



Targeting Nuclear Programs in War and Peace

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Targeting Nuclear Programs in War and Peace

Abstract

When do states attack or consider attacking nuclear infrastructure in nonnuclear weapons states? Despite the importance of this question, relatively few scholarly articles have attempted to identify the factors that lead a state to attack another state's nuclear facilities. This paper conducts the first large- n analysis on when states use force as a way to control proliferation. We develop four arguments on when states attack nuclear infrastructure and identify specific hypotheses that flow from each of them. We test these hypotheses using a new data set on all instances when countries have struck or seriously considered striking other states' nuclear infrastructure between 1941 and 2000. Our findings challenge existing arguments that states are deterred from attacking nuclear programs by the prospect of a military retaliation from the proliferating state or concerns about international condemnation. Instead, we find that states are more likely to attack nuclear programs when they believe that the proliferating state might use nuclear weapons or engage in other offensive behavior. States are willing to accept substantial costs in attacking if they believe that a particular country's acquisition of nuclear weapons poses a significant threat to their security.

Introduction

Since the 1940s, nearly two-dozen countries have raced to develop nuclear weapons. Though theoretical arguments have been made that more proliferation can be better, policymakers have almost universally shunned that argument and have worked to prevent proliferation.¹ A 1960 U.S. National Intelligence Estimate captured the counterargument to the more-weapons-are-better logic: “Even a small increase in the number of countries having nuclear weapons...would result in some increase in the elements of danger arising from world tensions [and] could magnify the consequences of acts based on miscalculation or taken through desperation and irrationality” (United States 1960). These fears continue today, as nuclear weapon programs in North Korea and Iran raise the prospect of further proliferation in the East Asia and the Middle East.

In response to the dangers associated with proliferation, the international community has crafted several strategies to limit the spread of nuclear weapons. Those include diplomatically negotiated measures such as security guarantees and the Nonproliferation Treaty (NPT), and economic tools such as export controls that restrict the supply of commodities used for nuclear weapons or that sanction proliferating states. The most extreme and indeed controversial form of opposition to proliferation is the use of military force. New data collected for this paper reveal that between 1941 and 2000, there were eighteen cases where countries seriously considered striking another country’s nuclear program and fifteen cases where attacks occurred.

The existing literature offers limited clues as to why states might resort to force. Proliferation itself, for example, is thought to increase the likelihood that one state will

¹ Not all scholars share this view. For an alternate perspective see Waltz and Sagan (2003).

attack nuclear facilities in another state to prevent it from acquiring nuclear weapons (e.g., Sagan 1994; Feaver 1997; Waltz and Sagan 2003). Other studies have sought to explain why states attacked or considered attacking nuclear facilities in particular cases. For example, Israel's decision to attack Iraq's Osirak facility in 1981 has received significant scholarly attention, both in terms of causes and consequences of the attack (e.g., Feldman 1982; Snyder 1983; Perlmutter, Handel, and Bar-Joseph 2003; Reiter 2005, 2006), as has the United States' considered use of preemptive force against China's nuclear program between 1961 and 1964 (e.g., Burr and Richelson 2000/01; Goldstein 2006).² Related research examines when the United States could use force against states that act in defiance of the nonproliferation regime (Feaver and Niou 1996). But none of these can account for empirical puzzles introduced by the record of attacks. For example, they do not explain cross-national variation in states' willingness to attack nuclear infrastructure, such as why Iran, Israel, and the United States launched attacks against Iraqi nuclear facilities but other countries with similar opportunities did not, or why Israel attacked nuclear facilities in Iraq and Syria but not in Libya or Pakistan.

Moreover, to our knowledge, no research has incorporated both positive and negative cases, that is, both cases where force was used as well as where it was considered as an option but ultimately dismissed. Unless these negative cases are taken to account, then studies may naturally bias toward the use of force seeming judicious or warranted, because they would have excluded cases where leaders decided that the military or normative costs were too high to carry out the attacks.

² Most of the research on the Osirak incident deals with the consequences of the attack rather than its causes (e.g., Reiter 2005).

In this paper, we examine why states attack or consider attacking nuclear infrastructure in nonnuclear weapons states. Drawing from the literatures on nuclear proliferation and international conflict, we develop four arguments on when states attack nuclear infrastructure and identify specific hypotheses that flow from each of them. Contrary to the existing literature on this topic (e.g., Feaver and Niou 1996; Goldstein 2006), we find that fears of provoking a military response from the proliferating state and concerns about international condemnation are not particularly salient in deterring attacks against nuclear programs. Rather, we find that states are more likely to attack nuclear programs when they believe that the proliferating state might use nuclear weapons or engage in other offensive behavior. This suggests that states are willing to accept substantial costs in attacking if they believe that a particular country's acquisition of nuclear weapons poses a great enough threat to their security.

This paper proceeds by defining attacks and considered attacks against nuclear facilities in nonnuclear weapons states. Subsequently, we develop four arguments on when states are likely to target or consider targeting nuclear programs and identifying testable hypotheses that flow from each of them. We next present our empirical strategy to test these hypotheses and discuss the statistical findings. The conclusion revisits the empirical, theoretical, and practical contributions of our study and offers directions for future research.

Definitions and the Universe of Cases

Rather than conceiving of a decision to use force as a dichotomous variable we conceptualize it along a continuum with three stages: (1) no interest in military action; (2) consideration of an attack; and (3) an actual attack.³ Studying the use of force in this way is appropriate because it mirrors the reality of how states decide to use force. States that ultimately resort to military force begin by considering whether it is a viable option and by making preparations to engage in it. Some states make preparations for using force but ultimately do not, either because they decide that attacking is not in the national interest or determine that the attack is not operationally feasible. This conception of attacks against nuclear programs is also useful because it allows us to generate additional leverage on our research question, since considered attacks are more common than actual attacks. It also allows us to examine whether the determinants of each stage of force are similar, which could shed additional light on the circumstances under which states will employ force in pursuit of nonproliferation objectives.

We define attacks as the state-sanctioned use of force against materials, commodities, or infrastructure related to a nuclear weapons program that has the intention of delaying a country's acquisition of nuclear bombs.⁴ Attacks are preventive in the sense that they are intended to "forestall [a] power shift by blocking the rise of [an] adversary while the opportunity is still available" (Walzer 1977, 76; Levy 2008). In

³ This approach mirrors Singh and Way's (2004, 865–867) conception of nuclear weapons proliferation. They create three dependent variables and conceptualize proliferation along a continuum: (1) *Exploration of weapons* includes states as proliferating if they seriously consider building nuclear weapons, even if steps are not taken to achieve this objective; (2) *Pursuit of weapons* classifies all countries as proliferators that have made an effort to pursue nuclear weapons; and (3) *First assembly of weapons* considers states to be proliferating if they have ever conducted a nuclear test or assembled a complete nuclear warhead.

⁴ Relevant infrastructure includes nuclear power and research reactors and facilities for fuel fabrication, uranium enrichment, or plutonium reprocessing. This definition is similar to a definition offered by Reiter (2006: 29): "Any use of force that has the intention or effect of substantially degrading or delaying the acquisition of [nuclear] weapons by a state or nonstate actor." Our definition differs from Reiter's in three respects: (1) we do not include attacks against nonstate actors; and (2) we exclude uses of force that had the intent of delaying nuclear proliferation if this was not the explicit intention of the attacking country.

principle, they can be limited military strikes (e.g., Israel's 1981 strikes against Iraq), occur as part of a broader campaign to initiate an all-out war (e.g., U.S. strikes during the 1991 Persian Gulf War), or can emerge as an aim during an ongoing armed conflict (e.g., Allied attacks against Germany during World War II). Our key criterion is that the attacks are intended to thwart a country from building nuclear weapons; for the purposes of this study, we are not interested in cases where states used force to reverse proliferation after the target country had assembled at least one nuclear weapon. Once a country acquires nuclear weapons, decisions to attack nuclear programs are fundamentally altered because it is possible for nuclear weapons to be used in retaliation against the attacking state (Feaver and Niou 1996).⁵ Thus, we exclude U.S. responses to the Soviet nuclear program in the 1950s because attacks were considered after Moscow had already acquired nuclear weapons. We also exclude uses of force intended to delay proliferation if nuclear materials, commodities, or infrastructure were not targeted. For example, we do not include attempts to interdict nuclear-related commodities or materials destined for countries of proliferation concern.⁶

States can take serious steps toward using force without actually doing so. Consideration of attacks comprises actions taken at the cabinet-level or above towards attacking nuclear infrastructure, short of actually resorting to force. We set a very high threshold for what constitutes "consideration" because we are aware that discussions on preventive action can represent what McGeorge Bundy described as "talk, not serious planning or real intent" (Burr and Richelson 2000/01, 54). The evidence we look for to

⁵ We acknowledge that attacks that occur or are considered after the target state acquires nuclear weapons are also interesting and we plan to analyze them in a future study.

