

State Compliance and the Track Record of International Security Institutions: Evidence from the Nuclear Nonproliferation Regime

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Abstract

Why do states choose to comply with international security institutions, and what factors drive changes in compliance behavior over time? This article argues that these institutions are based on a fundamental bargain among members—each is willing to comply only so long as others do—but there is often uncertainty about the compliance of others. The track record of the institution provides information that helps to resolve this uncertainty. As time passes with few violations, states will be more likely to comply themselves; evidence of increasing noncompliance, on the other hand, will make states more likely to cheat. Analysis of data on nuclear weapons programs from 1968 to 2010 finds that members of the nuclear nonproliferation regime are more likely to pursue nuclear weapons when there have been a greater number of recent violations of the regime. These findings point to a more dynamic view of international security institutions than has generally been recognized in the literature.

Resumen

¿Por qué los Estados deciden cumplir con las instituciones internacionales de seguridad y qué factores impulsan los cambios en el comportamiento de cumplimiento a lo largo del tiempo? En este artículo, se sostiene que estas instituciones se basan en un acuerdo fundamental entre sus miembros (cada uno está dispuesto a cumplirlo solo si los demás lo hacen), pero a menudo existe incertidumbre sobre el cumplimiento de los demás. El historial de la institución proporciona información que ayuda a resolver esta incertidumbre. A medida que pase el tiempo con pocas infracciones, será más probable que los estados cumplan por sí mismos; la evidencia de un creciente incumplimiento, en cambio, hará que los estados sean más propensos a hacer trampa. El análisis de los datos sobre los programas de armas nucleares de 1968 a 2010 revela que los miembros del régimen de no proliferación nuclear son más propensos a buscar armas nucleares cuando ha habido un mayor número de infracciones recientes del régimen. Estos resultados apuntan a una visión más dinámica de las instituciones de seguridad internacionales de lo que generalmente se ha reconocido en la literatura.

Résumé

Pourquoi les États choisissent-ils de se conformer aux institutions internationales de sécurité et quels sont les facteurs qui favorisent des évolutions du comportement de conformité au fil du temps ? Cet article soutient que ces institutions reposent sur une négociation fondamentale entre membres—chacun n'étant prêt à se conformer que tant que les autres le font -, mais il y a souvent une incertitude quant à la conformité des autres. Le bilan des institutions fournit des informations qui contribuent à

remédier à cette incertitude. Si le temps passe avec peu de violations, les États seront davantage susceptibles de se conformer ; à l'inverse, les preuves d'une non-conformité accrue rendront les États davantage susceptibles de tricher. Une analyse de données sur les programmes d'armes nucléaires de 1968 à 2010 montre que les membres du régime de non-prolifération nucléaire sont davantage susceptibles de poursuivre les armes nucléaires lorsqu'il y a eu un plus grand nombre de violations récentes du régime. Ces conclusions suggèrent une vision plus dynamique des institutions internationales de sécurité que celle qui a généralement été reconnue dans la littérature.

Keywords: nuclear nonproliferation regime, nuclear proliferation, international institutions

Palabras clave: régimen de no proliferación nuclear, proliferación nuclear, instituciones internacionales

Mots clés: régime de non-prolifération nucléaire, prolifération nucléaire, institutions internationales

The nuclear nonproliferation regime has long been hailed as one of history's most successful international security institutions (Cirincione 2008), enjoying high levels of compliance and near-universal membership. In recent years, however, many have been sounding the alarm about the decline of the regime, arguing that efforts by some states to circumvent the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), and the ongoing pursuit of nuclear weapons both within and outside of the treaty, make others less likely to comply with the regime in the future (Williams and Wolfsthal 2005; Perkovich 2006; Sauer 2006; Allison 2010; Müller 2010; Kaplow and Gibbons 2015).¹ These analysts see the track record of the nuclear nonproliferation regime—in terms of past compliance and other factors—as an important element in the decisions of member states to comply with their obligations in the future. On the other side of this debate, several scholars see the regime's health as largely independent of its past performance (Walsh 2005; Fields and Enia 2009; Potter 2010).

This debate raises several fundamental questions about international security institutions such as the nuclear nonproliferation regime. Why do states choose to comply with these institutions? What factors drive changes in compliance behavior over time? Does the past performance of the institution affect a state's decision to comply in the future? I theorize that the decision of a state to comply depends in part on whether it expects a substantial number of other states to comply as well. The track record of the institution provides states with a valuable signal about its future performance. States are likely to adjust their compliance behavior in response to this signal.

This article builds on recent efforts to evaluate the efficacy of the NPT (Coe and Vaynman 2015; Fuhrmann and Lupu 2016) and engages in an ongoing debate about the importance of precedent in the functioning of the non-proliferation regime. I analyze data on nuclear weapons programs from 1968 to 2010, finding that members of the nuclear nonproliferation regime are more likely to pursue nuclear weapons when there have been a greater number of recent violations of the regime. This result holds even when accounting for alternative explanations or potential sources of bias, such as secret information about nuclear weapons programs, proliferation cascades, the proliferation behavior of states outside the regime, lack of progress in nuclear disarmament, and uncertainty about whether regime violators will be punished by the international community.

This article makes contributions to both the international security and international organization (IO) literatures. First, I offer a novel institutional explanation for the decision by states to pursue nuclear weapons or exercise nuclear restraint, complementing the state-level theories most prevalent in the proliferation literature. The quantitative nuclear proliferation literature, in particular, has largely ignored institutional factors in theorizing about why states seek nuclear weapons. Scholars conducting detailed case studies of nuclear behavior also generally have not identified a constraining role for the regime (Reiss 1988; Paul 2000; Hymans 2006, 2012; Solingen 2007; Mehta 2020).²

Second, my theory helps to account for changes in the level of compliance within an institution over time. Institutionalist scholars have long emphasized the role of IOs in providing the information that makes compliance possible (Keohane 1984; Smith 1987); the monitoring and verification mechanisms within the nonprolifer-

¹ On the extensive and persistent pessimism surrounding the regime's prospects, see Horowitz (2015).

² An important exception is Rublee (2009).

ation regime may serve that function for NPT member states (Dai 2002, 2007). A substantial literature in international institutions sees IOs as activating reputational effects or linking to domestic institutions to ensure compliance (Cortell and Davis 1996; Mansfield, Milner, and Rosendorff 2002; Dai 2005; Lupu 2013). However, characteristics of both international and domestic institutions generally change slowly or not at all, and so have trouble explaining the shifts in compliance that we see in many IOs.

Finally, I move beyond the design features and treaty language of the institutions within the regime, as well as factors specific to individual states, to focus on the aggregate behavior of the wider population of member states and what that information reveals about the efficacy of the regime. Examining these spatial or peer effects—the interaction between the population of member states and the institution itself—can give us new insight into equilibrium levels of compliance for a particular institution and set of state parties.

The Track Record Mechanism of State Compliance

There is a bargain at the core of the nuclear nonproliferation regime: non-weapon states forego nuclear weapons development in exchange for similar forbearance on the part of other member states.³ When a particular state's willingness to comply depends on the compliance of others, and when the compliance of others is uncertain, new information about the overall level of compliance with the nonproliferation aspects of the regime should make states more or less likely to exercise nuclear restraint themselves. The track record of the regime is the best source of such information: as time passes with few violations overall, states should in turn be more likely to comply themselves, while evidence of increasing noncompliance should make states more likely to cheat.⁴

³ Mutual forbearance, the focus of this article, is one of several bargains in the design of the nuclear nonproliferation regime. The NPT is often said to be based on three pillars—nonproliferation, disarmament, and the peaceful uses of nuclear technology (see, for example, Obama 2009).

