collude to stop a state from getting nuclear weapons.

A state seeking nuclear weapons, and a superpower enabling it to do so, would obviously have strong incentives to conceal their actions, so as to prevent others from reacting adversely. The possibility that these might go undetected is why the states' and the superpowers' decisions are each treated as simultaneous, and revealed only with some probability. Each state must decide whether to pursue nuclear weapons, not knowing whether other states are at that moment doing so. It might learn of another state's program before it succeeds, giving it a chance to react accordingly, or it might remain in the dark until that state's program succeeded and it revealed the new capability. Similarly, a superpower must react to the discovery of a state's program, not knowing how the other superpower is reacting.

All players discount the future by $\delta > 0$, and all payoffs are common knowledge. Let S_N^t be the set of states that have nuclear weapons at the end of period t. The per-period payoff of each state $j \in S$ is $v_j(S_N^t)$. We assume that, for any $j \in S$, $T \subset S$, and $k \neq j$, $v_j(T) \geq v_j(T \cup \{k\})$: for any given state, the spread of nuclear weapons to other states is (weakly) bad. We also make the following "breakdown" assumption: if any state gets nuclear weapons, and the superpowers will not collude to prevent any other state from following, then all states that do not have nuclear weapons will seek them immediately, and $S_N = S$ will be the unique equilibrium outcome. In effect, if proliferation gets started and is not

stopped, then it will snowball.[6] This nuclear domino theory was and is widely believed, at least among US policymakers, and there is now substantial evidence for it (Miller, 2014*b*).

The per-period payoffs of the superpowers are $v_{US} = p(S_N^t) + \alpha\left[i(S_N^t) - l_{US}(S_N^t)\right]$ and $v_{SU} = -p(S_N^t) + \alpha\left[-i(S_N^t) - l_{SU}(S_N^t)\right]$. These represent the two different effects that proliferation can have on the superpowers' interests, termed *inter*- and *intra*-alliance effects, with the relative importance of the latter given by α. First, proliferation may alter the balance of power between the superpowers' alliances, represented by $p(\cdot)$. Because nuclear-armed clients would be stronger, the spread of weapons to a superpower's clients might strengthen its side relative to the other superpower's. The change in sign of $p(\cdot)$ between the superpowers reflects the fact that what strengthens one side's relative power must weaken the other's. We assume that, for any $T \subset S$ and $j \notin T$, $p(T \cup \{j\}) \geq p(T)$ if $j \in S_{US}$, and $p(T \cup \{j\}) \leq p(T)$ if $j \in S_{SU}$. In other words, the spread of nuclear weapons to one superpower's ally (weakly) shifts the inter-alliance balance of power in that superpower's favor.[7]

The second effect of proliferation is to alter the balance of power *within* each superpower's alliance, represented by the bracketed terms in the superpowers' payoffs. A client that got nuclear weapons would no longer need to rely so heavily on its superpower patron, as its nuclear arms would partially substitute for a patron's protection. Thus, a nuclear-armed client might be more assertive of its interests within the alliance or seek more autonomy from it. On the one hand, the patron's loss of influence over a newly nuclear-armed client

[6] If instead a subset of states R refrained from proliferation in breakdown, our results would still be valid, but with $S \setminus R$ replacing S below. This would make the conditions for nonproliferation more restrictive, since breakdown would not be as bad for the other players.

[7] Kroenig (2010, 2014) shows that this hypothesized effect of proliferation cannot account for the superpowers' attitudes toward it *generally*. However, we show below that, at least initially, the superpowers took it seriously, and this is crucial to explaining why the nonproliferation regime came about when it did.

would be good for the other superpower, who would face a less-cohesive opposing alliance and possibly find common interests with the erstwhile client. This is represented by $i(\cdot)$, which can be thought of as the total US influence over all states with respect to issues where US and Soviet interests are directly opposed. The sign of $i(\cdot)$ changes between the superpowers because one's loss of influence on such issues must be the other's gain. We assume that, for any $T \subset S$ and $j \notin T$, $i(T \cup \{j\}) \leq i(T)$ if $j \in S_{US}$, and $i(T \cup \{j\}) \geq i(T)$ if $j \in S_{SU}$. That is, the spread of nuclear weapons to one superpower's ally is (weakly) bad for that superpower and (weakly) good for the other, as the ally may now act less consistently with the interests of its patron superpower and more consistently with those of the other superpower.[8]

On the other hand, the patron's loss of influence is not fully recouped by the other superpower, because newly nuclear-armed states achieve greater autonomy from *both* superpowers, and so may pursue interests that neither superpower supports. Proliferation can thus shift influence, not just from one superpower to the other, but from the superpowers to the other states. This is represented by the functions $l_{US}(\cdot)$ and $l_{SU}(\cdot)$, which can be thought of as each superpower's loss of influence over nuclear-armed states on issues where the superpowers' interests are not opposed. For any $T \subset S$ and $j \notin T$, $l_{US}(T \cup \{j\}) \geq l_{US}(T)$ and $l_{SU}(T \cup \{j\}) \geq l_{SU}(T)$, so that these losses (weakly) grow as nuclear weapons spread.

"Power" and "influence" as we use the terms here should be construed quite broadly. A state's acquisition of nuclear weapons can affect a superpower's interests in many ways: deterring the superpower from using military force against that state; reducing its ability to coerce that state; triggering regional instability that might entrap the superpower or require its mediation; undermining the superpower's alliance structure by reducing the value of or need for its security guarantees; absorbing strategic attention that a superpower might

[8]This does not imply that one superpower sees an *overall* benefit to proliferation to a client of the opposing superpower: the former's gain in competitive influence may be outweighed by its losses due to the other effects of proliferation.

otherwise devote to other states; all in addition to the possibility of generating further proliferation (Kroenig, 2009, 2010, 2014). Each of these can be understood in terms of $p(\cdot)$, $i(\cdot)$, and $l.(\cdot)$. As examples, the risk of entrapment increases $l.$, while the reduced ability to coerce a nuclear-armed Soviet client may decrease p (the Soviet alliance is more powerful) but increase i (the freed client may drift toward the US).