⁶ Although interdiction for the purposes of counterproliferation is an interesting phenomenon, it was not a frequent instrument that states have employed prior to the onset of the Proliferation Security Initiative (PSI) in 2003.

determine whether attacks were considered includes: (1) a leader's expression of interest in military action in meetings with cabinet-level officials where the use of force is debated; (2) the authorization of analysis on the costs and benefits of a preventive attack; (3) asking for collaboration from another state in attacking a third state's nuclear infrastructure; and (4) a political decision to use military force that is made but later reversed.⁷ These actions are sufficiently costly that they are indicative of genuine interest in military action among leaders and/or cabinet level officials. We exclude other, less costly actions that could also be interpreted as preparations for military action. For example, we do not classify the development of operational plans, intelligence collection on nuclear-related targets, and threats to use force as indicators that attacks were seriously considered. Powerful countries such as the United States often collect intelligence or draw up plans for military action because they want to be prepared for a wide variety of scenarios that could occur in the future—not because they are preparing for imminent action. Additionally, threats to attack nuclear programs can be a sign of public posturing or attempts to appease domestic or international audiences as much as they are a sign of genuine interest in military action.⁸

Consider two examples that illustrate our coding procedures. We code the United States as having considered using force against China between 1961 and 1964. Washington asked the Soviet Union for assistance in orchestrating the attack and

⁷ Determining whether a state took one of the four actions described above is sometimes challenging given the secrecy surrounding these issues. But a significant amount of material has been declassified and much has been written about considered attacks against nuclear programs in the international news media, the memoirs of leaders and cabinet level officials, and in the large secondary literature on states' nuclear weapons programs. These sources generally make it possible to identify whether actions constituting the consideration of an attack were taken. More information on this point is available in the online appendix.

⁸ For example, in August 2007 French President Sarkozy threatened to bomb Iran's nuclear program but this was more an attempt to highlight the urgent need for a diplomatic solution than an expression of genuine French interest in attacking Tehran.

President Kennedy (and to a lesser extent President Johnson) often expressed interest in attacking China during meetings with cabinet-level officials (Chang 1988; Burr and Richelson 2000/01). He stated to his advisors on occasion, “You know, it wouldn’t be too hard if we could somehow get kind of an anonymous airplane to go over there, take out the Chinese facilities—they’ve only got a couple—and maybe we could do it, or maybe the Soviet Union could do it, rather than face the threat of a China with nuclear weapons” (Burr and Richelson 2000/01, 54). On the other hand, we do not code the United States as having considered using force against South Africa in the late 1970s even though there is some evidence that the idea was entertained. The Soviets approached the Americans about cooperating in attacking South Africa but we found no evidence that Washington took this request seriously (e.g., Albright 1994). All of the evidence in the public record—including hundreds of declassified documents on South Africa’s nuclear program and U.S.–South African relations (e.g., National Security Archive 2006)—suggests that although the costs and benefits of attacking may have been briefly considered, the United States quickly dismissed this option and never seriously debated the merits of attacking during a cabinet-level meeting.

Based on these criteria, we collect new data on the instances where countries have attacked or considered attacking nuclear infrastructure between 1941 and 2000. We identify eighteen dyads where attacks were considered over seventy-one dyad years. A total of twelve different states gave serious consideration to attacking, suggesting that this is not just something that only one or two “rogue” states think about. We also identify fifteen separate attacks against nuclear programs involving six different attacking states. Of the states that pursued nuclear weapons, 14 percent were attacked at some point and

each country that was targeted experienced multiple attacks against its facilities. The dyads and years where force was used or considered are listed in table 1. (Please see the appendix for detailed information on the sources we used to code each case.)

Theory and Hypotheses

In this section, we draw from the small but growing literature on this subject as well as on the broader nuclear proliferation (e.g., Sagan 1996/97) and international conflict (e.g., Bremer 1992) literatures to develop four arguments explaining the targeting of nuclear programs. We then identify testable hypotheses that flow from the logic of each of these arguments.

RISKS OF RETALIATION

One of the most prominent arguments appearing in the extant literature (e.g., Feaver and Niu 1996; Levy 2008) is that countries are more willing to attack nuclear programs when they expect a limited military response and avoid such attacks when they expect a massive response. Historical examples support this expectation. Israel's calculation that Iraq would not respond militarily contributed to its decision to attack in 1981. Similarly, one of the principal reasons why Israel attacked a Syrian nuclear reactor in 2007 was because the potential for Damascus to retaliate was very limited (interview by author 2008). Conversely, one of the reasons why the United States refrained from raiding Chinese nuclear facilities in the 1960s was that they worried about a massive military response (Burr and Richelson 2000/01). According to Secretary of State Dean Rusk, "The

[Chinese] reaction would be violent and would result essentially in the employment of their principal weapon, their enormous manpower, in offensive retaliatory operations beyond their borders. In this connection we could not employ U.S. manpower to resist such an action” (Goldstein 2006, 71).

This logic suggests that weak proliferators are more likely to be attacked because the potential for retaliation is reduced:

Military Response Hypothesis 1: States are more likely to attack or consider attacking weak states’ nuclear programs.

The power ratio between the attacking and target states could also affect the likelihood of a military response from the target. Insights from the international conflict literature reveal that peace within a dyad is more likely when one state is significantly stronger than the other because “the clearly weaker side would not be so foolish as to...be drawn into a war it cannot win” (Bremer 1992, 313). Thus, even if the target state is capable of responding militarily, it might refrain from doing so if the attacking state is notably stronger than it to avoid the prospect of a war it is likely to lose.⁹ This logic suggests, for example, that all other things being equal Israel was more likely than Jordan to attack Syria’s nuclear program, which it did in September 2007. Syrian President Bashar Assad’s comments in the wake of the attack lend support to this argument. He said: “we could have responded to the IAF strike by firing a missile, but it would have given Israel an excuse to start a war, and we did not want that” (Stern 2007).

⁹ This assumes that the attacking state intends the attack to be limited (e.g., Israel’s attacks against Iraq and Syria) and not part of an all-out war.

Military Response Hypothesis 2: States are more likely to attack or consider attacking nuclear programs when the power differential within the dyad is large and in the attacking state's favor.

FEAR OF INTERNATIONAL CONDEMNATION

Articles 56 and 15 of Protocol I Additional to the Geneva Conventions (1977) state:

“Works or installations containing dangerous forces, [including] nuclear electrical generating stations, shall not be made the object of attack, even where these objects are military objectives, if such attack may cause the release of dangerous forces and consequent severe losses among the civilian population.”¹⁰ Although this provision excludes military use facilities, it is consistent with a norm against attacking nuclear facilities (Goldblat 2002, 164–165). Given that norm violators are expected to face political or economic costs, we would expect this norm to shape state behavior, making attacks against nuclear programs less likely (e.g., Finnemore and Sikkink 1998; Simmons 2000). Indeed, countries that attack nuclear facilities are often censured, which at least temporarily weakens their standing in the international system. For example, as we discuss below, Israel was sanctioned by the United Nations Security Council after its raid against Iraq's nuclear program in 1981.

While international condemnation would likely have adverse consequences for both democratic and nondemocratic regimes, it is comparatively worse for the former. Previous research reveals that domestic constituencies often punish leaders who flaunt international norms or reverse international commitments (e.g., Fearon 1994). As

¹⁰ Protocol I Additional to the Geneva Conventions of August 12, 1949, entry into force December 7, 1978, <http://www.unhcr.ch/html/menu3/b/94.htm>.

Simmons (1998, 84–85) argues, “The weight of an international obligation...may be vital in convincing domestic audiences actively to oppose a government policy, raising the political costs of noncompliance.” Facing domestic disapproval is relatively more problematic for democratic leaders because they must satisfy larger constituencies in order to govern effectively or remain in power (e.g., Bueno de Mesquita and Lalman 1992). Evidence from specific cases underscores that democratic regimes are sensitive to the risks of international condemnation. For example, the chief of operations for the Indian Air Force advised against attacking Pakistan’s uranium enrichment plant at Kahuta during the 1980s because “the international community would condemn us...India would not be able to get away with [attacking]” (Ramberg 2006, 53). Similarly, Shimon Peres, the leading opposition candidate in Israel’s 1981 elections, opposed the raid against Iraqi nuclear facilities on the grounds that the attack would violate an international norm and leave Israel isolated “like a tree in the desert” (Perlmutter, Handel, and Bar-Joseph 2003, 59). When considering attacks, autocratic leaders would be expected to have or express these types of concerns less often.¹¹

The preceding logic suggests that democratic sensitivity to norm violations will lead to the following expectations:¹²

¹¹ For example, fears of international condemnation do not appear to be salient in explaining why the Soviet Union’s considered attacks against Israel and South Africa but ultimately chose not to use military force (e.g., Albright 1994; Ginor and Remez 2007).

¹² The logic we advance above focuses on the institutional structure of democracies and the costs resulting from international condemnation. There are other monadic democracy arguments we could draw from to explain attacks against nuclear programs. For example, democracies may be less likely to attack nuclear programs democratic societies find attacks against nuclear facilities repugnant (e.g., Schweller 1992) or because democratic norms operating domestically limiting the use of lethal force translate to the international sphere (e.g., Rummel 1983). These arguments predict the same outcome as the argument we articulate above—that democracies should be less likely to attack or consider attacking nuclear programs. Future research should examine which of these logics offers the most explanatory power.

International Condemnation Hypothesis 1: Democracies are less likely to attack or consider attacking nuclear programs than nondemocracies.

A state's perception of whether an attack against a nuclear program is "just" might also affect whether it endorses sanctions or condemns the attacking state. Proponents of just war theory—dating back to Saint Augustine, Hugo Grotius, and Immanuel Kant—make ethical arguments about the resort to war on the assumption that morality has a place in international politics. In determining whether the use of force is morally acceptable (*jus ad bellum*), just war theorists assess whether a state is acting out of self defense; while responses to armed aggression are perceived to be legitimate, unprovoked attacks are not (Walzer 1977; Crawford 2003). Drawing from these insights, recent research finds that countries are more likely to get involved in crises if they are first provoked because this makes it easier for them to justify their involvement to domestic and international audiences (Butler 2003).