⁴ In this article, I refer to an NPT member state as “in compliance” if it is not pursuing nuclear weapons, and “in violation” if it is seeking nuclear weapons. There are, of course, other ways that states might fail to live up to their obligations under the nonproliferation regime. I address noncompliance by nuclear-weapon

Reciprocity and the Strategic Setting of the NPT
Reciprocity is central to an international institution when the compliance of others factors into the benefit a state realizes in abiding by its commitments; compliance becomes more attractive when others comply, and less desirable when others violate.⁵ This basic reciprocity is frequently a key element of the collective action problems that IOs endeavor to solve (Keohane 1984; Oye 1985; Fearon 1998). In the prisoner's dilemma, for example, each player's payoff is greater when the other chooses to cooperate. In iterated games, strategies that rely on punishing noncooperative behavior, such as tit for tat, further emphasize reciprocity—the player that chooses to defect invites punishment in future rounds (Axelrod 1984; Oye 1985).⁶

The prisoner's dilemma is not the only strategic setting with this characteristic; in many other familiar two-by-two games, the decision of one party to cooperate rather than defect can change the payoffs for other parties (Oye 1985; Snidal 1985). This is true of most *n*-player versions of the stag hunt and other coordination games (Kim 1996), the related critical mass game (Granovetter 1978; Schelling 1978), and the volunteer's dilemma game (an *n*-player version of the familiar chicken game with collective interaction) (Diekmann 1985), to name a few. Each of these strategic settings calls on an actor to make some judgment about the level of cooperation by all other actors.

There are many examples of international agreements in which one party's compliance is contingent on the compliance of others. In arms control and nonproliferation treaties, states give up the right to develop new weapons systems in exchange for the same concession from others. The more member states that are discovered

states—in terms of their failure to work toward nuclear disarmament—in the supplementary file.

⁵ I use the term “reciprocity” to refer to the idea that the compliance of one state is contingent upon the compliance of other states. A state will reciprocate the compliance of others by complying itself, and the violations of others by cheating itself.

⁶ The underlying game type for many IOs is probably closer to an *n*-player iterated prisoner's dilemma or a public goods game, where each player's payoff is a function of the number of other players who choose to cooperate or defect. See Yao and Darwin (1995) for a description of the *n*-player prisoner's dilemma and a discussion of successful strategies. For discussion of the added complexity of the *n*-player version of the prisoner's dilemma, see Axelrod and Dion (1988), Molander (1992), and Seo, Cho, and Yao (2000).

to have cheated by developing new weapons, the more other states will begin to doubt the underlying bargain and seek to violate the agreement themselves. International trade agreements can similarly break down when a substantial number of member states (or a few particularly influential states) fail to cooperate. Some international environmental agreements have this structure: states may agree to take costly steps to reduce greenhouse gas emissions, for example, only if other states do not try to realize a competitive advantage.

This reciprocal dynamic is common in international institutions but not universal (Guzman 2008). In some strategic settings, actors will cooperate or not without regard to the behavior of other players, because that behavior does not affect the payoff structure of the game (or perhaps does so in only a small or indirect way). Some human rights agreements seem to fit this description (Simmons 2010).⁷ That a foreign country is mistreating its own citizens does not directly make a state more or less likely to do the same, at least not in the same way that a foreign country erecting trade barriers or developing nuclear weapons might make others more likely to follow suit.⁸ Environmental agreements designed to protect endangered species or conserve natural resources may also lack a reciprocal dynamic. One state's failure to safeguard its natural resources may have little effect on another state's propensity to do so.

Resolving Compliance Uncertainty

States will comply with their international commitments when the benefits of compliance outweigh the benefits of violation. In strategic settings characterized by reciprocity, in which the benefits of abiding by international commitments are a function of the compliance of others, we can simplify member states' payoffs such that each requires a particular level of overall compliance with the

international agreement in order to make its own continued cooperation worthwhile.⁹

Figure 1 illustrates the relationship between the requirement for reciprocity and the state's own compliance, for a particular state at a particular time. The horizontal line represents the range of possible compliance with the institution overall. Each state can be thought of as having a particular level of reciprocity that it requires for its own compliance, shown here with a dotted vertical line. When the compliance of others is above this level, the benefits to the state of abiding by its commitments outweigh the benefits of violating the agreement, and it chooses to comply. When the compliance of others is below this level, the benefits to the state of violating the agreement outweigh the benefits of abiding by its commitments, and it chooses to violate.

The requirement for reciprocity is shown here in terms of the number of member states complying with the agreement. The track record mechanism I describe, however, does not require that a state find the compliance of every other member state equally reassuring, and states may well differ in how they assess overall compliance with the institution. For some states, the compliance or noncompliance of specific parties might send a particularly strong signal about the overall performance of the institution. In the context of a trade agreement, for example, states might see the requirement for reciprocity in terms of the share of world exports involving parties that are in compliance with a trade agreement, rather than simply the number of other member states that comply.

However they assess overall compliance, states also are likely to vary in the level of reciprocity they require from others in an international institution to ensure their own continued compliance. Many state parties to the NPT would not violate their agreements even if this violation carried no international consequences. While we often treat international agreements as a prisoner's dilemma, some states may have payoff structures that do not reward defection. States that do not face significant external threats, for example, may see little need to develop nuclear weapons, regardless of the proliferation behavior of others. To the extent that international agreements screen, rather than constrain, member states, the compliance of others is not likely to matter much to the decisions of states to violate treaties. These states can be thought of as having a low requirement for reciprocity; other parties to the agreement can cheat on their commitments without prompting these states to follow suit.

⁷ However, not all human rights treaties lack direct reciprocity. Restrictions on child labor, for example, engage reciprocity in the same way as some international environmental regulations. States may be willing to set minimum labor standards as long as other countries are not able to exploit this for competitive advantage. For international labor standards modeled as a stag hunt, see Hyde (2009).

⁸ Normative theories, however, do provide for a more indirect kind of reciprocity. If a norm against torture is violated by one state, for example, the weakened norm may do less to constrain the behavior of other states, leading to more torture generally. On the effect of widespread violations on the credibility of international human rights law, see Hafner-Burton (2013).

⁹ The importance of this threshold point was emphasized by Schelling (1978) and expanded in the realm of international cooperation by Molander (1992). See Molander (1992) for a formal proof.

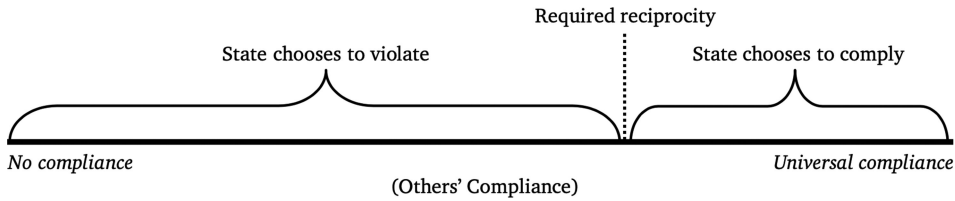


Figure 1. Required reciprocity and compliance with the nuclear nonproliferation regime.

On the other hand, for some states the issues governed by the IO will be particularly salient. These states might feel more threatened by others, and so bear a higher cost to comply with the nuclear nonproliferation regime. The steeper costs of compliance translate into a higher requirement for reciprocity; at the extreme, these states might demand close-to-universal compliance with a treaty as a condition for their own compliance, or there may be no level of compliance by others that compensates these states sufficiently that they will comply themselves.