For convenience, we normalize $p(\emptyset)$, $i(\emptyset)$, $l_{US}(\emptyset)$, and $l_{SU}(\emptyset)$ to zero. We also assume that $p(S) = i(S) = 0$ and $l_{US}(S) = l_{SU}(S) = l(S)$: if proliferation goes from zero to universal, the many resulting gains and losses in power and competitive influence for each superpower will cancel out, and each will suffer the same total loss of non-competitive influence. Finally, we assume that, for any $T \subset S$, $(1+\delta)\,|i(T)| \leq \frac{\delta^2}{1-\delta} l(S)$. That is, any *momentary* shift in influence between the superpowers due to some states getting nuclear weapons is no larger than the loss of influence that would result from *permanent* universal proliferation.

Collusion and Nonproliferation

We look for a Perfect Bayesian Equilibrium in which no state seeks nuclear weapons.[9] We require that no individual state has an incentive to deviate from nonproliferation, as is standard, but additionally that no *coalition* of states drawn from S and either superpower has an incentive to deviate together. A regime that managed to keep individual states in line, but could not prevent a concerted breakout by a group of "spoilers," possibly aided by a superpower, would not last long. Let S^1 be composed of every state $j \in S$ such that $v_j(j) + \delta\left[\sigma v_j(S) + (1-\sigma)v_j(j)\right] + \frac{\delta^2}{1-\delta} v_j(S) \geq \frac{1}{1-\delta} v_j(\emptyset)$.[10] As we will explain, S^1 is the set of potential spoilers.

[9]The conditions for a partial nonproliferation equilibrium, with some nuclear-armed states, are more restrictive for the other players since their value will be lower relative to breakdown.

[10]We also assume that $v_j(S^1) + \delta\left[\sigma v_j(S) + (1-\sigma)v_j(S^1)\right] + \frac{\delta^2}{1-\delta} v_j(S) \geq \frac{1}{1-\delta} v_j(\emptyset)$ for every $j \in S^1$. This renders the spoilers willing to collaborate in pursuit of nuclear weapons.

Proposition 1. *There is a universal nonproliferation equilibrium if and only if, for all* $j \in S^1$, $T \subset S^1$, *and* $a \in \{US, SU\}$*:*

1. $\sigma d \geq (1-\sigma)\left[(1+\delta)v_j(j) + \frac{\delta^2}{1-\delta}v_j(S) - \frac{1}{1-\delta}v_j(\emptyset)\right]$;

2. $\frac{1}{1-\delta}v_a(\emptyset) - |T|c \geq v_a(T) + \delta(1-\tau)^{|T|}v_a(T) + \delta\left[1-(1-\tau)^{|T|}\right]v_a(S) + \frac{\delta^2}{1-\delta}v_a(S)$.

If this equilibrium exists, it is enforced by superpower collusion to stop the spoilers.

Under this equilibrium, each state is deterred from seeking nuclear weapons in one of two ways. First, most states are deterred by the fact that their acquisition of nuclear arms would lead to the breakdown of the nonproliferation regime, leading other states to seek weapons. For these states, the resultant widespread proliferation would be worse than abiding by the nonproliferation regime, even if it meant giving up the chance to be the first, and temporarily the only, state to acquire nuclear weapons.

However, other states—the spoilers—have the opposite preference. These states would actually prefer seeking nuclear weapons, even if all other states followed, to complying with the nonproliferation regime along with the other states. This preference is formalized in the condition defining S^1. The right side is the value of abiding by the regime, while the left side is the value of cheating on it: the spoiler enjoys sole possession of nuclear weapons temporarily, but eventually all other states get nuclear weapons as well.

Obviously, the spoilers cannot be deterred from seeking weapons by the threat of the regime's subsequent breakdown, since they actually prefer this outcome. Instead they are deterred by the prospect that, if they seek nuclear weapons and are detected, the superpowers will collude to stop them, so that the resources invested in a nuclear program will be lost. In condition 1 above, the left side is the expected cost of pursuing nuclear weapons (sacrificing the investment d if caught and stopped), while the right side is the expected benefit of going undetected and getting nuclear weapons, over and above the value received from abiding by

the regime. Thus, this condition specifies that, for any spoiler, the expected cost of cheating on the regime outweighs the expected benefit.

These spoilers are not just a theoretical possibility. India sought nuclear weapons despite surely knowing Pakistan would follow and preferring that it not; it is hard to believe that North Korea would have been deterred from pursuing nuclear weapons if it thought that South Korea, or any other countries, would get them in response. In a counterfactual world without superpower enforcement of nonproliferation, it is easy to imagine other spoilers. For instance, West Germany, which had to contend with the massive conventional forces of the Warsaw Pact and the uncertain reliability of its US security guarantee, might have resorted to nuclear arms, in spite of the likelihood that other European states would follow.