This logic suggests that, despite the norm against attacking nuclear facilities described above, countries are comparatively more likely to condemn attacks if they are launched without provocative actions taken by the proliferating state rather than in self-defense. The 1981 Osirak raid illustrates this proposition. The attack was quickly condemned by the United Nations Security Council as unlawful under the UN Charter (Carnahan 1992). Sir Anthony Parsons, the British representative to the Security Council, argued that the Israeli attack "was not a response to an armed attack on Israel by Iraq. There was no instant or overwhelming necessity for self-defence. Nor can it be justified as a forcible measure of self-protection. The Israeli intervention amounted to a use of force which cannot find a place in international law or in the [UN] Charter and which

violated the sovereignty of Iraq” (Parsons 1981). Other delegates shared these views. For example, the Sierra Leonean delegate asserted that Israel’s “plea of self defense is untenable where no armed attack has taken place or is imminent” (Arend 2006).

Potential attacking states understand that diplomatic costs can follow attacks against nuclear programs conducted in the absence of aggressive actions taken by the proliferating state. For example, when considering whether to attack Chinese nuclear facilities in the 1960s, President Johnson and his foreign policy advisors were aware that an attack in the absence of Chinese hostility would invite international condemnation. They concluded: “If for other reasons we should find ourselves in military hostilities at any level with the Chinese Communists, we would expect to give very close attention to the possibility of an appropriate military action against Chinese facilities” (Goldstein 2006, 61). This logic suggests a second hypothesis relating to fears of international condemnation:

International Condemnation Hypothesis 2: States are more likely to attack or consider attacking nuclear programs if the proliferating country first initiates militarized conflict against it.

Many scholars have argued that the nuclear Nonproliferation Treaty has limited the spread of nuclear weapons globally by institutionalizing a norm against pursuing these weapons (Epstein 1977; Sagan 1996/97; Jo and Gartzke 2007).¹³ Whether a proliferating country is a NPT member might affect whether other states attack or consider attacking it. When states sign this treaty, they make a legal commitment not to manufacture or otherwise acquire nuclear weapons (Article II). If a state is pursuing

¹³ Although John F. Kennedy predicted in 1960 that 15 to 25 countries would acquire nuclear weapons in the near future, only four states crossed the nuclear threshold after the NPT entered into force in 1970. Using statistical analysis, Jo and Gartzke (2007) do not find empirical support for this argument.

nuclear weapons while a NPT member, other states might believe that actions to oppose proliferation in that country are legitimate. Conversely, if a country is not an NPT member—and therefore is not violating an international commitment by pursuing nuclear weapons—it may be more difficult for countries to justify taking actions to oppose its nuclear program. Indeed, the reason Iran was sanctioned by the United Nations Security Council in 2006–07 (Resolutions 1696, 1737, and 1747) was not because it was pursuing nuclear weapons per se, but because it failed to meet its obligations under the NPT. Likewise, Israel and the United States justified and garnered international support for their attacks against Iraqi nuclear facilities in 1981 and 1991, respectively, on the basis of Iraq’s breached NPT commitment (Carnahan 1992). This logic suggests the following hypothesis:¹⁴

International Condemnation Hypothesis 3: States are more likely to attack or consider attacking the nuclear programs of proliferators that are NPT members.

LOSS OF BARGAINING LEVERAGE

One of the most widely cited consequences of nuclear proliferation appearing in the extant literature is the loss of bargaining leverage (e.g., Schelling 1966). State A may be forced to make concessions in disputes with State B if that country acquires nuclear weapons because the expected costs of armed conflict would be prohibitively high. Indeed, Beardsley and Asal (2007) find that states are less likely to obtain their desired outcome and convince their opponent to back down in a crisis if the opponent possesses

¹⁴ It is also plausible that NPT members are less likely to be attacked because they are subject to International Atomic Energy safeguards, which makes it more difficult to divert technology and materials to a weapons program. Ultimately, the results from our statistical analysis will shed light on which argument is correct.

nuclear weapons. This logic suggests that states will oppose another state's acquisition of nuclear weapons—and possibly resort to military force to prevent it from happening—if they perceive that this outcome will constrain their bargaining leverage. As Levy (2008) suggests, countries may be willing to attack nuclear programs to avoid making unwanted concessions in the future. The historical record of U.S. decisionmaking on possible attacks during the early 1960s illustrates that fears about the loss of political leverage can influence a country's willingness to attack. According to one of his advisors, Kennedy believed that a Chinese nuclear test would be “the most significant and worst event of the 1960s” (Fetzer 1989). He attached a high priority to this issue because he feared that the Chinese would be “our major antagonists of the late 60s and beyond” and that a nuclear-armed China would undermine the U.S. position in Asia (Burr and Richelson 2000/01, 67). By July 1963, many in the State Department argued that a Chinese nuclear capability was unlikely to be “used as an umbrella for aggression” but still worried that a Chinese bomb would weaken U.S. leverage (Burr and Richelson 2000/01, 76). According to declassified State Department documents, “Communist China will try...to use its nuclear capability to weaken the will of Asian countries, to stimulate divisions among them, to put political pressure on the U.S. military presence in the area; and to obtain support for Chinese claims to status as a world power” (United States 1964).

The likelihood that states will experience future disagreements is contingent on the congruence of their foreign policy interests. A state might not worry about losing leverage vis-à-vis states with similar foreign policy interests to its own because future disagreements or crises are relatively unlikely. On the other hand, states with dissimilar interests can expect to disagree over contentious issues in the future. Therefore, if State A

and State B have dissimilar interests and State B acquires nuclear weapons, State A would lose leverage and be less able to defend its future interests. Under such circumstances, State A might be willing to use military force to prevent State B from acquiring nuclear weapons.

Loss of Leverage Hypothesis I: States are more likely to attack or consider attacking the nuclear programs of states that have dissimilar foreign policy interests.

FEAR OF OFFENSIVE BEHAVIOR

The use of nuclear weapons has not been attempted since 1945 and their use is threatened only on rare occasions (Betts 1987). The use of nuclear bombs would provoke a massive military response, especially if used against a nuclear opponent with a second-strike capability, and lead to considerable normative costs (Tannenwald 2007). Nevertheless, countries often oppose proliferation on the grounds that it increases the likelihood that nuclear weapons would be used. Existing case studies of attacks against nuclear programs (e.g., Feldman 1982; Snyder 1983; Perlmutter 2003) indicate that concerns about the proliferating state using nuclear weapons or engaging in other reckless actions such as selling warheads to terrorists or other countries motivate states to attack nuclear programs.

Two factors are likely to influence states' perception of whether the proliferating country will use nuclear weapons. The first is whether the attacking state recently experienced violent militarized conflict with the proliferating state. If State A initiates a nuclear weapons program after experiencing violent conflict with State B, State B might

perceive that it is the intended target of State A's bomb. For example, Indian officials were well aware that it was the target of Pakistan's weapons program, which began in the immediate aftermath of the Indo-Pakistani War of 1971 (Perkovich 1999). Consequently, India considered attacking Pakistani nuclear facilities on a number of occasions during the 1980s (Schneider 1995; Waltz and Sagan 2003). Additionally, if State A had a weapons program prior to conflict with State B or began a program during the conflict, State B might fear that the bomb, if acquired, would be used against it to resolve the issues at the heart of the dispute. For example, the United States and Britain recognized the need to attack key German nuclear installations because Germany's nuclear weapons program was intended to produce a bomb for use against the Allies during World War II. Referring to the German campaign to produce an atomic bomb, Winston Churchill stated, "it would be unforgivable if we let the Germans develop a process ahead of us by means of which they could defeat us in war or reverse the verdict after they had been defeated" (Goudsmit 1996, 7–8).

Offensive Behavior Hypothesis 1: States are more likely to attack or consider attacking the nuclear programs of states they recently experience violent militarized conflict with.

The proliferating state's regime type also affects whether it might resort to offensive behavior. Scholars have argued that democratic norms and institutions constrain leaders and prevent them from engaging in violent conflict or other risky ventures (e.g., Russett 1993; Dixon 1994). This logic suggests that democratic states are more likely than nondemocratic states to behave as relatively responsible nuclear powers. Since nondemocratic leaders are less accountable to domestic constituencies they may be

more inclined to threaten states with nuclear weapons, sell weapon technology to other states or nonstate actors, or actually use nuclear bombs against an adversary despite the “nuclear taboo” (Tannenwald 2007). When states fear that these types of activities are possible they are more likely to use force to prevent proliferation. For example, U.S. National Security Advisor Brent Scowcroft stated that Saddam Hussein’s “notoriously mercurial” behavior provided additional incentives to end the Iraqi nuclear program during the 1990–91 Persian Gulf War (Bush and Scowcroft 1998, 306–307). President George H.W. Bush echoed these sentiments: “No one knows precisely when this dictator may acquire atomic weapons...[but] he has never possessed a weapon that he hasn’t used” (Freedman and Karsh 1993, 224). More recently, President George W. Bush has repeatedly asserted that the world cannot allow Iran to acquire nuclear weapons because Iran has a “nontransparent” government, implying that its regime type heightens the risk of unpredictable or aggressive behavior (Garamone, 2006).

Israel’s raid on Osirak is also revealing. Israel decided to attack Iraq’s nuclear program in 1981 largely because it perceived that the Iraqi bomb would eventually be used against it (e.g., Feldman 1982; Snyder 1983; Perlmutter 2003). Israeli officials emphasized that the threat of an Iraqi bomb was magnified because Saddam Hussein’s regime was dictatorial, fanatical, and unpredictable (Feldman 1982). Consequently, Defense Minister Ariel Sharon proclaimed, “Israel cannot afford the introduction of the nuclear weapon [in Iraq]. For us it is not a question of balance of terror but a question of survival” (Snyder 1983, 583). This might help explain why Israel attacked Iraq and not other Arab states that might have been pursuing nuclear weapons (Snyder 1983).

Offensive Behavior Hypothesis 2: States are more likely to attack or consider attacking nondemocratic states with nuclear programs.