Another factor that affects the way a state responds to the track record of an IO is the state's capacity to violate the treaty. States without significant domestic resources and a cadre of skilled engineers face a much tougher path to developing nuclear weapons than do states with richer endowments of financial, natural, and human resources. For states with little capability to violate, the opportunity cost of complying is low, and so many other states must fail to comply to prompt cheating. On the other end of the spectrum, the most capable states bear the greatest opportunity cost of complying, and so demand the highest level of reciprocity for their continued cooperation.

The overall level of compliance with the regime is almost never clear in advance; other states may or may not be cheating or may choose to do so in the future. In the face of this compliance uncertainty, states must take their best guess about the behavior of others when making their own decisions about whether to abide by their commitments. IOs provide two primary pieces of information that can resolve compliance uncertainty and shape perceptions of member state behavior: the design of the institution and the IO's track record over time.

Design features of an international institution, particularly monitoring, verification, and enforcement measures, send an important signal about the likely extent of member state compliance even before an international agreement has come into force. A substantial theoretical literature points to the provision of information as a principal function of international institutions (Keohane 1984; Oye 1985), and to verification and monitoring measures as the mechanism by which IOs increase transparency (Keohane 1984; Snidal 1985; Mitchell 1998; Dai

2002). When a country commits to declarations, surveillance, inspections, or other measures, it increases the likelihood that its noncompliance will be discovered and that it will face some reputational cost or other form of punishment, reducing its incentive to defect in the first place.¹⁰

When states' compliance decisions are contingent on the compliance of others, there is an additional indirect effect. The increased costs to noncompliance for each individual country as a result of verification and monitoring measures reassure other states that treaty violations will be less likely overall, making these states themselves less likely to cheat on their commitments. In this way, states consider the design features of an international institution to form a baseline assessment of the overall likelihood of compliance. Stronger verification and monitoring measures suggest greater compliance in general, which makes states correspondingly less likely to cheat. Weaker measures, in turn, suggest noncompliance is more likely, increasing the chance that states will violate the agreement themselves.

The design of an international institution allows states to form a baseline assessment of the likelihood of compliance overall, but this assessment probably will change over time as states acquire new information about the violations of others and further resolve their compliance uncertainty. The performance of the IO itself is the best source of this information. States learn from the track record of the nonproliferation regime: As noncompliance is discovered or as time passes without a violation, states update their assessments to reflect this new information. Revised assessments of overall compliance with the regime can then be incorporated into each state's decision about whether to comply or cheat. An IO's track record of recent compliance makes states more confident that others are abiding by their agreements and thus more likely to comply themselves, while a recent history of noncompliance raises concerns about the compliance of others and leads to further cheating.

¹⁰ See the supplementary file for additional discussion of the role of monitoring and verification mechanisms in the track record of the regime.

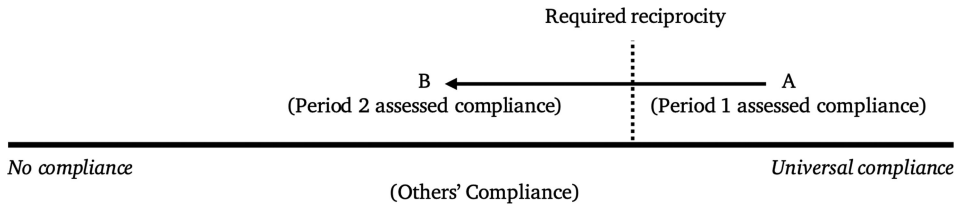


Figure 2. The regime's track record of noncompliance leads to further violations.

The track record of the institution also affects states' expectations for future compliance because it provides a signal, albeit in some cases a noisy signal, about the efficacy of the international agreement itself. A poor track record may not just indicate that present compliance is worse than expected, but also suggests that the treaty, which may once have been seen as having significant constraining power, in fact is not up to the task of incentivizing state compliance. States may thus revise their assessments of future compliance upward or downward based on perceptions of the regime's effectiveness in addition to judgments about the likely behavior of other member states.

Of course, this reassuring or worrying signal of treaty performance is visible to states outside of the institution as well. This signal is likely to be more central to the decision-making of states within the IO, however, because they have more on the line when it comes to the institution's efficacy. Member states in the NPT, for example, by virtue of their commitment to forgoing nuclear pursuit, face generally higher costs in seeking nuclear weapons and risk greater punishment if their nuclear efforts are discovered. These additional costs from noncompliance limit members' freedom of action and potentially put their security at risk. While the security benefits of an effective regime accrue to members and nonmembers alike, only for member states does this effectiveness help to mitigate the significant costs associated with forgoing nuclear weapons.

Figure 2 illustrates how the track record of the regime can affect the decisions of states to comply or violate. In period 1, perhaps based on the specific design of the institution, the state assesses that other members would comply with their commitments at the high level represented by point A. Because point A exceeds the state's required level of reciprocity, the state's expected benefit from complying with the treaty given others' compliance at point A is greater than its expected benefit from violating. As a result, the state chooses to comply in period 1. Prior to period 2, however, the state evaluates the track record of the regime, and sees more noncompliance than expected. It thus revises downward its assessment of the compli-

ance of others to point B. Because point B falls short of the state's requirement for reciprocity, its expected benefit from violating the agreement outweighs its expected benefit from complying, and the state chooses to violate in period 2.

This logic suggests the central hypothesis of this article:

Track record hypothesis: *In strategic settings characterized by reciprocity, states will be more likely to comply with international institutions when the IO's track record indicates increasing levels of compliance, and will be more likely to violate when the IO's track record indicates increasing levels of noncompliance.*

The decisions by individual states to comply or violate, when aggregated, determine the overall level of compliance with the regime. This theory suggests that the regime might settle into different equilibria based on its compliance and enforcement track record and variation in member states' requirement for reciprocity. It is easy to see how these factors can lead to a spiral of regime decline, for example. As violations are discovered, states see others as less likely to comply and thus are less likely to comply themselves.¹¹ This leads to additional violations, making states even less likely to comply, and so on. This equilibrium echoes findings from recent research on the decline of IOs. Ultimately, such IOs may be reduced to zombie institutions; they may continue to exist—IOs are very difficult to dispose of—but would no longer exert any constraining power on their members (Gray 2018). If violations lead states to withdraw from the institution, more withdrawals would be likely to follow (von Borzyskowski and Vabulas 2019).

On the other hand, confidence in the institution might breed more confidence, leading to a virtuous cycle of self-reinforcing compliance. As time goes by without violations, states revise upward their assessments of the compliance of others, making states more likely to com-

¹¹ This dynamic may cause states or international institutions to hesitate to reveal the violations of others publicly. See Carnegie and Carson (2018, 2019).

ply themselves. This would lead to a more constraining regime, with high levels of compliance overall. This equilibrium is consistent with the literature pointing to the instantiation of international norms against nuclear proliferation as an important aspect of the regime's influence on nuclear behavior (Müller and Schmidt 2010; Rublee and Cohen 2018; Carranza 2019). The norm embodied in the regime may actually persuade member states, changing their preferences in a way that moves beyond concerns about being punished for violations (Rublee 2008, 2009).

Finally, the regime might vacillate between compliance and noncompliance, the result of a high level of compliance uncertainty and a narrow distribution of state requirements for reciprocity. As a wavering institution, the regime would exert very different constraining effects on member states depending on where we look in these cycles of compliance and noncompliance.