For their part, the superpowers enforce nonproliferation because the cost of doing so is outweighed by the losses they will suffer from proliferation if they shirk. For each possible set of spoilers, and each superpower, condition 2 above requires that the superpower's value of enforcing the regime at least equal its value of shirking, wherein the superpower allows the set of spoilers to get nuclear weapons, but soon faces proliferation by the other states.[11]

This result synthesizes the grand bargain and cartel views of the nonproliferation regime, and also exposes the flaws of each view when considered on its own. The grand bargain envisions a set of states that agree to eschew nuclear weapons so long as other states do so, too. And indeed, this is an apt description of the way the equilibrium looks from the point of view of the non-spoiler states. These states prefer nonproliferation to widespread proliferation, are willing to give up weapons themselves to support the former, and will renege only if other states cheat on the bargain. These states abide by the regime voluntarily, rather than being coerced into compliance by the superpowers. However, this in itself is not enough to make the regime viable. In the absence of superpower enforcement, the spoiler states

[11]This nonproliferation regime is the least demanding one possible for the superpowers, because they are only required to stop *spoilers* caught pursuing nuclear weapons.

would seek nuclear weapons, and in response other states would pursue nuclear weapons, and yet more states would acquire weapons in response to these, so that proliferation would eventually be widespread.[12] The grand bargain is thus not robust to spoilers.

To make the regime—and the underlying grand bargain among the non-spoilers—viable, the spoilers must be coerced into nonproliferation so that it is safe for the non-spoilers to abide by their bargain. From the spoilers' point of view then, the nonproliferation equilibrium looks much more like the cartel: the superpowers collude to strong-arm these states into the regime. The flaw in the cartel view is that because this enforcement is expensive for the superpowers, it is only worth doing if, by coercing just a few states, the superpowers can make nonproliferation among a much wider set of states possible. Thus, the superpowers are willing to form a cartel only because many states needn't be strong-armed into nonproliferation at all. In short, the cartel is needed to render the grand bargain robust to spoilers, and the grand bargain is needed to make the cartel affordable.

The Origins and Roles of the NPT

We first discuss the origins of the NPT in a shift in the superpowers' perceptions of the effects of proliferation. We then explain how the NPT itself affects the underlying parameters that govern the viability of the nonproliferation regime. This in turn leads to the observable implications of our theory that are tested in the subsequent section. We use the following result to make explicit how the regime's viability is affected by the parameters of our model.

Proposition 2. *The nonproliferation equilibrium only exists if α, σ are high enough and c is low enough, and is more likely to exist if τ is higher and $|S^1|$ is lower.*

Recall that α governs the importance of the intra-alliance effects (a superpower loses

[12]Notice that the issue here is not the quality of monitoring. Whether spoilers are detected before they get nuclear weapons or not, they will soon be followed by non-spoilers.

influence over a nuclear-armed client) relative to the inter-alliance effects (a superpower's side gets stronger with nuclear-armed clients) of proliferation. In the limiting case where $\alpha = 0$, there are no intra-alliance effects, and proliferation simply increases one side's power and decreases the other's by the same amount, so that proliferation is zero-sum. Then for any set of states that get nuclear weapons, one superpower will be left at least equally well off by this proliferation. This superpower will be unwilling to pay the costs of enforcing nonproliferation against these states, and anticipating this, the other superpower will not try either, since enforcement would fail without the first superpower's help. So, if proliferation is zero-sum, neither superpower will ever enforce nonproliferation in equilibrium.

As α rises from zero, proliferation has increasingly strong intra-alliance effects. Because one superpower's loss of influence over a nuclear-armed client is not fully recouped by the other, proliferation becomes increasingly negative-sum. Now, if nuclear weapons spread far enough, *both* superpowers could be left worse off because of their net loss of influence. Once α is high enough, the anticipated joint loss of influence from proliferation will outweigh the costs of stopping it, and the superpowers will become willing to institute a nonproliferation regime. Essentially, α controls the size of the net benefits to the superpowers from nonproliferation.

The superpowers' perceived value of α changed over the course of the early Cold War, explaining why the regime was not instantiated until the late 1960s. In principle, the superpowers could have pushed the NPT forward as early as the 1950s, once both had nuclear weapons and established alliances, and thus something potentially to lose from further proliferation. However, until well into the 1960s, each superpower instead saw substantial advantages to be gained from selective proliferation to certain of their clients. The US perceived nuclear cooperation and weapons-sharing with its European allies to be a valuable counter to the USSR's superior conventional forces, and these initiatives were prioritized over nonproliferation. As late as the mid-1960s, the US interest in sharing weapons with West Germany in the form of the Multi-Lateral Force (MLF), adamantly opposed by the Soviets,

was an important obstacle to creating the regime (Brands, 2007). High-level US officials also privately advocated the consideration of giving weapons to India and Japan, reasoning that this would help to balance the threat from nuclear-armed China.[13] For its part, the USSR greatly facilitated China's development of the bomb in the 1950s, providing expertise and materials, and even building a model weapon intended for China to copy (Timerbaev, 1999). In short, both superpowers focused on the inter- as opposed to intra-alliance effects of proliferation, suggesting they perceived the importance of the latter (that is, α) to be low.

The experience of dealing with newly nuclear—and newly obstreperous—allies led the superpowers to reassess the intra-alliance effects of proliferation, raising their perceived value of α. The estrangement of China from the USSR allowed the US to play one against the other, while the ructions France generated in NATO were surely to the USSR's liking. However, after ending its alliance with the USSR, China proselytized for a more radical version of communist ideology that neither superpower favored, while France sought to preserve control over its remaining colonies against both superpowers' desires for colonial independence. In the US, elites increasingly recognized that nonproliferation was needed to limit the superpowers' joint loss of influence. High-level deliberations after China's nuclear test led to the US dropping its support for the MLF in favor of establishing a nonproliferation regime (Brands, 2007). A similar evolution of views took place in the Soviet Union (Potter, 1985). With both superpowers weighing the intra-alliance effects of proliferation more heavily, both became more willing to pay the costs of enforcement under a nonproliferation regime, and so the NPT was agreed. Thus, the increase in α explains the origins of the NPT.