Countries that share a common regime type—whether democracy or autocracy—are less likely to engage in militarized conflict (e.g., Russett and Oneal 2001; Peceny, Beer, and Sanchez-Terry 2002). This means that a state is unlikely to be targeted with nuclear weapons by a state that has a similar regime type. As a result, the benefits of attacking to end the program are comparatively reduced under these circumstances. Additionally, states with common polities tend to share common values which can promote trust and reduce uncertainty (e.g., Doyle 1983). This might inspire a greater degree of confidence that the target state would act as a responsible nuclear power and provide attacking states with assurances that military force is unnecessary. Under these circumstances, states should be less willing to attack nuclear programs.

Offensive Behavior Hypothesis 3: States are less likely to attack or consider attacking the nuclear programs of states that have the same regime type.

Research Design

We seek to estimate the effects that independent variables have on attacks and considered attacks against nuclear programs between 1941 and 2000. We adopt a standard time-series cross-section data structure with the directed dyad year as the unit of analysis. The estimation sample includes twenty-one proliferating countries and their politically relevant counterparts.¹⁵ To determine which states pursued nuclear weapons, we

¹⁵ Countries exit the sample once they either acquire nuclear weapons or terminate their weapons programs. We include only politically relevant attackers because we are not interested in states that have no credible

consulted proliferation data compiled by Singh and Way (2004) and Jo and Gartzke (2007).¹⁶ The states that pursued nuclear weapons and the years they are included in the sample are listed in table 2. As we described above, we employ two dependent variables. *Attack* is a dummy variable that is coded 1 if a state attacked a proliferating country in year t and 0 otherwise. *Considered attack* is a dummy variable that is coded 1 if a state seriously considered attacking a proliferating country in year t and 0 otherwise.

A number of independent variables are used to test our hypotheses. We group proxy explanatory variables under the headings of the arguments developed above.

RISKS OF RETALIATION

Target's power. To determine the power of the target state, we consult the Correlates of War composite indicator of national capability (CINC) scores (Singer, Bremer, and Stucky 1972).¹⁷ This variable takes on the value of the target state's CINC score, which ranges from 0 to 1, in year $t-1$.

Power ratio. Using the Correlates of War data (Singer, Bremer, and Stucky 1972), we divide the attacking state's CINC score by the target state's CINC score to calculate how strong the former state is relative to the latter state.

capability to effectively destroy nuclear facilities. We define politically relevant attackers as all major powers and all states within 600 miles. If a country is more than 600 miles away and it is not a major power, it is extremely unlikely that it would be able to meet the operational requirements associated with an attack of this nature.

¹⁶ We primarily use Singh and Way's "explore" data since states could be attacked even if there is the slightest suspicion that they are using nuclear weapons. For the period prior to 1945, we rely on Jo and Gartzke's data.

¹⁷ The CINC score is computed by adding all observations for six unique capability components in a given year, converting each state's score to represent its share of the international system, and then averaging across the 6 components. The six indicators include total population, urban population, iron and steel production, energy consumption, military personnel, and military expenditure.

FEAR OF INTERNATIONAL CONDEMNATION

Attacker's polity. To code the attacking state's regime type we rely on data from the Polity IV project (Marshall and Jaggers 2007). This variable measures the Polity score, which ranges from -10 to 10, of the attacking state in year $t-1$.¹⁸

Provoked attack. To determine whether the target state initiated a militarized interstate dispute against the attacking state we consult version 3.0 of the Correlates of War MID data (Ghosn, Palmer, and Bremer 2004).¹⁹ We create a dichotomous variable and code it 1 if the proliferating state initiated a MID against the attacking state at any point between year $t-1$ and year $t-5$ that involved either the threat to use force, the display of force, or the use of force.

NPT. Using a list compiled by the Center for Nonproliferation Studies (Du Preez 2006), we create a dichotomous variable that equals 1 if the target state has signed the NPT in year $t-1$ and 0 otherwise.

LOSS OF BARGAINING LEVERAGE

Foreign policy similarity. As a measure of foreign policy similarity, we use Signorino and Ritter's (1999) S-score, which measures the similarity of states' foreign policy positions based on alliance portfolios and United Nations voting. Specifically, we code the dyad's S-score, which ranges from 0 to 1 with higher scores indicating more similar interests, in year $t-1$.²⁰

¹⁸ The Polity score measures the "concomitant qualities of democratic and autocratic authority in governing institutions" (Marshall and Jaggers, 2007). Higher scores indicate higher levels of democracy.

¹⁹ These data were generated using EUGene (Bennett and Stam, 2000).

²⁰ We use the un-weighted regional S scores.

FEAR OF OFFENSIVE BEHAVIOR

Violent conflict. As a measure of whether states in a dyad are involved in violent militarized conflict we create a dichotomous variable that equals 1 if they are involved in an ongoing militarized interstate dispute (MID) in year $t-1$ involving the use of force.²¹ We consult the aforementioned Correlates of War MID data (Ghosn, Palmer, and Bremer 2004) to code this measure.²²

Target's polity. Mirroring *Attacker's polity*, this variable measures the target state's Polity score, which ranges from -10 to 10, in year $t-1$.

Shared regime type. Using the Polity IV data, we code a dichotomous variable that equals 1 if the attacking and target states have the same regime type in year $t-1$ and 0 otherwise.²³

CONTROL VARIABLES

We control for other variables that could affect attacks and considered attacks against nuclear programs. In particular, we account for the operational feasibility of attacking a nuclear program and the target state's progress towards developing nuclear weapons. Including only politically relevant dyads in our sample helps control for operational feasibility. We include two additional variables. *Contiguity* is a dichotomous variable that is coded 1 if the target and attacking states share a land border and 0 otherwise and *attacker's power* is the attacking state's CINC score in year $t-1$.²⁴ We also control for how close the target state is to developing nuclear weapons since previous research

²¹ Based on the coding of the MID data, this includes "use of force" and "war."

²² These data were generated using EUGene (Bennett and Stam, 2000).

²³ States with Polity scores above 6 are considered democracies and states with Polity scores below 7 are considered nondemocracies.

²⁴ Contiguity data are obtained by consulting Stinnett et al. (2002).

suggests that this can influence states' willingness to attack or consider attacking (e.g., Feaver and Niou 1996). We include program years, which is a count of the number of years the nuclear weapons program has been active. We also measure a state's progress towards developing nuclear weapons using data on bilateral nuclear cooperation agreements.²⁵ Nuclear assistance is a variable measuring the cumulative number of these agreements the target state has received as of year $t-1$.²⁶ This measure is appropriate because states typically acquire the knowledge and capacity required to produce nuclear bombs as a result of foreign assistance (Kroenig 2009; Fuhrmann 2008).

To account for temporal dependence, we include the controls recommended by Beck, Katz, and Tucker (1998). Our analyses of considered attacks include a variable—*no attack years*—that counts the number of years that pass in between attacks and three cubic splines. We do not include these variables in our analyses of attacks since none of them are statistically significant in any model specification.

Method

We first explore cross-tabulations of attacks and considered attacks against all of the independent variables. This simple analysis is useful because it sheds light on the strength and subtlety of underlying relations.

Then we turn to statistical analysis to determine whether the relationships we identify are due to confounding variables. The phenomena we are studying—attacks and

²⁵ Nuclear cooperation agreements authorize the transfer of nuclear technology, materials, or knowledge from one state to another for “peaceful purposes.” They are required to be in place in virtually all cases before such items can be exchanged. See Fuhrmann (2008).

²⁶ These data are taken from Fuhrmann (2008).

considered attacks against nuclear programs—are relatively rare occurrences. Since standard techniques such as logit or probit generate biased coefficients when applied to rare events we use rare events logit, an estimator designed to cope with this problem.²⁷ This estimator is appropriate when researchers employ binary dependent variables with thousands of times fewer ones than zeros (King and Zeng 2001). Attacks and considered attacks occur in 0.31 percent and 1.37 percent of the observations in our sample, respectively—well within the ratio of ones to zeros that is suitable for rare events logit. We use robust standard errors clustered by dyad to control for heteroskedastic error variance. All independent variables are lagged one year behind the dependent variable to control for possible simultaneity bias.

Results

Table 3 displays simple cross-tabulations of the independent variables against considered attacks and attacks of nuclear programs.²⁸ These cross-tabulations are revealing in a number of respects. In general they suggest that the relationships between the independent variables and attacks are probabilistic, not deterministic. As the following discussion will demonstrate, even the presence of factors that have very strong substantive effects on attacks do not guarantee that they will occur.

The cross-tabulations do not support the argument that a fear of a strong military response affects decisions to attack nuclear facilities. A chi-square test reveals that one

²⁷ For the sake of robustness, we also employ other estimators. Using logit or ordered logit (with a dependent variable coded 0 for no consideration, 1 for considered attack, and 2 for attack) produces results that are virtually identical.

²⁸ For ease of interpretation, continuous variables are broken down into dichotomous variables coded as 1 for values above the mean and 0 for values below the mean.

can reject the null hypothesis that there is a relationship between either *target's power* or *power ratio* and attacks or considered attacks against nuclear programs (see tables 3A and 3B).

Table 3C reveals that, contrary to expectations, democracies are more likely to consider attacking nuclear programs and that there is no significant relationship between the attacking state's polity score and actual attacks. On the other hand, the cross-tabulations of *provoked attack* and *NPT* against attacks and considered attacks indicate partial support for the argument that states are sensitive to possible costs resulting from international condemnation. When a country is provoked by a proliferating state, it is more likely to consider attacking its nuclear facilities; attacks were seriously contemplated in 4.7 percent (37) of the dyad years where a country was provoked and only in 0.7 percent (27) of the dyad years where a country was not provoked. A chi-square test, however, reveals no statistically significant relationship between provocation and actual strikes. Table 3E reveals a significant, albeit subtle relationship between attacks and NPT membership; attacks occur in 0.6 percent (10) of the dyad years when the proliferating country is a NPT member and only in 0.2 percent (5) of the dyad years when it is not a treaty member.²⁹ Although countries consider attacking a greater percentage of NPT members than non-NPT members, a chi-square test reveals that this relationship is not significant.