Track Record and Compliance in the Nuclear Nonproliferation Regime

The strategic setting of nuclear nonproliferation is such that the benefits of complying with the rules of the regime and foregoing the development of nuclear weapons are tightly linked to the willingness of others to do so. States have historically been wary of unilaterally giving up the right to any kind of defensive capability, particularly nuclear weapons. In 1962, for example, the UN Secretary General asked states about the conditions under which they would give up the right to develop nuclear weapons. Most of the 62 nations that responded said they would only agree to do so if their neighbors also forswore nuclear weapons (Sokolski 2010). We would expect, then, that the predictions of theory will hold: a track record of compliance should breed future compliance.

A Brief History of Compliance in the Nonproliferation Regime

Iran and North Korea, despite their current prominence as nonproliferation hotspots, are not the first challenges to the nonproliferation regime. Figure 3 depicts violators of the nonproliferation regime over time.¹² The solid line shows the number of NPT members seeking nuclear weapons by year. The dashed line shows the three-year trend in these violators as one measure of the regime's track record (the number of violators in a given year minus the number of violators three years earlier).

¹² Program dates are updated from Jo and Gartzke (2007). See the supplementary file for a table of nuclear weapons program and NPT membership dates.

The countries listed are those that initiated or ended nuclear weapons programs in each time period; states that were NPT members at the time a program began or ended are denoted with bold italics. To be considered an NPT violator in this analysis, a state must be pursuing a nuclear weapon in the same year that it was a member of the NPT.¹³

Sixteen states have had an active nuclear weapons program since 1968, when the NPT first opened for signature.¹⁴ Half of these were NPT members at some point during the program. Only one NPT member state has acquired nuclear weapons; North Korea withdrew from the treaty in 2003 and conducted its first nuclear test in 2006.

Two time periods in the NPT's history—the 1970s and the 1990s—are particularly instructive. In the early years of the treaty, many states had reservations about setting aside their nuclear weapons ambitions. Several countries widely considered capable of nuclear development, including Australia, Japan, South Korea, Taiwan, Israel, Iran, West Germany, India, and South Africa, were considering or even pursuing nuclear weapons in this time period. As a consequence, anxiety about the viability of the treaty, let alone its effectiveness, ran high. The NPT member states developing a latent nuclear capability in this time frame—Taiwan, South Korea, Iraq, Iran, and Libya—seem to have been motivated in part by assessments that the NPT was unlikely to be successful in limiting the proliferation of others.

For at least some of the states seriously considering nuclear pursuit at this time, the perceived success of the treaty seemed to play a role in their decision-making process. Australian defense studies in the late 1960s, for example, pointed to the future effectiveness of the treaty as one of several potential factors that could lead to a reevaluation of Australia's own nuclear weapons ambitions over the long term (Australia Department of Defence 1968a, 1968b). Skepticism of the likely effectiveness of the proposed treaty pushed Swedish military leaders to develop a nuclear "backup option" that would preserve Sweden's freedom of action, maintaining some nuclear

¹³ By this definition, South Korea is considered an NPT violator, because it had an active nuclear weapons program in 1975, the same year it joined the NPT. While Jo and Gartzke (2007) consider the South Korean program to have ended in 1975, others code South Korea's nuclear pursuit as continuing through the 1970s (Bleek 2017). On South Korea's nuclear weapons efforts, see Fitzpatrick (2016).

¹⁴ This tally excludes the nuclear-weapon states recognized by the treaty (the United States, Russia, United Kingdom, China, and France).

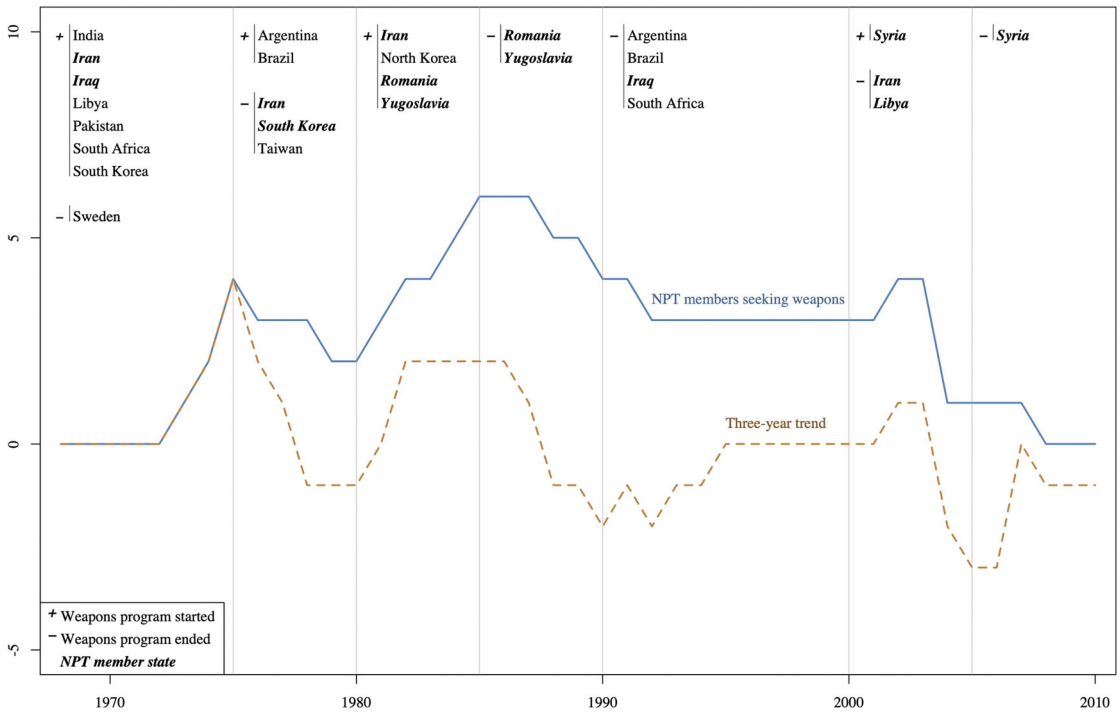


Figure 3. Nuclear proliferation and NPT violators over time.

capabilities into the early 1970s (Jonter 2016, 253). Domestic political opposition to the NPT in Switzerland struck a similar tone, arguing that the NPT was a failure and so the Swiss must retain their ability to develop a nuclear weapons capability in the future (US Department of State 1974). Even after signing the NPT, the Swiss military maintained a committee on nuclear issues tasked with maintaining a small nuclear weapons breakout capability in case the fledgling nonproliferation regime ultimately failed. The committee was finally shuttered in the late 1980s due in part to greater confidence in the efficacy of the regime (Stussi-Lauterberg 1995; Bühlmann 2007).

In contrast to the 1970s, the early 1990s saw a series of very public successes for the regime.¹⁵ South Africa joined the NPT, having dismantled its small arsenal of nuclear weapons. Brazil and Argentina put an end to long-standing nuclear weapons efforts. The newly independent states of Belarus, Ukraine, and Kazakhstan renounced the nuclear weapons they had inherited from the Soviet Union and joined the NPT. Two long-time NPT holdouts, China and France, finally acceded. The

¹⁵ The early to mid-1990s has some of the characteristics of a norm cascade. See Carranza (2019)

crisis of North Korean nuclear weapons development was temporarily addressed with the 1994 Agreed Framework. All of this good news culminated in the decision of the international community at the 1995 NPT Review Conference to extend the treaty indefinitely without condition.

It seems that the regime's positive track record in the early part of the decade bred further success, as theory suggests it would. The 1990s was the first decade since the start of the nuclear age in which no new nations launched a nuclear weapons program. While several countries took stock of their nuclear options around this time period, all chose to remain in compliance with the regime. Japan's defense policy study of 1994–1995, for example, concluded that nuclear weapons would not serve Japan's strategic goals, citing, among several costs, the potential harm from a breakdown in the nonproliferation regime (Kurosawa 2004; Mochizuki 2007; Green and Furukawa 2008).