The NPT contributes to the viability of the incipient nonproliferation regime in four ways. First, the inspections which non-nuclear signatories are required to accept increase the chance

[13] "Principals Committee Meeting, Memorandum of Conversation, November 23, 1964." US Department of State, *Foreign Relations of the United States* 1964-1968 Arms Control and Disarmament, Vol XI, p.122-125.

that a covert nuclear weapons program will be detected and subsequently stopped (raising σ). This decreases the willingness of spoilers to try to cheat under the regime, and thus also renders enforcement cheaper for the superpowers. Second, the same inspections also make it easier to catch a superpower surreptitiously helping a state with its program or simply allowing it to proceed (increasing τ). This increases the willingness of each superpower to enforce nonproliferation, secure in the knowledge that the other superpower is doing its part and thus that their efforts will be effective, and decreases the temptation to enable favored states to get nuclear weapons. Third, the willingness of non-nuclear states to sign the NPT, and thus voluntarily subject themselves to better monitoring, reveals that most states are not spoilers.[14] This lowers the superpowers' perceived costs of enforcing the regime (by decreasing $|S^1|$), because it enables the superpowers to confirm that only a few holdouts will have to be strong-armed into nonproliferation. And finally, the NPT served as a device to coordinate all states on the nonproliferation equilibrium, rather than the widespread proliferation that might otherwise result. By leading non-spoilers to expect nonproliferation to be upheld, it encouraged them to abide by it and contribute to the superpowers' efforts to enforce the regime, lowering the costs of enforcement (c).

Our theory of the nonproliferation regime, and the origins and roles of the NPT within it, offers at least three observable implications. First, our model assumes that collusion between the superpowers is central to the regime's establishment and enforcement, so the first implication is that this collusion should have taken place, during negotiations over the regime and in reactions to states' noncompliance with the regime.

Hypothesis 1. *The superpowers will collude with one another on nonproliferation concerns and press one another to comply with their side of the collusion terms.*

Second, the theory implies that the superpowers should pressure the other states into

[14]To be clear, our model assumes that all players know which states are spoilers. More realistically, this would be uncertain, and joining the NPT would be an important signal.

joining the NPT. If a state refused to join, it would increase the difficulty of catching it pursuing nuclear weapons covertly, undermine the willingness of other states to join and comply with the treaty, and thereby increase the superpowers' costs of enforcing the regime. Since each superpower ought to have more leverage over its own clients than other states, we expect that each would be held responsible for policing its own clients, while the other superpower would be expected not to interfere in or obstruct this policing. We also expect the superpowers to apply this pressure only when it is actually perceived as necessary to induce a state to join the NPT, and only when it is perceived to have some chance of success.

Hypothesis 2. *Each superpower will pressure other states, especially its own clients, to join the NPT, focusing its efforts on cases where pressures are likely to be both necessary and effective, and neither superpower will undermine the other's efforts.*

Third, the superpowers should collude to stop any state that is revealed to be (potentially) pursuing nuclear weapons, as doing otherwise could lead to the breakdown of the regime. Here again, we expect that each superpower would be most involved in the policing of its own clients, while the other superpower would be expected not to aid the erstwhile client.

Hypothesis 3. *Each superpower will apply pressure to prevent other states, especially its own clients, from moving toward acquiring nuclear weapons. Neither superpower will offer assistance to a state suspected to be pursuing a nuclear weapons program.*

Empirical Tests

We turn now to testing these observable implications of our theory. Looking at archival and secondary sources, we evaluate the history of nonproliferation-related interactions between the superpowers, superpower responses to those states that hesitated to join the NPT, and finally superpower responses to suspicions of nuclear weapons programs in various states.

We also demonstrate that neither the grand bargain nor the cartel theory can account for the evidence on its own. Extensive documentation of our sources, the set of cases we employ, and our coding of data is available in the online appendix.

Hypothesis 1: Superpowers Collude over Nonproliferation

While we do not expect collusion to be explicit in all cases, a total absence of observable collusion would call our theory into question. We examined declassified documentation of private meetings between the superpowers to assess whether collusion occurred, focusing on episodes particularly relevant to nonproliferation: the NPT negotiations, and instances when states came under suspicion of pursuing nuclear weapons. We found ample evidence that when the superpowers discussed proliferation issues, they did so in collusive terms.

The US and the Soviet Union had numerous disputes in negotiating the NPT, and the process was at times seriously stalled due to their disagreements (Brands, 2007). However, when it came to dealing with other states, their discussions became remarkably cooperative. First, the superpowers sought to coordinate their mutual efforts to corral states into the treaty. In joint meetings in 1967 and 1968, high level US and Soviet officials discussed concern over which states would join and measures the superpowers were taking to promote signature of the treaty. They reported on prospects for signature among their respective allies Japan and Latin American countries in the case of the US; Romania and some African countries in the case of the Soviet Union. After the NPT was opened for signature, senior US and Soviet officials exchanged explicit assessments of whether Japan, Brazil, Argentina and India would sign, and expressed hopes that the other superpower would use its leverage to cajole the holdouts.[15] The US and USSR also worked together to control the process of the treaty negotiations; drafts of the treaty were prepared privately by the superpowers before being presented to other states (Swango, 2014).

[15]See online appendix for quotes and citations from declassified State Department records.

Finally, the superpowers often presented a united front to the rest of the international community, and this evidence of their collusion was noticed by other states. For example, Soviet and US delegations regularly coordinated their strategies on nonproliferation discussions at the UN General Assembly (Quester, 1981, 228). While the superpowers attempted to keep their cooperation private, numerous states, including US and Soviet allies, decried the treaty's discriminatory nature, referring not to the official discrimination between nuclear haves and have-nots, but to the US-Soviet hegemony they saw the regime as entrenching.