Table 3F indicates strong empirical support for the argument that reservations about the loss of bargaining leverage affect decisions to attack nuclear programs. Of the dyad years including states with dissimilar foreign policy interests, attacks were

²⁹ Four of the five attacks against non-NPT members occurred prior to the entry into force of the treaty in 1970.

considered in 2.1 percent (39) versus 0.8 percent (25) of the dyad years including states with similar interests. Similarly, the vast majority (13 of 15) of dyad years where an attack occurred included states with dissimilar foreign policy interests.

Perhaps the most interesting findings deal with the effect that *violent conflict* and *target's polity* have on strikes of nuclear facilities. Attacks and considered attacks are much more common when preceded by armed conflict, although not all conflicts lead to strikes. For example, 8.2 percent (42) of the dyad years where conflict previously took place experience considered attacks while only 0.5 percent (22) of dyad years face considered attacks that are not preceded by conflict. Likewise, attacks occurred in 2.5 percent (13) of the dyad years preceded by conflict and only 0.1 percent (2) of the dyad years not preceded by conflict. Interestingly, even the most extreme form of violent conflict, war, does not always produce attacks against nuclear programs. For example, Egypt and the Soviet Union did not attack Israeli nuclear infrastructure during the 1967 Six Day War despite having operational plans to do so. Nuclear programs were also not targeted during the Indo-Pakistani War of 1971 or during the 1962 Sino-Indian War.³⁰

As table 3H reveals, states have greater interest in attacking nondemocratic states than democratic states. Only 0.6 percent (11) of the dyad years including a proliferating state with a high polity score experience considered attacks compared to 1.8 percent (53) of dyad years including a proliferating state with a high polity score. Even more striking, all 15 of the dyad years where attacks occurred included a proliferating country with a low polity score, although not all nondemocratic proliferators were attacked; 0.5 percent (15) of the dyad years including a country with a low polity score experienced attacks.

³⁰ These three conflicts all involve at least one country that was pursuing, but had not yet acquired, nuclear weapons.

Table 3I offers some evidence that having a shared regime type affects raids against nuclear programs. While there does not appear to be a statistically significant relationship between common regime types and actual attacks, countries are less likely to consider targeting those states that have a regime type similar to their own. For example, 2.2 percent of the dyad years where countries had dissimilar regime types experienced attacks, compared to 0.6 percent (16) of the dyad years where countries had common regime types. These findings—particularly those relating to *violent conflict* and *target's polity*—offer significant empirical support for the argument that countries are more likely to attack nuclear programs when they think the proliferating country might use nuclear weapons or otherwise behave offensively.

The next step is to determine whether the relationships suggested by table 3 hold when controlling for the factors thought to influence attacks against nuclear programs. For example, will *violent conflict* and *target's polity* still be salient in explaining attacks once we account for the other explanatory variables (e.g., *foreign policy similarity*) and the controls (e.g., *contiguity*)?

Table 4 displays the initial results of the multivariate statistical analysis.³¹ Models 1 and 2 differ in that they use *considered attacks* and *attacks* as the dependent variable, respectively. Table 5 lists the substantive effects produced by each of the statistically

³¹ As a robustness check, we add additional control variables to the models displayed in table 4. We include an interaction term between *target's power* and *violent conflict* and between *target's power* and *target's polity*. Because states might want to maintain cordial relations with the system leader, it is plausible they are less inclined to attack or consider attacking countries that have close relations with it. Thus, we include the target state's S-score with the most powerful state in the system. We include a dichotomous variable that equals 1 if the attacking state possesses nuclear weapons in year $t-1$ and 0 otherwise because states already in possession of nuclear weapons might have greater incentives to attack proliferators in order to preserve their relative advantage. Finally, we include a dummy variable that is coded as 1 for all years after 1981 to control for the effect that the Osirak raid might have had on states' willingness to attack nuclear facilities. None of these variables attain conventional statistical significance and their inclusion does little to change the other results.

significant variables using a program developed by Tomz, King, and Zeng (1999). To interpret substantive effects, we compute the relative risk for each significant variable. The relative risk refers to the probability of an event in the treatment group divided by the probability of an event in the control group. The numbers displayed in Table 5 are calculated by the probability of a dyad experiencing considered attacks or attacks when a variable rises to its 75th percentile, divided by the probability of considered attacks or attacks when the variable is set at its sample mean, *ceteris paribus*.³²

The statistical results presented in table 4 are generally consistent with the cross-tabulation analysis presented in table 3. There are, however, a few notable differences. We find some evidence that contradicts the argument that states refrain from attacking nuclear programs because they worry about the risk of retaliation. The results indicate that strong states are actually more likely to be attacked than weak states. The relative risk of *target's power* is 0.96, which means that increasing the value of this variable from its mean to its 75th percentile decreases the likelihood of an attack by 4 percent.³³ After accounting for confounding variables, we find less support for the fear of international condemnation argument; *attacker's polity* and *provoked attack* do not have a statistically significant effect in the expected direction on considered attacks. *Provoked attack* actually reduces the likelihood that a nuclear program will be raided by 84 percent. A final difference relates to *foreign policy similarity*; we do not find a statistically significant relationship between this variable and attacks, which diminishes support for

³² Dummy variables are increased from 0 to 1.

³³ The percentage changes are calculated by the following formula: $[\text{relative risk} - 1] * 100$. This result should be interpreted cautiously because it is largely driven by the attacks against Germany's program in the 1940s.

the argument that states attack nuclear programs when they worry about the loss of political leverage.

Like the simple cross-tabulation analysis, our statistical analysis offers strong support for the argument that states attack nuclear programs when the fear that the proliferating state might use nuclear weapons or engage in other offensive behaviors. *Violent conflict* and *target's polity* both have strong, statistically significant effects on the likelihood of attacks and considered attacks. Interestingly, these variables are the only two that have a statistically significant effect in the expected direction in both model 1 and model 2. Substantively, the relative risk of *violent conflict* is 2.88 for considered attacks and 220 for attacks. This means that violent conflict increases the likelihood of having a considered attack by 188 percent and an actual attack by 21,900 percent. The latter effect is extraordinarily large. While it is unusual to have a substantive effect this big, it makes sense when one considers that 13 of the 15 attacks against nuclear programs were preceded by violent conflict. The relative risk of *target's polity* is 0.85 for considered attacks and 0.34 for attacks, indicating that relatively democratic states are 15 percent less likely to have countries consider attacks against them and 66 percent less likely to be attacked.

The control variables shed interesting light on attacks against nuclear programs. The closer a country is to developing the bomb the more likely states are to consider attacking it. On the other hand, progress decreases the likelihood that a country will actually be attacked. Substantively, having a weapons program in place for a long period of time increases the likelihood of a considered attack by 79 percent but reduces the likelihood of an actual attack by 81 percent. This indicates that states are less inclined to

attack when they believe that a proliferator has accumulated sufficient technological and intangible competence in nuclear matters because this makes it difficult to reverse proliferation, even with the use of military force. It is also noteworthy that operational feasibility affects considered attacks but not actual attacks. The relative risk of *attacker's power* is 1.09, indicating that relatively strong states are 9 percent more likely than weak states to consider attacks. Similarly, the relative risk of *contiguity* is 3.56, which means that considered attacks are 256 percent more likely among states that border one another. That these variables do not have the same effects on actual attacks is revealing because it hints that states find a way to attack states they believe the proliferator will act capriciously, even if the operational requirements of the mission are daunting.

SENSITIVITY ANALYSIS

How robust are these findings? To answer this question, we conduct some further sensitivity analysis. Specifically, we increase the sample size and exclude countries that frequently consider attacking nuclear programs to determine if our results are driven by the inclusion of one particular country. The results are presented in table 6. Models 1 and 2 include all potential attacking states in the sample—rather than only politically relevant ones—to analyze considered attacks and attacks, respectively. This increases the sample size significantly, from 4,372 to 44,348. Models 3 and 4 exclude the United States from the sample as an attacking country while models 5 and 6 exclude Russia and models 7 and 8 exclude Israel. Each of these countries considered attacking the nuclear programs of more than one country.

The results presented in table 6 are generally consistent with the results displayed in table 4. *Foreign policy similarity* and *violent conflict* are statistically significant in models 1–8, while *target's polity* is significant in six of the eight models displayed in table 6.³⁴ *NPT* also has a positive and significant effect in all of the attack models (2, 4, 6, and 8). The principal difference to emerge from this sensitivity analysis relates to the variables capturing operational feasibility. Not surprisingly, when including all potential responders to a proliferator's nuclear program—not just politically relevant responders—*contiguity* and *attacker's power* become more important in explaining attacks against nuclear programs. Overall, the results presented in Table 6 should inspire greater confidence that our findings are robust.

Conclusion

This paper makes a number of important contributions empirically, theoretically, and in terms of policy debates on proliferation. First, we produce a new data set that incorporates all known historical episodes in which one state attacked or contemplated attacking another state's nuclear infrastructure. As such, the dataset goes far beyond a single case study, which is the dominant approach to the study of when states attack suspected proliferators' nuclear installations. It also is the first to include cases in which force was considered but not used, which gives a more comprehensive understanding not just of when states did use force but the conditions under which they deemed it unwise.

³⁴ This suggests that the finding that non-democratic states are more likely to be attacked is driven largely by the United States.

Having assembled this data, the paper constitutes the first statistical analysis of when states resort to force or consider force but ultimately decide against it.