Perceived weaknesses in the nuclear nonproliferation regime in the early 2000s led Japan to reconsider its non-nuclear weapons policy. North Korea's continued violation and then exit from the NPT played a significant role in this perception, along with the suspected violations of Iraq (before the 2003 war), Iran, and Libya and the

nuclear tests by India and Pakistan in 1998 (Kurosawa 2004; Mochizuki 2007). A number of analysts have come to see perceived weaknesses in the nonproliferation regime as a factor that might push Japan toward nuclear pursuit in the future (Campbell and Sunohara 2004; Moltz 2006; Hughes 2007; Furukawa 2012).

Modeling the Track Record Mechanism of Compliance

The overall trend in NPT violations shows significant variation over time, giving us some leverage in answering a key question about state compliance: Does the past performance of the nuclear nonproliferation regime affect the decisions of states to comply with or violate the rules of the regime in the future? Addressing this question requires untangling the various other factors that affect the decision to violate the NPT by seeking nuclear weapons.

I test my track record hypothesis using a dataset of nuclear weapons efforts from 1968, the year that the NPT opened for signature, to 2010.¹⁶ My theory hypothesizes effects for state parties to the treaty, and so I limit the analysis to states that have ratified or acceded to the NPT.¹⁷ While most states outside the NPT maintain some links to the nuclear nonproliferation regime, the centrality of the NPT to the overall regime suggests that it is a useful cut-point in distinguishing regime members from nonmembers. I also exclude from my analysis the P-5 nuclear-weapon states (the United States, United Kingdom, Russia, France, and China). Because the nuclear weapons programs in these states are permitted under the NPT, we would not expect their presence to color perceptions of regime effectiveness in the same way as the illicit weapons programs of other member states.¹⁸

The data are structured as a pooled time series, with a country-year unit of analysis. My analysis builds on a rich and growing quantitative literature in nuclear proliferation; to the extent that it is theoretically justified, I employ a modeling approach and explanatory variables similar to those commonly used in this literature to facilitate comparisons with existing models.¹⁹ The dependent variable in this analysis is the pursuit of nuclear weapons, a dichotomous measure that takes on the value of 1 when a state has a nuclear weapons program in a given year.²⁰

There are several possible ways to operationalize my key explanatory variable, the track record of the nonproliferation regime. In this analysis, I employ one of the simplest such measures: the three-year trend in the number of NPT violators; that is, the number of NPT violators in the current year minus the number of violators three years ago (shown as the dashed line in figure 3).²¹ If the track record hypothesis is correct, we would expect an

perceptions of the strength of the treaty, this mechanism is distinct from the mutual forbearance dynamic that is the focus of this article. I address the implications for my empirical tests of the lack of P-5 disarmament in the supplementary file.

¹⁹ This approach necessarily omits some potentially important drivers of nuclear pursuit that are not amenable to quantitative analysis. I do not address here, for example, explanations for nuclear pursuit based on the psychology of leaders (Hymans 2006; O'Reilly 2012) or norm-based theories of nuclear restraint (Ruble 2009).

²⁰ Nuclear weapons program dates are updated from Jo and Gartzke (2007), but the original Jo and Gartzke coding, or alternative codings of nuclear weapons pursuit from Singh and Way (2004) or Bleek (2017), yields the same results. Please see the supplementary file for details. Because my theory suggests the track record of international institutions affects both the initiation of new nuclear programs and the decision to continue those programs, I include country-years both before and during a nuclear weapons effort (Jo and Gartzke 2007; Brown and Kaplow 2014).

²¹ I consider several alternative measures of regime track record in the next section and in the robustness checks detailed in the supplementary file, including trends longer or shorter than three years and a measure of regime track record that considers only violations by nuclear-capable states. States also consider a variety of other signals short of others' nuclear weapons programs when evaluating the efficacy of the regime, including the perceived interest of others in nuclear weapons and the pursuit of dual-use nuclear technology that could be used for weapons purposes in the

¹⁶ Using data beginning in 1970, when the NPT entered into force, does not change the results of the analysis. Please see the supplementary file for details of this and other robustness checks.

¹⁷ Taiwan is a special case of NPT membership; while it signed and ratified the NPT, it was not officially recognized as a member after 1971. In this article, I follow most analysts in treating Taiwan as if it was never an NPT member, but this choice does not affect my analysis. Coding Taiwan as an NPT member from 1970 to 1971, or from 1970 onward, yields the same results. North Korea is omitted from the dataset for the years following its withdrawal from the NPT in 2003, but alternative specifications with North Korea treated as a regime violator after 2003 give the same results.

¹⁸ While the unwillingness of the P-5 states to engage in meaningful nuclear disarmament may well affect

increase in the three-year trend in violators to be associated with an increase in an individual state's likelihood of pursuing nuclear weapons.

My analysis models the proliferation decisions of individual states as a function of a system-level variable—an aggregation of individual-level decisions. This approach is subject to some of the complications faced by the empirical identification of peer effects in labor economics (Angrist 2014). A particular concern here is the reflection problem (Manski 1993), a form of endogeneity in which one state's proliferation behavior affects the track record of the regime, which in turn affects that state's proliferation behavior. To at least partially address this issue, I follow the peer effects literature and adjust the track record of the regime so that it does not include the proliferation decisions of the state in question. The explanatory variable of interest, then, is the track record of the regime based on the behavior of all other states. Following common practice in the literature, I lag this and all other explanatory variables by one year to reflect the fact that nuclear decision-making is far from instantaneous.

I include in my analysis three additional categories of factors that have been found to affect states' propensity to proliferate: nuclear capability, nuclear willingness, and domestic politics. The literature on nuclear proliferation has found a strong association between the nuclear capacities of states—access to resources, nuclear material and infrastructure, and expertise—and their tendency to seek nuclear weapons (Kroenig 2009, 2010; Fuhrmann 2009, 2012; Brown and Kaplow 2014). To address a state's overall resources, I include in the models a measure of real GDP, using data from Gleditsch (2002). To account for state access to nuclear technology, I include a count of the number of fuel-cycle-related International Atomic Energy Agency Technical Cooperation projects a state was involved in for a given year (Brown and Kaplow 2014). Brown and Kaplow (2014) found that this measure is strongly associated with a state's pursuit of nuclear weapons, perhaps because this form of multilateral nuclear assistance reduces the cost for states to initiate and continue weapons efforts.

I include in my models three variables that address a state's underlying interest in pursuing weapons. First, because a propensity for conflict may drive states to seek a nuclear deterrent, I employ a dichotomous variable that takes on the value of 1 if a state has engaged in a militarized interstate dispute in the previous five years (Ghosh, Palmer, and Bremer 2004). Second, to capture a state's response to the direct threat posed by a proliferating ad-

future. I do not consider these signals short of violation in the following analysis.

versary, I use a dichotomous variable that takes on the value of 1 if a state's rival is pursuing or has already acquired nuclear weapons in a given year, using rivalry data from Thompson and Dreyer (2011). Third, the extension of a nuclear umbrella might help to alleviate states' security concerns and thus their willingness to proliferate. Following standard practice in this literature, I include a dichotomous measure that takes on the value of 1 if a state has a defense pact with a nuclear weapon state, using data from the Correlates of War project (Gibler and Sarkees 2004).