We also found instances of explicit US-Soviet collusion in responding to suspicious nuclear activity by another state. In surveying cases where a state was suspected of pursuing a nuclear weapons program, we find that such states were most often pressured by their patron superpower, without comment or interference by the other superpower. In this respect, collusion is implicit in the other superpower's acquiescence to the patron's pressure. However, there are at least two cases—North Korea and South Africa—where collusion was explicit in requests from one superpower to the other to police the state in question.

In the mid-1980s, US satellites detected the construction of nuclear reactor at Yongbyon. US officials approached the Soviet Union, highlighting its obligations under the NPT and calling into question its provision of nuclear technology assistance to North Korea. The USSR responded positively, and during the next visit to Moscow of North Korean KWP Secretary Kang Song San, the USSR pushed for North Korea to sign the NPT, offering to provide new nuclear energy reactors if it did (Mazarr, 1995, 40-41). The episode shows the US pressing the USSR to act on the obligation implicit in the superpowers' collusion, and the USSR willing to comply and even offer incentives. It suggests that the DPRK proliferation issue was not one of opposition between the two superpowers, but rather cooperation.

We observe a similar incident in the case of South Africa, but with the roles reversed. In July 1977, a Soviet reconnaissance satellite detected a site for a possible South African nuclear test. The USSR passed the information to the US, with a personal request from

Secretary Brezhnev to President Carter for assistance in stopping the test (Richelson, 2007, 278). Several days later Carter replied to Brezhnev that the US assessment was in agreement. Collusion in pressuring South Africa continued during the following months, and declassified memos refer to ongoing "quiet cooperation" on the issue.[16] This cooperation was kept private. Publicly, Soviet newspapers alleged that the US was helping South Africa with a nuclear program. However, declassified documents reveal a recognition on the US side that the USSR was likely using the South Africa issue to divert attention from international criticism of the superpowers failing to curb the growth of their own arsenals.[17] This connection between private and public approaches suggests that the superpowers had a considerable understanding of each others' real interests in preventing proliferation.

Our findings reinforce the conclusions of the most recent historiography of the NPT, which has documented the superpowers' discussions of mutual interests in maintaining dominant positions within their alliances, their support for the NPT over allied opposition, and their attempts to control the drafting of the treaty itself (Brands, 2006, 2007; Gavin, 2004, 2010; Popp, 2014; Swango, 2014). Our points on the superpowers' coordination of efforts to get treaty signatures, and cooperation in dealing with suspected nuclear weapons programs in South Africa and North Korea, contribute important new examples to the increasingly strong body of evidence on collusion between the superpowers over nonproliferation.

Hypothesis 2: Superpowers Pressure States to Join the NPT

The superpowers have a clear interest in other states joining the NPT, as this signals their commitment to eschew nuclear weapons and eases the monitoring of that commitment. Our

[16]Department of State, Leslie Gelb to Cyrus Vance, "Your Meeting with Gromyko: South African Nuclear Issue." September 21, 1977. Digital National Security Archive.

[17]U.S. Embassy, Soviet Union, "Soviet Press Again Attacks South African Nuclear," September 10, 1980. Cable number:14927. Digital National Security Archive.

theory also implies that the number of states which the superpowers needed to pressure to join should be relatively small; most states should join the treaty voluntarily. To evaluate this hypothesis, we assess how the superpowers acted toward those states they judged as technologically capable of, and potentially interested in, seeking nuclear weapons. Such states would pose the greatest threats to the nonproliferation regime, since states that lacked either capability or interest would be unlikely to acquire nuclear weapons even if they stayed out of the treaty. Because our theory posits that the superpowers are the main enforcers of nonproliferation, our selection of cases relies on the superpowers' own contemporary assessments of which states were worrisome. We intentionally do *not* use present-day assessments of states' historical nuclear interest and capability. Such assessments would pose an unfair test for the theory, because the superpowers were, at the time, simply unaware of what would later be revealed about certain states' nuclear programs, and thus would not be predicted to do anything about these programs.

For the US side, we use a series of intelligence estimates from 1957 to 1974 that assess states' technological capability for, and, after 1960, interest in, developing nuclear weapons. Unfortunately, the analogous documents are not available from the Soviet side. The documents we do have indicate that the US saw the Eastern bloc states as under the tight control of the USSR, which would not allow them to develop nuclear weapons.[18] From the Soviet side, certain Eastern European states were likely considered nuclear-capable, and the USSR would probably have added North Korea to the list, as the state had received Soviet nuclear assistance in the 1950s and 1960s (Szalontai and Radchenko, 2006).

We also use other declassified documents, containing superpower assessments of states' positions on the NPT, to evaluate whether the superpowers were uncertain or suspicious of a given state's intent toward nuclear weapons. As long as some doubt remains, we expect the

[18]Memorandum of Feb 12, 1963, From Secretary of Defense McNamara to President Kennedy. National Security Archive. Quoted in Bunn (1992, 68).

superpowers to explicitly pressure the state to join the treaty. However, if a state expresses a resolute position against the treaty, and it becomes apparent to the superpower that no feasible measures would alter its position, then it would be reasonable for the superpower to reassess whether any available pressure is worth exerting. Additionally, if a state delays joining the NPT, but the superpowers are confident that this is driven by something other than an interest in nuclear weapons, then we do not expect the superpowers to apply pressure.