The empirical findings reveal that attacks against nuclear programs do not occur randomly; rather, they are systematically and significantly influenced by states' political relationships and the institutional characteristics of the proliferating country. This means that even though attacking nuclear programs may be an increasingly appealing strategy, strikes are not equally likely to occur among all combinations of attacking and proliferating states.

Our findings challenge existing accounts about when states attack nuclear infrastructure in a proliferating country. Scholars and practitioners have generally assumed that states are more likely to attack weak proliferators because the opportunities for retaliation are reduced. The recent Israel-Syria case supports this line of thinking but we find that, on average, risks of retaliation are not salient in explaining either attacks or considered attacks. The finding that NPT members are more likely to be attacked offers some empirical support for the argument that attacks against nuclear programs are rare because the costs of international condemnation are high. But overall, broad support for this argument is lacking.

Our analysis lends much greater support to the arguments that states attack nuclear programs when proliferation threatens to weaken their bargaining leverage or when they fear that the proliferating state might engage in reckless behavior that threatens their interests or in the extreme, threatens their existence. These are interesting results because they suggest that states are willing to attack a proliferator when they are

sufficiently opposed to its acquisition of nuclear weapons, despite the consequences that could ensue from doing so.

Second, this paper has implications for theoretical debates on proliferation. Proliferation pessimists (e.g., Sagan 1994; Feaver 1997) cite the potential for attacks against nuclear programs as one reason why the horizontal spread of nuclear weapons can be destabilizing. This study indicates that attacks and considered attacks should indeed be taken seriously as an important consequence of nuclear proliferation. It adds nuance to the literature by highlighting cross-national variation in states' willingness to respond to nuclear proliferation with the use of military force. Ultimately, this sheds light on when proliferation can be particularly destabilizing for international security. In particular, proliferation may be less harmful than proliferation pessimists maintain if states do not fear that nuclear weapons could be used or that the proliferator will engage in other offensive behavior. In a more general sense, this paper contributes to the nuclear proliferation literature by offering insights into why countries oppose proliferation strongly enough to use military force to prevent it. We have a solid understanding of why countries pursue (or do not pursue) nuclear weapons (e.g., Sagan 1996/97; Singh and Way 2004; Hymans 2006; Solingen 2007), but the literature to date has largely neglected the issue of proliferation opposition.

Third, the results of this study have policy implications for entities such as the United Nations Security Council that have interests in mediating international disputes. Future attacks are likely to occur if states believe that a proliferating country will not behave as a responsible nuclear power. As this research shows, that risk will be exacerbated if the proliferator bullies its neighbors, adopts an offensive posture, or

threatens to use nuclear weapons to resolve existing disputes. If the Security Council understands this, it can redouble its efforts to bring a peaceful end to the proliferator's nuclear program when the likelihood of an attack is high.

Our findings underscore the importance of violent conflict in understanding attacks against nuclear infrastructure. But as we highlighted above, attacks on nuclear facilities do not occur during all conflicts involving proliferating states. Future research should explore this type of inter-war variation in the willingness and opportunity to target nuclear infrastructure. Additional research might also investigate the consequences of preventive nuclear strikes, since studies of the effects of these strikes—as with studies of the causes—tend to be single case studies that fail to capture in a systematic way whether and under what conditions the use of force might be effective. Finally, future studies might complement this research by examining the use of force as one instrument on a menu of policy choices (e.g., Most and Starr 1989) that also includes diplomatic or economic sanction against proliferating states. Particularly worth exploring is when a state uses instruments short of force in pursuit of nonproliferation objectives and what the choice of instruments across states says about the strength of the nonproliferation norm.

Table 1: Cases Where States Considered Attacking or Attacked Nuclear Facilities, 1941-2000

Attacking State	Target State	Year(s) Considered Attacking	Year(s) Attacked
Egypt	Israel	1960–67	--
India	Pakistan	1981–87	--
Iran	Iraq	1980–81	1980
Iraq	Iran	1984–88	1984, 1985, 1986, 1987, 1988
Israel	Iraq	1979–81	1979, 1981
Israel	Pakistan	1983–87	--
Norway	Germany	1942–45	1942, 1943, 1944
Pakistan	India	1984	--
South Korea	North Korea	1991–94	--
Soviet Union	Israel	1967	--
Soviet Union	South Africa	1976	--
Taiwan	China	1961–64	--
United Kingdom	Germany	1942–45	1942, 1943, 1944
United States	China	1961–64	--
United States	Germany	1942–45	1943
United States	Iraq	1990-2003	1991, 1993, 1998, 2003
United States	North Korea	1993–94	--
United States	Pakistan	1978–79	--

Table 2: Dates of Nuclear Weapons Programs for Nonnuclear Weapons States, 1941–2000

Country	Years
Algeria	1983–
Argentina	1968–90
Brazil	1953–90
China	1955–64
France	1946–60
India	1954–88
Iran	1984–
Iraq	1976–2003
Israel	1949–71
Korea, North	1965–2003
Korea, South	1959–78
Libya	1970–
Pakistan	1972–87
Romania	1985–90
South Africa	1969–79
Soviet Union	–1949
Sweden	1945–69
Taiwan	1967–77; 1987–88
United Kingdom	1947–52
United States	–1945
Yugoslavia	1954–65; 1974–88

Notes: The end dates indicate that the state either acquired nuclear weapons (in the cases of China, France, India, Israel, North Korea, Pakistan, South Africa, the Soviet Union, the United Kingdom, and the United States) or ended their nuclear weapons programs. Coding is based on Singh and Way's (2004) measure of whether a country is at least "exploring" nuclear weapons. Dates prior to 1945 are taken from Jo and Gartzke (2007).

Table 3: Cross Tabulations of Independent Variables against Considered Attacks and Attacks, 1941–2000

A. Target's Power

		Target's Power				Target's Power	
		Weak	Strong			Weak	Strong
Considered Attack	No	3,667 (98.7%)	1,110 (98.5%)	Attack	No	3,703 (99.7%)	1,123 (99.6%)
	Yes	47 (1.3%)	17 (1.5%)		Yes	11 (.3%)	4 (.4%)
Chi-square p-value: 0.532				Chi-square p-value: 0.756			

B. Power Ratio

		Power Ratio				Power Ratio	
		Small	Large			Small	Large
Considered Attack	No	3,675 (98.8%)	1,102 (98.4%)	Attack	No	3,709 (99.7%)	1,117 (99.7%)
	Yes	46 (1.2%)	18 (1.6%)		Yes	12 (.3%)	3 (.3%)
Chi-square p-value: 0.341				Chi-square p-value: 0.773			

C. Attacker's Polity

		Attacker's Polity				Attacker's Polity	
		Low	High			Low	High
Considered Attack	No	2,346 (99.1%)	2,431 (98.3%)	Attack	No	2,362 (99.7%)	2,464 (99.6%)
	Yes	22 (.9%)	42 (1.7%)		Yes	6 (.3%)	9 (.4%)
Chi-square p-value: 0.019				Chi-square p-value: 0.489			

D. Provoked Attack

		Provoked Attack				Provoked Attack	
		No	Yes			No	Yes
Considered Attack	No	4,034 (99.3%)	743 (95.3%)	Attack	No	4,050 (99.7%)	776 (99.5%)
	Yes	27 (.7%)	37 (4.7%)		Yes	11 (.3%)	4 (.5%)
Chi-square p-value: <.001				Chi-square p-value: 0.265			

E. NPT

		NPT				NPT	
		<i>No</i>	<i>Yes</i>			<i>No</i>	<i>Yes</i>
Considered Attack	<i>No</i>	3,191 (98.9%)	1,586 (98.3%)	Attack	<i>No</i>	3,223 (99.8%)	1,603 (99.4%)
	<i>Yes</i>	37 (1.1%)	27 (1.7%)		<i>Yes</i>	5 (.2%)	10 (.6%)
Chi-square p-value: 0.130				Chi-square p-value: 0.006			

F. Foreign Policy Similarity

		Similarity				Similarity	
		<i>Low</i>	<i>High</i>			<i>Low</i>	<i>High</i>
Considered Attack	<i>No</i>	1,839 (97.9%)	2,938 (99.2%)	Attack	<i>No</i>	1,865 (99.3%)	2,961 (99.9%)
	<i>Yes</i>	39 (2.1%)	25 (.8%)		<i>Yes</i>	13 (.7%)	2 (.1%)
Chi-square p-value: <0.001				Chi-square p-value: <0.001			

G. Violent Conflict

		Conflict				Conflict	
		<i>No</i>	<i>Yes</i>			<i>No</i>	<i>Yes</i>
Considered Attack	<i>No</i>	4,309 (99.5%)	468 (91.8%)	Attack	<i>No</i>	4,329 (99.9%)	497 (97.5%)
	<i>Yes</i>	22 (.5%)	42 (8.2%)		<i>Yes</i>	2 (.1%)	13 (2.5%)
Chi-square p-value: <0.001				Chi-square p-value: <0.001			

H. Target's Polity

		Target's Polity				Target's Polity	
		<i>Low</i>	<i>High</i>			<i>Low</i>	<i>High</i>
Considered Attack	<i>No</i>	2,914 (98.2%)	1,863 (99.4%)	Attack	<i>No</i>	2,952 (99.5%)	1,874 (100%)
	<i>Yes</i>	53 (1.8%)	11 (.6%)		<i>Yes</i>	15 (.5%)	0 (0%)
Chi-square p-value: <0.001				Chi-square p-value: 0.002			