A number of analyses credit domestic politics in driving the pursuit of nuclear weapons (Solingen 1994; Montgomery 2005; Way and Weeks 2014). As an admittedly rough measure of the role that domestic interests may play in a state's proliferation decision-making, I include as an explanatory variable the Polity project's measure of domestic regime type, which runs from -10 (strong autocracy) to 10 (strong democracy) (Marshall, Jaggers, and Gurr 2010).

To address temporal dependence in the data, I include a simple count of the number of years that have passed without the state violating the NPT, along with its squared and cubed terms (Carter and Signorino 2010).²² Because my data include country-years in which a state is pursuing nuclear weapons, I also employ a cubic polynomial representing the number of years that have passed in the course of a state's nuclear program (Brown and Kaplow 2014). In pooled time-series cross-section data, unobserved heterogeneity across units is also a concern. While I show results from a pooled model to facilitate comparisons with the existing literature, a version of the model employing country fixed effects yields the same findings for the explanatory variable of interest.²³ Violation of the NPT is a rare event, accounting for only 2 percent of observations in my data. To address rare-event and finite-sample bias in my analyses, I use penalized likelihood logistic regression (Firth 1993).

Findings

Table 1 shows the results of four penalized likelihood logistic regression models of nuclear proliferation. Model 1 tests the association between the regime's track record

²² Diagnostic checks for spurious regression, including a linear time trend and a linear and quadratic time trend, do not change the results. Please see the supplementary file for details and a discussion of possible time-varying effects.

²³ Please see the supplementary file for full regression results.

Table 1. Analysis of NPT violations, 1968–2010

		<i>Model 1</i>	<i>Model 2</i>	<i>Model 3</i>
Track record	NPT violators (three-year trend)	0.411 (0.110)	0.406 (0.096)	0.359 (0.115)
Nuclear capability	Real GDP	—	0.017 (0.041)	–0.055 (0.086)
	Multilateral nuclear assistance	—	0.254 (0.054)	0.381 (0.063)
Nuclear willingness	Interstate disputes (previous five years)	—	0.674 (0.518)	0.229 (0.485)
	Rival with nuclear weapons program	—	1.099 (0.336)	0.738 (0.403)
	Defense pact with nuclear state	—	0.195 (0.492)	0.007 (0.522)
Domestic politics	Regime type	—	—	–0.350 (0.079)
	Constant	–2.239 (0.389)	–2.973 (0.544)	–4.496 (0.649)
	N	5,624	5,556	4,802
	AIC	234.18	230.80	206.14

Notes: Penalized likelihood logistic regression coefficients with robust standard errors, clustered on country, in parentheses. Bold values are statistically significant ($p < .05$). Cubic polynomials of the years without an NPT violation and the years since a violation began are included in all models but not shown. All explanatory variables are lagged by one year.

and a state's likelihood to violate the NPT, without regard for other drivers of nuclear weapons pursuit. Model 2 adds a set of controls for nuclear capability and willingness. Model 3 adds a measure of state regime type. For all models, I report robust standard errors, clustered by country.²⁴

Consistent with the track record hypothesis, I find a strong association between the track record of the regime and a state's likelihood of having a nuclear weapons program. As the regime's track record worsens, an NPT member state becomes more likely to pursue a nuclear weapon. As the track record improves, a state is less likely to violate the treaty. This association holds even when controlling for other drivers of proliferation behavior, as in Models 2 and 3.

The findings for the control variables are largely consistent with expectations and the existing literature. States with greater access to nuclear technology—as measured by receipt of multilateral nuclear assistance—are more likely to seek weapons despite their NPT commitments. The presence of a nuclear weapons program in a rival state also is associated with proliferation in Model 2. More democratic states appear less likely to pursue

nuclear weapons while a member of the NPT. Variables representing GDP, involvement in interstate conflict, and the presence of an alliance with a nuclear state do not reach statistical significance in these models.

Figure 4 illustrates the substantive effect of the regime's track record on the risk of NPT violation.²⁵ Because proliferation is a rare event, the absolute effect of the regime track record across all observations is quite low. To give a better sense of the substantive effect of this variable among cases of interest, figure 4 holds all factors at their mean among those observations predicted to have at least a 1 percent chance of NPT violation (Beck, King, and Zeng 2000; Kaplow 2016).²⁶ The shaded area in the figure represents the 95 percent confidence interval. As the figure shows, the track record of the regime has a substantively significant effect on the risk of cheating. Shifting from the best regime track record to the worst is associated with about a 24 percentage-point increase in the probability of violating the treaty, holding all other variables at their mean among observations with at least a 1 percent chance of proliferation.

²⁴ Two-way clustering by country and year yields the same result.

²⁵ Substantive effects are calculated using Model 3.
²⁶ About 10 percent of the observations used in Model 3 have a predicted probability of proliferation of at least 1 percent.

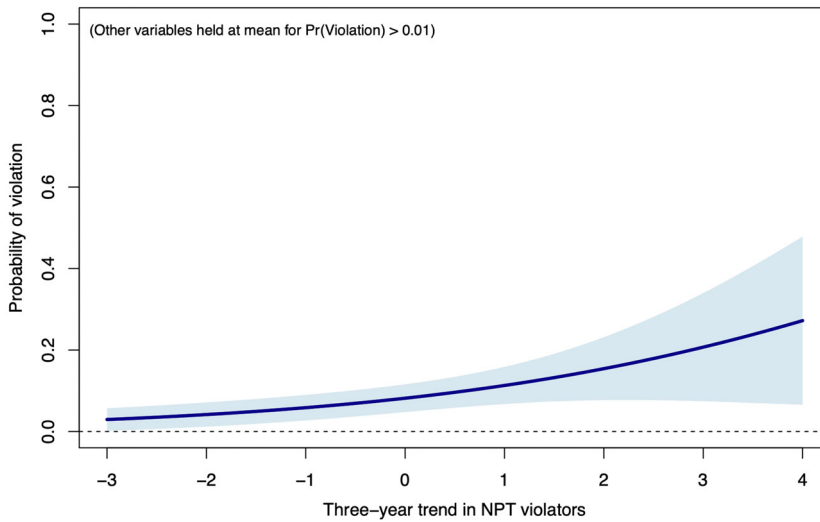


Figure 4. The substantive effect of NPT track record on the probability of violation.

We can also examine the substantive effect of regime track record at the system level. Moving from a slightly favorable three-year trend in violations of -2 (about one standard deviation below the mean) to the slightly unfavorable trend of 1 (about one standard deviation above the mean)—and holding all other variables at their true values in the data—leads to one additional violating state about every three and a half years.

Nuclear Secrecy

My measure of the track record of the international regime—the three-year trend in NPT violations—is calculated with the benefit of hindsight. Even with decades to reflect, however, coding decisions about the particular years a nuclear weapons program was active are quite uncertain, and reasonable analysts can disagree.²⁷ One potential problem, then, with my measure of the track record of the regime is that it assumes that all NPT member states are aware of others' transgressions even though nuclear weapons programs are often among the best protected of national secrets.

We may take some comfort in the fact that any general bias created by nuclear weapons program secrecy would probably lead to understating the relationship between the overall level of noncompliance and the deci-

sions of states to engage in a weapons effort. If states at the time were not aware of all the violations reflected in the dataset, then they would, in effect, receive less of the “treatment” than our measure assumes. Had we accurately captured their true assessment of others' noncompliance, we would expect the association between track record and proliferation behavior to be even stronger.