We then assess superpower behavior towards each state. In some cases, the superpowers took no action; in others, their actions involved only informational meetings and diplomatic discussions with the state in question; and in still others, the superpowers resorted to stronger pressures, such as explicit threats or offers of benefits in exchange for joining the treaty. In the results presented in Table 1, a coding of "yes" indicates that the observed superpower behavior is consistent with our theory expectations. A coding of "partial" means that the limited historical record is supportive for the theory, but additional information would be needed for a more confident assessment. A coding of "mixed" implies that that we found mixed support for the theory: the superpowers pursued the expected action, but either to a lesser extent or inconsistently. Finally, a "no" coding indicates evidence of superpower behavior opposed to our expectations, such as assisting a state in avoiding NPT signature, or failing to pay attention to a possible nuclear state's rejection of the NPT.

To summarize, we see that a number of states assessed to be nuclear-capable did not join the NPT completely voluntarily. Rather, when voluntary participation did not appear forthcoming, these states were pressured, largely as expected though not always successfully, by the superpowers. By contrast, but also as expected, the superpowers paid little attention to clear joiners. We also observe some interesting changes in the level of pressure applied in cases where doubts regarding signature are introduced or dispelled. South Korea, for example, was an early supporter of the NPT, and there is initially little action by the US to persuade it to sign the treaty. However, when South Korea was identified as having nuclear

capabilities and delayed ratifying the treaty in the early 1970s, the US applied pressure to encourage speedier ratification. In the case of Israel, pressure and incentives were attempted until it became clear to key negotiators that Israel had already developed a nuclear device, so that no available means of pressure would be effective. In no case did we find any evidence of one superpower undermining the other's efforts to pressure a state into joining.

Finally, we note that the evidence does not support either the grand bargain or the cartel theory alone. If the grand bargain were correct, then all states should be better off with the NPT, and all should join voluntarily given that they expect others to do so. This was clearly not the case, and for a number of states the superpowers had to go to considerable lengths to ensure their participation. Additionally, the fact that this pressure was at times ineffective suggests that some states had very strong incentives to stay out of the treaty, even as most others joined. If instead the cartel view is correct, then all states would have to be pressured to join the treaty, and all would do so with a desire to cheat. However, the evidence shows that numerous nuclear-capable states, even those that had previously considered weapons programs, joined the regime with little or no pressure from the superpowers.

[Table 1 about here.]

Hypothesis 3: Superpowers Pressure States not to Proliferate

As in the previous hypothesis, if a state is suspected of making a move towards nuclear weapons, its patron superpower ought to have the most leverage over it, and so we expect its patron to be the one to apply pressure, while the other superpower refrains from assisting the aspirant. With non-aligned states, we expect that either or both superpowers would apply pressure, and neither should assist the errant state in anyway. To test this, we considered all cases where a state became suspected of pursuing a nuclear weapons program, and evaluated the superpowers' response. Our findings are presented in Table 2. In each case, we assess what the superpowers perceived about a state's activity, and how they responded. A coding

of "yes" indicates that the superpower acted as our theory predicts, taking steps to restrain a client's progress towards nuclear weapons or its access to dual-use nuclear technology needed to make progress in the future. As before, a coding of "mixed" means that the superpowers sought to restrain the proliferant, but either to a lesser extent or inconsistently. "Partial" implies that the limited historical record is supportive for the theory, but additional information would be needed to reach a confident assessment. Finally, a "no" coding indicates that the superpower did not behave as our theory predicts, instead aiding a client state with a nuclear weapons program or turning a blind eye to apparent attempts to proliferate.

We find general support for Hypothesis 3, with a few mixed cases. In the majority of cases, the superpower patron of each nuclear aspirant intervened with threats or incentives to prevent the nuclear program from progressing, so that the "policing" element of superpower relations with nuclear aspirants is clear. Examples of policing actions by the superpowers included direct instructions to stop the suspicious activity, threats to withdraw some military or economic support, restrictions on suppliers and access to technology, and high-level diplomatic pressure. By contrast, we find no cases where the opposing superpower provided assistance, reassurance, or any support for the fledgling nuclear state. To investigate this point, we surveyed a wide range of primary and secondary sources for evidence that such assistance occurred, and also looked for any accusations that might have been made by one superpower against the other for such a transgression. Although it is difficult to prove that neither superpower sought to lure away the opponent's ally by offering nuclear support, we have not located any evidence of such behavior in all the cases surveyed.

Neither the grand bargain nor the cartel theory fit this evidence. The nuclear weapons states were widely perceived as reneging on their end of the grand bargain. No significant disarmament on the part of any of the nuclear-weapons states occurred until the very end of the Cold War. Moreover, there is no evidence that NPT membership increased a state's chance of receiving nuclear energy assistance (Fuhrmann, 2009*b*). Despite this: hardly any of

the non-nuclear weapons states cheated on the regime; those few that did were not motivated by the need to punish the nuclear-weapons states for not disarming; and these were stopped from getting nuclear weapons not by the prospect that others would follow but by the intervention of the superpowers. None of these three facts is consistent with the grand bargain theory. While the superpowers' enforcement of nonproliferation is consistent with the cartel view, the small number of cases in which such enforcement was needed is not. Most states showed no interest in bucking the nonproliferation regime and abided by it voluntarily, without pressure from the superpowers.

[Table 2 about here.]