I. Shared Regime Type

		Shared Regime Type				Shared Regime Type	
		<i>No</i>	<i>Yes</i>			<i>No</i>	<i>Yes</i>
Considered Attack	<i>No</i>	2,118 (97.8%)	2,659 (99.4%)	Attack	<i>No</i>	2,157 (99.6%)	2,669 (99.8%)
	<i>Yes</i>	48 (2.2%)	16 (.6%)		<i>Yes</i>	9 (.4%)	6 (.2%)
Chi-square p-value: <0.001				Chi-square p-value: 0.234			

Table 4: Rare Events Logit Analysis of Attacks and Considered Attacks against Nuclear Programs, 1941–2000

	(1) Considered Attacks	(2) Attacks
MILITARY RESPONSE		
<i>Target's power</i>	3.109 (3.743)	13.436** (6.504)
<i>Power ratio</i>	0.000 (0.012)	0.011 (0.040)
INTERNATIONAL CONDEMNATION		
<i>Attacker's polity</i>	-0.002 (0.011)	-0.002 (0.012)
<i>Provoked Attack</i>	0.787 (0.575)	-2.002** (0.944)
<i>NPT</i>	0.505 (0.435)	5.706*** (1.555)
LOSS OF LEVERAGE		
<i>Foreign policy similarity</i>	-1.169*** (0.402)	-2.634 (1.626)
OFFENSIVE BEHAVIOR		
<i>Violent Conflict</i>	1.051* (0.579)	5.478*** (1.997)
<i>Target's polity</i>	-0.016* (0.010)	-0.107*** (0.035)
<i>Shared regime type</i>	-0.916* (0.542)	-0.463 (0.981)
CONTROLS		
<i>Program years</i>	0.099*** (0.025)	-0.284** (0.115)
<i>Foreign Assistance</i>	-0.008 (0.028)	-0.306*** (0.107)
<i>Attacker's power</i>	8.562*** (2.806)	7.753 (5.429)
<i>Contiguity</i>	1.282** (0.563)	0.728 (1.224)
<i>No consider years</i>	-1.387*** (0.270)	
<i>Spline 1</i>	-0.036*** (0.011)	
<i>Spline 2</i>	0.021*** (0.008)	
<i>Spline 3</i>	-0.004* (0.002)	
Constant	-4.005*** (0.689)	-8.911*** (3.183)
Observations	4841	4841

Notes: Robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%

Table 5: Substantive Effects of Statistically Significant Variables

Variable	Relative Risk for Considered Attacks	Relative Risk for Attacks
<i>Target's Power</i>	–	0.96
<i>Provoked Attack</i>	–	0.14
<i>NPT</i>	–	270
<i>Similarity</i>	0.60	–
<i>Violent Conflict</i>	2.88	220
<i>Target's Polity</i>	0.85	0.34
<i>Shared Regime Type</i>	0.40	–
<i>Program Years</i>	1.79	0.19
<i>Foreign Assistance</i>	–	0.30
<i>Attacker's Power</i>	1.09	–
<i>Contiguity</i>	3.56	–

Notes: Values are calculated using the `setx` and `relogitq` commands in Stata 8.0 (Tomz, King, and Zeng 1999).

Table 6: Sensitivity Analysis

	(1) Consider- All Countries	(2) Attack- All Countries	(3) Consider - No USA	(4) Attack- No USA	(5) Consider- No Russia	(6) Attack- No Russia	(7) Consider- No Israel	(8) Attack- No Israel
MILITARY RESPONSE								
<i>Target's power</i>	3.371 (3.943)	11.257* (6.708)	1.596 (5.010)	3.070 (9.971)	3.631 (4.356)	11.570 (7.645)	5.228 (4.234)	20.411*** (5.637)
<i>Power ratio</i>	0.007 (0.009)	0.014 (0.018)	0.031*** (0.010)	-0.679 (0.846)	0.001 (0.015)	0.013 (0.015)	0.009 (0.008)	0.013 (0.016)
INTERNATIONAL CONDEMNATION								
<i>Attacker's polity</i>	0.003 (0.015)	-0.002 (0.012)	0.001 (0.012)	-0.009 (0.014)	0.005 (0.014)	-0.000 (0.012)	0.001 (0.014)	-0.021* (0.013)
<i>Provoked Attack</i>	1.027* (0.616)	-2.052** (0.881)	0.696 (0.855)	-3.137*** (0.879)	1.050* (0.613)	-2.032** (0.821)	1.206* (0.623)	-0.083 (1.141)
<i>NPT</i>	0.569 (0.470)	6.172*** (1.558)	0.608 (0.567)	7.803* (4.601)	0.619 (0.476)	6.455*** (1.703)	0.492 (0.410)	2.696*** (0.594)
LOSS OF LEVERAGE								
<i>Foreign policy similarity</i>	-1.165*** (0.443)	-3.375** (1.625)	-0.643* (0.376)	-2.346** (1.028)	-1.307*** (0.462)	-2.948* (1.529)	-1.591*** (0.447)	-3.532*** (1.196)
OFFENSIVE BEHAVIOR								
<i>Violent Conflict</i>	1.129* (0.613)	6.215*** (1.868)	1.664** (0.827)	6.568* (3.435)	1.101* (0.614)	6.069*** (1.737)	1.128* (0.618)	- -
<i>Target's polity</i>	-0.015** (0.008)	-0.110*** (0.039)	-0.010 (0.009)	-0.121 (0.081)	-0.015* (0.008)	-0.106*** (0.038)	-0.018* (0.010)	-0.036* (0.020)
<i>Shared regime type</i>	-1.219** (0.514)	-0.754 (1.022)	-1.089** (0.548)	-1.620** (0.723)	-1.073** (0.539)	-0.572 (0.996)	-0.898 (0.570)	-0.091 (1.220)
CONTROLS								
<i>Program years</i>	0.104*** (0.022)	-0.300*** (0.115)	0.082*** (0.021)	-0.503 (0.354)	0.100*** (0.022)	-0.301** (0.118)	0.120*** (0.026)	-0.118 (0.127)
<i>Foreign Assistance</i>	0.012 (0.023)	-0.345*** (0.115)	0.012 (0.027)	-0.378 (0.253)	0.019 (0.023)	-0.330*** (0.109)	-0.003 (0.028)	-0.036 (0.061)
<i>Attacker's power</i>	14.449*** (2.744)	14.071*** (4.890)	4.914 (5.471)	12.326 (11.638)	15.887*** (3.001)	14.930*** (4.728)	17.482*** (2.437)	24.797*** (5.538)
<i>Contiguity</i>	2.739*** (0.509)	1.994** (0.959)	3.069*** (0.652)	2.112 (1.347)	2.967*** (0.571)	2.053** (0.966)	3.390*** (0.428)	4.230*** (0.757)
<i>No consider years</i>	-1.473*** (0.273)		- 1.522*** (0.331)		-1.569*** (0.298)		-1.409*** (0.293)	
<i>Spline 1</i>	-0.040*** (0.011)		- 0.042*** (0.014)		-0.043*** (0.013)		-0.036*** (0.011)	
<i>Spline 2</i>	0.024*** (0.008)		0.026*** (0.010)		0.027*** (0.009)		0.022*** (0.008)	
<i>Spline 3</i>	-0.004** (0.002)		-0.005* (0.003)		-0.005** (0.002)		-0.004* (0.002)	
Constant	-5.884*** (0.599)	-10.952*** (2.830)	- 6.031*** (0.756)	-9.014* (4.616)	-5.998*** (0.709)	-11.096*** (2.820)	-6.921*** (0.434)	-11.177*** (1.877)
Observations	48942	48942	48543	48543	48546	48546	48587	48587

Notes: Robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%

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APPENDIX

In this appendix we provide short descriptions of the cases where countries considered targeting or actually targeted nuclear infrastructure in another country to delay its ability to produce nuclear weapons. We also list a small number of cases that some studies mention as constituting consideration of force but that we exclude because they do not meet our definition of “consideration.” Each description includes a list of the sources we relied on in making our coding decisions.

I. Cases Constituting Attacks and Considered Attacks of Nuclear Infrastructure

•Egypt – Israel (1960–1967)

As early as 1959, Egypt realized that Israel had begun a nuclear weapons program. In a speech given in December 1960, President Nasser threatened to destroy Israel’s nuclear infrastructure before that “base of aggression is used against us.” Egyptian consideration of striking Dimona, Israel’s key nuclear facility, continued throughout the 1960s. Nasser’s threats to attack became increasingly frequent during 1966–67. In early 1966 he noted on several occasions that “Arab countries must immediately wipe out all that enables Israel to produce atomic bombs.” In 1967, Egyptian jets made reconnaissance flights over Dimona and Israel’s nuclear facilities were considered “high priority targets” in Egyptian war plans. Although nuclear issues were not the principal causes of the June 1967 Six Day War, Egypt clearly had plans to strike Dimona during the conflict and they would have done so (with Soviet assistance) had the war not ended so quickly.

Sources: Avner Cohen, *Israel and the Bomb* (New York: Columbia University Press, 1998), pp. 243–276; Yitzhak Rabin, *A Service Record* (in Hebrew) (Tel Aviv: Ma’ariv, 1979), pp. 136–137; and “Nasser Threatens Israel on A-Bomb,” *New York Times*, December 24, 1960.

•India – Pakistan (1981–1987)

Following Israel’s destruction of the Osirak reactor in 1981, the Israelis approached the Indians and asked for cooperation in a joint operation to attack Pakistan’s uranium enrichment facility in Kahuta. The operational plans called for Israel to carry out the raid on Kahuta, using an Indian air base in Gujarat as a launching point and another base in northern India to refuel. In March 1984, Indian Prime Minister Indira Gandhi approved this operation but later vetoed the plan before it could be executed. Consideration of a joint strike continued through 1987, when Pakistan assembled its first nuclear weapon.³⁵ Further, considerations of a sole-Indian attack against Pakistani nuclear facilities went all the way up to the most senior decision makers in New Delhi in January 1987.