On the other hand, if states believe there are more NPT violators than there actually are, my results may be overstated. This seems less likely; cases of nuclear false alarms are rare, although not unheard of. The most prominent case, of course, is the US assessment that Iraq was reconstituting its nuclear weapons program prior to the 2003 invasion. While the Iraq case is especially salient, most of the uncertainty in nuclear assessments revolves around the level of progress that the program has achieved, rather than whether or not a program exists in the first place (Montgomery and Mount 2014).

To examine more systematically whether contemporaneous knowledge of nuclear weapons programs changes my analysis, I recalculated the explanatory variable using a new dataset of public and US government knowledge of nuclear weapons.²⁸ For each NPT violator, I identified credible public reports that a weapons effort was underway, as well as credible reports (or world events) that indicated the program had been halted. I then assembled a measure of the public track

²⁷ See the supplementary file for a comparison of dates in widely used nuclear datasets. On the dangers of relying on a particular coding of nuclear weapons programs, see Montgomery and Sagan (2009).

²⁸ See the supplementary file for a detailed discussion of these data.

record of the regime—the number of publicly known violators this year minus the number of states known to have been violating the treaty three years ago. I collected similar data on US government knowledge of nuclear weapons programs, using declassified US intelligence and policy documents, to piece together what the most effective intelligence services might have known about the regime's track record at the time. Together, these measures bound the problem of nuclear secrecy. State knowledge of the regime track record at the time was unlikely to be worse than what had been publicly reported, and unlikely to be better than US estimates.²⁹

The results of analyses using these alternative explanatory variables are shown in [table 2](#). Model 4 uses a measure of the public track record of the regime, while Model 5 examines the track record of the regime based on contemporaneous US government judgments. In both models, the coefficient on the track record variable is positive and significant; both the regime's public track record and the track record as known to the US government are strongly associated with the likelihood that a state will violate the treaty.

The analytical approach in Models 4 and 5 assumes that all states have the same information about the non-compliance of others. It is possible, of course, that some states are able to detect a secret weapons program where others are not. While this is undoubtedly true when considering the full population of states, the states that exert the most effort in areas of nuclear intelligence probably are the P-5 nuclear states, and these states are excluded from my analysis. India, Pakistan, and Israel probably also have strong resources in this area, but they too are omitted from my data because they have not joined the NPT.

There is likely still to be variation among the remaining states in their knowledge of others' nuclear weapons

efforts. The United States or another state with strong intelligence capabilities, for example, might provide this information to its allies. As a sensitivity test, I assume states that have a defense pact with a nuclear weapon state enjoy privileged knowledge of the regime track record. In Model 6, states in nuclear alliances are credited with full knowledge of actual weapons efforts, using the same coding as Models 1–3, while the remaining states are aware only of those programs that have been reported on publicly. Model 7 assumes states with nuclear allies share the contemporaneous assessments of the US intelligence community, while remaining states again have only public knowledge of weapons efforts. In each case, the regime's perceived track record is significantly associated with the decision to seek nuclear weapons while an NPT member.

The worse the trend in NPT violations, then, the more likely states are to seek nuclear weapons themselves, even accounting for contemporaneous knowledge of weapons programs and the fact that some states may have more knowledge of nuclear weapons efforts than others. This reanalysis provides some support for the assertion that the secrecy of nuclear weapons programs does not substantially bias my results.

Addressing Alternative Explanations

In this section, I consider several possible objections to my analysis. Possible alternative explanations for my findings include the presence of proliferation cascades, the proliferation behavior of non-NPT states, and the membership and enforcement record of the treaty. Three other plausible alternative explanations—the lack of progress in nuclear disarmament by nuclear-weapon states, the diffusion of nuclear technology, and nonproliferation pressure by the United States—are discussed in the supplementary file. In each case, I continue to find support for the track record mechanism of state compliance even after accounting for potential confounding variables. Fundamentally, the pattern of compliance and noncompliance we see in the data is not a good fit for plausible alternative explanations, lending further support to the track record hypothesis.

Proliferation Cascades and the Behavior of Non-NPT States

In a proliferation cascade, State A's pursuit of nuclear weapons makes State B more likely to violate the treaty, because State B is directly threatened by State A's behavior. This mechanism is distinct from the track record

²⁹ Across all country-years, there is substantial overlap between retrospective and contemporaneous nuclear weapons pursuit data. The correlation coefficient between contemporaneous public knowledge and my retrospective nuclear pursuit data is 0.94 for all observations, and 0.54 when considering only observations included as nuclear pursuit in the datasets frequently used in this literature ([Singh and Way 2004](#); [Jo and Gartzke 2007](#); [Bleek 2017](#)). Contemporaneous US government knowledge of nuclear weapons programs and the retrospective data have a correlation coefficient of 0.94 for all observations and 0.58 among observations judged by at least one other dataset to be an incidence of nuclear pursuit.

Table 2. Contemporaneous knowledge of weapons programs, 1968–2010

		<i>Model 4</i>	<i>Model 5</i>	<i>Model 6</i>	<i>Model 7</i>
Track record	Public knowledge of NPT violators (three-year trend)	0.235 (0.118)	—	—	—
	US intelligence knowledge of NPT violators (three-year trend)	—	0.270 (0.137)	—	—
	Actual knowledge of NPT violators for allies of nuclear-weapon states (three-year trend)	—	—	0.268 (0.132)	—
	US intelligence knowledge of NPT violators for allies of nuclear-weapon states (three-year trend)	—	—	—	0.285 (0.112)
Nuclear capability	Real GDP	-0.319 (0.161)	-0.072 (0.161)	-0.322 (0.162)	-0.318 (0.158)
	Multilateral nuclear assistance	0.440 (0.102)	0.371 (0.112)	0.442 (0.102)	0.445 (0.102)
Nuclear willingness	Interstate disputes (previous five years)	0.038 (0.563)	0.380 (0.625)	0.028 (0.555)	0.020 (0.555)
	Rival with nuclear weapons program	0.852 (0.677)	0.644 (0.618)	0.844 (0.677)	0.846 (0.671)
	Defense pact with nuclear state	0.216 (0.934)	0.220 (0.882)	0.189 (0.943)	0.273 (0.932)
Domestic politics	Regime type	-0.299 (0.051)	-0.301 (0.061)	-0.300 (0.050)	-0.305 (0.051)
	Constant	-4.991 (0.983)	-5.603 (1.069)	-4.929 (0.983)	-4.942 (0.971)
	<i>N</i>	4,802	4,802	4,750	4,750
	AIC	415.60	443.04	413.19	413.93

Notes: Penalized likelihood logistic regression coefficients with robust standard errors, clustered on country, in parentheses. Bold values are statistically significant ($p < .05$). Cubic polynomials of the years without an NPT violation and the years since a violation began are included in all models but not shown. All explanatory variables are lagged by one year.

mechanism theorized in this article, in which the violations of others may lead a state to adjust its assessment of overall compliance with an international agreement and the efficacy of the IO, and ultimately cause changes in the state’s compliance behavior. The distinction between these causal processes is of some importance, because proliferation cascades bypass the nuclear nonproliferation regime, while the track record mechanism works via the international institution. These mechanisms are separate in theory but can be difficult to untangle empirically. It is worth considering, then, whether the empirical results above are really capturing the role the NPT plays in constraining state behavior, or whether states are simply made to feel less secure when others proliferate and so are more likely to do so themselves.

I attempt to distinguish proliferation cascades from the track record mechanism in two ways. First, I control in Models 2–7 for the pursuit of nuclear weapons by a state’s rival. This variable would address the most

straightforward cases of nuclear dominoes falling, such as South Korea’s potential response to North Korea’s nuclear program. The track record variable in these models remains a significant determinant of nuclear weapons pursuit, even when accounting for the behavior of rivals, suggesting that the result is not exclusively due to a response to the dangerous behavior of a single rival state.