Implications

We conclude by discussing the implications of our study for the broader literature on nuclear proliferation. Hymans (2010) argues that the fundamental question for students of proliferation is why so few of the nuclear-capable states ended up acquiring nuclear weapons: some six nuclear-weapons states out of more than 40 estimated to be nuclear-capable by 1970. Our answer is that once the superpowers realized nonproliferation was necessary to preserve their influence and set about colluding to enforce it, many states chose not to realize their latent nuclear capacity. A few of these states refrained because they were deterred by the punishment the superpowers would impose if they were caught seeking nuclear weapons. But most did so because they preferred nonproliferation to widespread proliferation, and were confident enough that the superpowers would be able to curtail proliferation to voluntarily forego weapons for themselves. These latter states' willing compliance with nonproliferation made the regime's enforcement affordable for the superpowers. Moreover, we presented evidence, consistent with this answer, that the superpowers explicitly colluded to create the nonproliferation regime and to cajole the few worrisome states into joining and complying

with it. Within this regime, the NPT serves to ease detection of cheating by either these states or the superpowers, to identify potential spoilers, and finally to coordinate states' expectations on widespread nonproliferation.

This strongly suggests that the nonproliferation regime, and the treaty that coordinated states onto behaving in accordance with it, substantially reduced proliferation, relative to what would have occurred in its absence. To explain, we need to specify exactly what is meant by "the regime" and "its absence", since the latter is the appropriate counterfactual for assessing the regime's overall effect. In our theory, the regime is an equilibrium in which the superpowers are able and willing to enforce nonproliferation because of the voluntary compliance of non-spoiler states, whose support is driven by the expectation that others will either not seek weapons or be stopped from getting them. The absence of the regime is an equilibrium in which states expect spoilers to get nuclear weapons and others to follow, eventually resulting in widespread proliferation, so that many non-spoiler states are unwilling to eschew nuclear weapons, which in turn makes the superpowers unwilling to stop them. The NPT coordinates the movement of all states from the latter equilibrium to the former.

To conclude that the regime did *not* substantially reduce proliferation, one of two claims would have to be true. First, that breakdown would not occur in the absence of the regime: the numerous states that were initially—or might in response become—interested in nuclear weapons would prefer to abstain, even knowing that they would not be stopped and that proliferation would eventually be widespread. Or second, that in the absence of the NPT to coordinate states on nonproliferation, the superpowers would be able and willing to stop proliferation, even given that many states were seeking nuclear weapons and would thus have to be coerced. The history of states' nuclear decision-making and of the superpowers' attitudes toward proliferation presented here shows that neither claim is plausible.

By contrast, the most recent previous research concludes that the regime has had little effect on proliferation (Sagan, 2011). Although several studies find that NPT membership

is associated with a reduced risk of seeking or getting nuclear weapons (Fuhrmann, 2009*a*, 2012; Jo and Gartzke, 2007; Kroenig, 2010), some have suggested it may only be that NPT members are mostly those states that don't want nuclear weapons anyway, so that the treaty does not constrain states so much as screen them (Fuhrmann, 2012; Jo and Gartzke, 2007).[19] Similarly, Hymans (2006) and Solingen (2007) argue that the regime only appears successful because it prohibits things that few states want. Fuhrmann (2009*b*, 2012) shows that NPT membership has little effect on the provision of peaceful nuclear assistance, and that, having received such assistance, NPT membership has little effect on a state's subsequent pursuit of nuclear weapons. Jo and Gartzke (2007) find that the adoption of the NPT (measured by the proportion of states that are members) is not associated with a reduction in the initiation of weapons programs, and Kroenig (2010) finds that the establishment of the NPT doesn't itself affect the provision of sensitive nuclear assistance. Finally, Hymans (2012) argues that it is managerial incompetence due to domestic politics, rather than the nonproliferation regime, that explains why states seeking nuclear weapons after the regime's creation have been less likely to succeed and taken much longer to get them when they do.

Our theory yields a different interpretation of these findings that is consistent with the regime substantially reducing proliferation overall. Even if NPT membership serves *only* to screen voluntary compliers, the wide joining of the NPT may still have a large effect by reinforcing the superpowers' belief that enforcement will be affordable and thus that the regime is viable. States that comply may simply not want nuclear weapons, as Hymans (2006) and Solingen (2007) find, but this likely depends in many cases on the belief that most other states are not seeking them, and in other cases on the belief that pursuing weapons would bring international pressure—both beliefs that only exist because of the regime.

The fact that the receipt of peaceful nuclear assistance and its link to nuclear weapons programs are unaffected by whether a state is an NPT member, as Fuhrmann (2009*b*, 2012)

[19]Kroenig (2010) argues that the NPT does indeed constrain states.

shows, is also explicable within our framework. The existence of the regime makes peaceful nuclear assistance less dangerous, regardless of whether the recipient is an NPT member, because even if an occasional state receiving assistance ends up getting nuclear weapons, the regime makes a subsequent breakdown into widespread proliferation less likely. Similarly, the regime makes the rare provision of weapons-relevant nuclear assistance more tempting to some potential suppliers, who can be assured that any resulting proliferation will be isolated. So, it is not surprising that the establishment of the regime is not associated with a reduction in such assistance, as Kroenig (2010) found. Finally, though Hymans (2012) is surely right that incompetence played an important role in the long timelines of later nuclear programs, the regime's prevention of a broad market in nuclear weapons likely also contributed.

We close with the hope that scholars of the politics of nuclear weapons will find this study helpful in developing new avenues for research and interpreting new findings. Our theory and evidence provide an overarching picture of the constellation of states' interests in and expectations about nuclear weapons that gave rise to the nonproliferation regime. This theory is built upon, but also clarifies and integrates, previous research on particular elements of this constellation. It should thus form a solid foundation for further research, including theorizing about the evolution of the nonproliferation regime since the Cold War's end, evaluating present-day fears about a "nuclear tipping point," and explaining the occurrence of and responses to the challenges to the regime posed by North Korea, Iran, and others.