Second, in a sensitivity test, I recode the explanatory variable of interest to include only NPT violations outside a state’s home region. A proliferation cascade is likely to be most strongly felt among neighboring states. The nonproliferation community worries about Japan’s response to North Korea’s nuclear weapons program, for example, and Saudi Arabia’s response to Iranian proliferation, but not as much about Saudi Arabia’s response to North Korea’s weapons efforts. By considering only the NPT violations outside a state’s region, we are more likely to be picking up the effect of these violations on state perceptions of the efficacy of the regime. The coef-

ficient on regime track record remains positive and statistically significant, even when this variable is recast as the extraregional trend in NPT violations.³⁰ This finding suggests that my empirical analyses are capturing the dynamics of the nonproliferation regime, rather than the direct effect of a proliferation cascade.

A related concern is that my analysis may miss the effect of nuclear weapons development outside of the nuclear nonproliferation regime. An alternative theory might acknowledge that states base their own nuclear weapons decisions on the overall trend in proliferation—not only the direct threat posed by a particular state, as in the proliferation cascades discussed above—but argue that the real concern is states outside the constraining influence of the NPT. If the pursuit of nuclear weapons by non-NPT states encourages proliferation by NPT members, and if the trend in non-NPT weapons programs correlates with the trend in regime noncompliance, then my analysis may suffer from omitted variable bias. I might mistakenly find support for the track record mechanism where none exists.

To examine this possibility, I repeat the analysis in Model 3 with the addition of a variable representing the three-year trend in nuclear programs among non-NPT members—the number of states seeking nuclear weapons outside the NPT in a given year minus the number of non-NPT states pursuing weapons three years prior. In this robustness check, the coefficient on my original variable of interest—the track record of the regime—remains positive and statistically significant, even when controlling for the behavior of states that are not NPT members.³¹ This result suggests that proliferation outside of the NPT is not responsible for my finding.

Enforcement and Membership

A complementary theory might posit that the track record of the regime provides information, not just about future compliance, but also about the prospects for punishment of treaty violators. Violations of the regime might actually send a signal of regime strength if those violations are met with a strong response by the international community, making states more likely to comply in the future. Such a mechanism may well be at play in the nuclear nonproliferation regime. Some argue, for example, that Libya's decision to give up its nuclear weapons efforts was prompted by the fear that the United States would attack Libya as it had Iraq (Bush 2004). Or potential proliferators may have learned the opposite lesson from the international community's inability to stop North Korea's nuclear efforts.

The findings presented in this article, however, are unlikely to be confounded by this alternative mechanism. This is because harsh international responses to nuclear weapons programs are fairly rare, and they are most likely to attend to an incidence of NPT violation. If some portion of NPT violators is strongly censured by the international community, then we might think of these violations as sending a constraining signal to other member states that encourages greater compliance. This is the equivalent of having fewer total NPT violators than are reflected in the data, causing my statistical models to underestimate the association between the regime track record and the decision to pursue nuclear weapons.

To examine the effect of the international response to violations in more detail, I repeated the analysis in Model 3 with the addition of variables representing different forms of punishment within the regime. First, I added a count of the number of NPT member states that were targeted by nuclear-related sanctions in a given year, building on data from Miller (2014), Morgan, Bapat, and Kobayashi (2014), and Reynolds and Wan (2012). Next, to capture more extreme forms of punishment, I added variables representing the number of NPT states in a given year whose nuclear facilities had been considered for attack, and whose nuclear facilities had actually been attacked, using data from Fuhrmann and Kreps (2010). In each case, the track record of the regime maintains a statistically significant association with a state's propensity to violate, suggesting that the response of the international community to violations is not a significant source of bias in my results.

A similar dynamic may apply to overall membership in the NPT. We may think of overall membership in the NPT as affecting compliance in at least two different ways. First, the extent of membership might be another, related source of information about the track record of the regime. States may look to membership as a complementary indicator of institutional success, driving expectations about whether others are likely to comply. This dynamic could potentially confound my results if the trends in membership and compliance are related—I could attribute to the track record of compliance an effect that is due to overall membership. The trend in NPT membership, however, is quite different from the trend in treaty compliance. In a robustness check, I include a variable in my models representing the three-year trend in NPT membership. This variable does not affect the results for the variable representing the track record in violations, and the variable representing the trend in membership does not itself reach statistical significance. This should increase our confidence that overall NPT membership does not confound my results.

³⁰ Full results are available in the supplementary file.

³¹ Please see the supplementary file for full results.

Second, membership might act as a kind of moderator for the effect of violation. Violations may matter more for a smaller pool of members than they would for a larger pool; one cheater out of a few states is perhaps more alarming than one cheater among dozens of countries. I address this possibility empirically in two ways. First, I adjust my measure of the regime track record to represent the three-year trend in the share of states violating, rather than the trend in the number of states violating. This version of the track record variable yields the same results as my main analysis. Second, I add a variable to my primary model representing the number of NPT members in a given year (or, alternatively, the three-year trend in NPT members). Adding these variables does not affect the result for the explanatory variable of interests, again suggesting that trends in regime membership are not a confounding factor here.

Conclusion

In this article, I have presented a new theory of compliance in the nuclear nonproliferation regime that sees a state's decision to abide by its commitments as a function of the behavior of the overall population of member states. My empirical analysis suggests that the track record of the nuclear nonproliferation regime does indeed influence future compliance, even after accounting for a variety of potential alternative explanations. This finding offers a new institutional determinant of nuclear weapons pursuit that has not been considered by existing scholarship. For IO scholars, this approach speaks to the utility of looking beyond the relatively static attributes of the institution and the state in question. By considering the aggregate behavior of member states, we reveal a more dynamic story of changing levels of compliance within the regime.

These findings also raise the stakes for the international community's response to proliferation challenges in Iran and North Korea. If Iran is seen as pursuing a nuclear weapons capability, the credibility of the regime would be damaged and other nations—even those not directly threatened by a nuclear Iran—would be more likely to follow suit. With dim prospects for nuclear reversal in North Korea, my results reinforce the importance of holding the line on onward proliferation by its neighbors. Strong security guarantees from the United States to Japan and South Korea, then, become an important policy tool not just for reassuring US allies in the region, but for preempting a breakdown of regime credibility.

More fundamentally, the track record of the regime should be incorporated into policy thinking about future proliferation risks. Twenty years ago, identifying

future proliferant states largely involved an assessment of which countries had enough economic and technical resources to make pursuing a weapon a reality. The nuclear landscape has shifted, and today a number of countries have a substantial latent nuclear capacity (Fuhrmann and Tkach 2015; Mehta and Whitlark 2017; Volpe 2016, 2017). Iran is perhaps the most visible example, but Japan, South Korea, Saudi Arabia, Brazil, Egypt, Indonesia, Turkey, and others either already have or are pursuing a civil nuclear infrastructure that could be repurposed for weapons work. The question for analysts thus has changed from *which* states could develop nuclear weapons to *when* nuclear-capable states may decide to make that final sprint to the finish line. Doubts about the track record of the regime, in this context, could function as a kind of nuclear trigger, pushing states that had been on the verge of seeking weapons to proceed with the last stages of nuclear development. Giving due consideration to the track record of the nonproliferation regime can help analysts assess the level of risk for individual countries at a particular time. Policymakers, as a result, can be better able to intervene to dissuade at-risk countries from pursuing weapons, using the full set of policy options at their disposal.

Supplementary Information

Supplementary information is available at the *Journal of Global Security Studies* data archive.

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