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Table 1: Superpower pressure for NPT membership

State	Perceived nuclear intentions	Theory Expectation	Observed behavior details (indicator of intentions, superpower response)	Theory support
Assessed as nuclear-capable (1957 - 1974 intelligence estimates)				
Australia	None or low. Superpowers expect state to join NPT, or state has low weapons interests or capabilities	Mild to no pressure by allied superpower	State supports NPT, ratification hesitation by some domestic political groups. Limited US attention (informational visits)	yes
Belgium			Early support of NPT, no US pressure	yes
Canada			Early support of NPT, no US pressure	yes
Italy			Early support of NPT, no US pressure, some diplomatic attention	yes
Sweden			Early support of NPT, no US pressure	yes
Switzerland			Some hesitation on treaty, few weapons interests, no US pressure	yes
Brazil			Opposes NPT, but low evidence of weapons intentions. US applies mild pressure for NPT, diplomatic attention by US and USSR, some incentives.	mixed
Argentina			Opposes NPT, but low evidence of weapons intentions; some pressure by the US on nuclear facilities	mixed
Poland			Early support of NPT; no pressure by USSR	yes
Czechoslovakia			Early support of NPT; no pressure by USSR	yes
Yugoslavia			Some opposition to NPT, early signer; likely diplomatic attention by USSR	partial
Romania			Opposes NPT, nuclear tech interests, early signer; possible USSR influence	partial
West Germany	Uncertain. Superpowers have doubts about states intentions to join NPT.	Explicit pressure by allied superpower	High level concern by the US, repeated reassurances	yes
Japan			Some hesitation in signing NPT (seeks to preserve full fuel cycle capability), urging by the US to sign, concerns expressed by USSR	yes
South Korea			Signed NPT early but did not ratify quickly, raising concerns. US applied pressure, threatened bilateral relations if treaty not ratified	yes
Israel			Initial pressure by the US, attempts link weapons sales, presidential level entreaties. Pressures unsuccessful, does not sign NPT, US stops pressuring.	yes
South Africa			Does not sign NPT; general sanctions and isolation, some US pressure against nuclear program, denial of nuclear technology	yes
India			India rejects treaty in 1968. Some US pressure, attempts at soliciting Soviet pressure, some Soviet pressure	mixed
Pakistan			Rejects NPT. Few strong pressures by US to encourage NPT signature, but later pressure on nuclear program.	mixed
Assessed as nuclear capable by USSR				
North Korea	Uncertain	Explicit pressure	Opposes NPT but also has low technological capabilities, low level but ongoing pressure by USSR, denial of nuclear technology	yes

Table 2: Superpower enforcement of the NPT

Nuclear Aspirant	Empirical evidence on superpower response	Theory support
South Korea	**US pressure to end program:** High level US threats to end security relationship & remove troops, threats to stop financing for civilian program, pressure to cancel purchases of nuclear technology, continued US attention to status of nuclear research.	yes
Taiwan	**US pressure to end program:** Repeated US intervention to stop procurement of reprocessing facility, threatened US support of civilian nuclear program, threatened general relationship w/US.	yes
Israel	**Limited US pressure to end program:** Attempts to limit nuclear program in 1968, some limited attempts in 1969. US intelligence assesses Israel likely has weapons in 1968. By 1969 US negotiations seek to prevent at least deployment of nuclear weapons, followed by tacit acceptance of Israeli nuclear weapons.	mixed
Pakistan	**US pressure to end program:** In late 1970's US interference to stop reprocessing plant acquisition, economic sanctions to curb nuclear program. 1980's-pressure decreases, sanctions waived. Reagan administration overlooks Pakistani nuclear developments in favor of military and economic cooperation. Congress remains concerned, passes further econ and military sanctions legislation.	yes/ followed by mixed
Iraq	US intelligence attention focused on Iraq, but no observed pressure to stop program. Iraqi interests in nuclear weapons perceived, but assessed as technologically limited. Significant advances towards nuclear weapons not detected until after Gulf War.	not detected
Iran	**US pressure to restrict access to fuel cycle technology:** Prior to Iranian revolution, US requested safeguards from third party suppliers. After revolution, US repeatedly pressured states (Germany, Spain, Argentina) to withdraw from contracts for finishing Bushehr reactor and for fuel fabrication & heavy water production	yes
South Africa	**Soviet coordination with US on pressure:** USSR monitored weapons activities and called for US pressure, US response was present but intensity unclear. US pursued trade embargoes, demarches, attempts to stop possible nuclear test.	yes
Brazil	**US and Soviet pressure to restrain fuel cycle acquisition:** High-level, persistent US pressure on Brazil and Germany opposing nuclear technology deal, esp reprocessing and enrichment technology. In 1976, additional pressure on Germany by USSR.	yes
Argentina	**US intervention with suppliers of nuclear technology:** US pressure on nuclear fuel cycle suppliers to prevent sales of technology to Argentina, including heavy water facilities.	yes
India	**Limited leverage by superpowers to apply pressure**: Some attempts to restrain program. India was closer aligned w/ USSR in early 70's; mixed response by the US to nuclear tests; USSR pressure for safeguards on heavy water in response to US requests.	mixed
North Korea	**Low level efforts by USSR to restrain DPRK capabilities:** USSR denial of technology access but few direct threats or incentives to DPRK, pressures by USSR for NPT signature in exchange for nuclear technology.	yes
Yugoslavia	**No evidence of interaction with USSR on nuclear program:** Program proceeded slowly due to domestic constraints; no evidence of Soviet assistance or opposition, possible Soviet tech denial.	no/ partial
Libya	**Pressure by USSR for safeguarded faculties, pressure by US to restrict nuclear sales:** USSR provided reactor technology, but not until Libya agreed to NPT and safeguards. US pressured other counties (Belgium) to cancel nuclear technology contracts.	yes