Sources: Scott Sagan and Kenneth Waltz, *The Spread of Nuclear Weapons: A Debate Renewed* (New York: W.W. Norton, 2003), pp. 94–95; Douglas Frantz and Catherine Collins, *The Nuclear Jihadist: The True Story of the Man Who Sold The World’s Most Dangerous Secrets and How We could Have Stopped Him* (New York: Twelve, 2007), pp. 88–89; Adrian Levy and Catherine Scott-Clark, *Deception: Pakistan, the United States and the Global Weapons Conspiracy* (New York: Walker, 2007); “India and Israel Planned to Hit Kahuta in 1980s,” *Business Recorder*, October 29, 2007; Bharat Karnad, “Hesitant Nuclear Realpolitik:

³⁵ India considered attacking Kahuta on occasions after 1987, but these fall outside the scope of this analysis since we are interested in attacks against non-nuclear weapon states. In 1991, India and Pakistan ratify an agreement pledging not to attack nuclear infrastructure in either state.

1966– To Date,” in *Nuclear Weapons and Indian Security: The Realist Foundations of Strategy* (New Delhi: Macmillan, 2002), pp. 349–350; Barry Schneider, *Radical Responses to Radical Regimes: Evaluating Pre-Emptive Counterproliferation* (Washington, D.C.: National Defense University, 1995); Peter Feaver, Scott Sagan and David Karl, “Proliferation Pessimism and Emerging Nuclear Powers,” *International Security*, Vol. 22, No. 2 (Fall 1997), p.195; “India, Israel Claimed Considering Attack,” *Muslim (Islamabad)*, March 28, 1988, p. 1; *Nuclear Developments*, May 23, 1988, pp. 26–27; in *Nuclear Threat Initiative Nuclear and Missile Database*, May 23, 1988, <http://www.nti.org/nuclear>.

•*Iran – Iraq (1980–1981)*

Prior to the onset of the Iran-Iraq war, Tehran did not consider attacking Iraqi nuclear infrastructure. The Israeli Chief of Staff encouraged Iran to attack Osiraq during the early days of the war. In September 1980, two Iranian F-4 aircraft attacked nuclear facilities at Osiraq but caused only minor damage. Iran did not seriously consider attacking Iraqi nuclear facilities after Israeli’s raid against Osiraq in 1981 because they perceived that enough damage had been done.

Sources: Dan Reiter, “Preventive Attacks against Nuclear, Biological, and Chemical Weapons Programs: The Track Record,” in William W. Keller and Gordon R. Mitchell, *Hitting First: Preventive Force in U.S. Security Strategy* (Pittsburgh, Pa.: University of Pittsburgh Press, 2006), pp. 27–44; Peter Scott Ford, “Israel’s Attack on Osiraq: A Model for Future Preventive Strikes?” Naval Postgraduate School, 2004, p. 19, <http://www.fas.org/nuke/guide/iraq/facility/osiraq.htm>; and interview by author with Iranian scholar, Cambridge, Massachusetts, April 26, 2008.

•*Iraq – Iran (1984–1988)*

Iraq did not consider attacking Iran’s nuclear facilities until the strategic bombing campaign began in 1984, during the Iran-Iraq war. A series of attacks occurred between 1984 and 1988. The first attack took place on March 24, 1984, followed by subsequent attacks on February 12, 1985; March 4, 1985; 1986; three attacks in November 1987; and a final raid in 1988.³⁶ Iraq’s early strikes on Iran consisted of Iraqi Air Force attempts to hit Iran’s economic and industrial centers of gravity, which included oil-related facilities but also the nuclear facilities. Despite an Iranian-sponsored resolution from the International Atomic Energy Agency (IAEA) that outlawed strikes against nuclear installations, Iraqi jets bombed a nuclear power plant, steel factory, and gas station in Bushehr. Iraqi officials defended the Iraqi Air Force’s actions, claiming that the nuclear plant was a legitimate military target.³⁷

Sources: Dilip Hiro, *The Longest War: The Iran-Iraq War* (London: Grafton, 1989); David Segal, “The Air War in the Persian Gulf,” *Air University Review*, March/April 1986; “Bushehr Construction Now Remote after Three Iraqi Air Strikes,” *Nucleonics Week*, November 26, 1987, p. 5; Andrew Koch and Jeanette Wolf, “Iran’s Nuclear Facilities: A Profile,” Center for Nonproliferation Studies, 1998, <http://cns.miis.edu/pubs/reports/pdfs/iranrpt.pdf>; “Nuclear News Briefs,” *Nuclear News*, (December 1987), p. 19; “Iran-Iraq War Air Raids and Denials by Both Sides,” *BBC World Broadcasts*, November 20, 1987; “New Attack on Iranian Nuclear Plant Is Reported,” *New York Times*, November 20, 1987, p. 5; Global

³⁶ The number of attacks on Bushehr during the middle of November 1987 is disputed but Iraq clearly staged a series of attacks in 1987 that proved to be the most destructive of any during the Iran-Iraq War. It appears that the Iraqi air force launched two strikes on 17 November 1987 and another on 19 November.

³⁷ Western military analysts suggested that perhaps Iraq had intended to strike tankers in the Persian Gulf but that may have been influenced by Western support for Iraq during the war. Mark Whitaker and Rod Nordland, “Teheran’s Blunder: A Decisive Defeat?” *Newsweek*, April 1, 1985, p. 36.

Security Bushehr website, <http://www.globalsecurity.org/wmd/world/iran/bushehr-intro.htm>; and Ronald Bergquist, "The Air War," in *The Role of Airpower in the Iran-Iraq War* (Montgomery, Ala.: Air University Series, 1988), pp. 41–68.

•*Israel – Iraq (1977–1981)*

The Begin cabinet first raised the prospect of striking Al-Tuwaitha in a 1977 cabinet meeting. Two of Israel's top generals, David Ivry and Raful Eitan, supported striking the facilities in this meeting while others opposed it. Begin said he would only approve of military action if he had 100 percent backing of his cabinet, so Israel pursued options short of force. Nevertheless, planning for what became the 1981 raid began. In 1979, unknown Israeli saboteurs attacked the facilities in southern France that were responsible for constructing the reactor cores and shipping them to Iraq and in another incident bombs destroyed the Rome offices of SNIA-Techint, the Italian nuclear company responsible for the Iraqi separation plant.³⁸ The Israeli Air Force followed up in 1981 with Operation Babylon—known as Operation Opera to Israel—that employed eight Israeli F-16 Falcons flanked by eight F-15 Eagles for cover to destroy Osirak and other nuclear facilities at Al Tuwaitha.

Sources: Karl Mueller, Jasen Castillo, Forrest Morgan, Negeen Pegahi, and Brian Rosen, *Striking First: Preventive and Preventive Attack in U.S. National Security Policy* (Washington, D.C.: RAND, 2006), pp. 211–215; Rodger Claire, *Raid on the Sun: Inside the Secret Campaign that Denied Saddam the Bomb* (New York: Broadway, 2004), pp. 41–44; Saad El Shazly, *The Arab Military Option* (San Francisco, Calif.: American Mideast Research, 1986), p. 47; and Amos Perlmutter, *Two Minutes over Baghdad* (New York: Routledge, 2003).

•*Israel – Pakistan (1983–1987)*

Following the Israel's destruction of the Osiraq reactor in 1981, the Israelis approached the Indians and asked for cooperation in a joint operation to attack Pakistan's uranium enrichment facility in Kahuta. The operational plans called for Israel to carry out the raid on Kahuta, using an Indian air base in Gujarat as a launching point and another base in northern India to refuel. In March 1984, Indian Prime Minister Indira Gandhi approved this operation but later vetoed the plan before it could be executed. The available evidence suggests that Israel continued to consider an attack against Kahuta until 1987 when Pakistan assembled its first nuclear weapon. In 1991, Pakistan and India ratified a treaty pledging not to attack each others' nuclear facilities.

Sources: Douglas Frantz and Catherine Collins, *The Nuclear Jihadist: The True Story of the Man Who Sold The World's Most Dangerous Secrets and How We could Have Stopped Him* (New York: Twelve, 2007), pp. 88–89; Bharat Karnad, "Hesitant Nuclear Realpolitik: 1966– To Date," in *Nuclear Weapons and Indian Security: The Realist Foundations of Strategy* (New Delhi: Macmillan, 2002), pp. 349–350; and Barry Schneider, *Radical Responses to Radical Regimes: Evaluating Pre-Emptive Counterproliferation* (Washington, D.C.: National Defense University, 1995).

•*Norway – Germany (1942–1945)*

³⁸ Israel also assassinated scientists working on the Iraqi nuclear program. They targeted an Egyptian nuclear engineer who had been supervising the Iraq-French nuclear deal, Yehia al-Meshad, as well as two Iraqi scientists. These do not constitute attacks against infrastructure, but they are worth noting.

Between 1942 and 1945, Norway engaged in joint operations with the British to destroy facilities related to the German nuclear program. In October 1942, a thirty-four person British sabotage team in two Horsa gliders undertook Operation Freshman to destroy the Norsk-Hydro heavy water facility in German-occupied Norway. The operation failed when poor weather caused them to crash into the mountains. Several of the saboteurs were killed on the spot and those that survived the crash were tortured and executed by the Germans. The intention was for the commandos from the First Airborne Division, aided by intelligence from an advance team of Norwegian commandos, to land in the plateau and proceed by bicycle to the Norsk Hydro facility, kill the German guards, destroy the machinery and heavy water, then divide and proceed to Sweden to return steel flasks of heavy water.

In February 1943 Operation Gunnerside was carried out by expert skiers from the Royal Norwegian Army seeking to exact revenge for the Germans' victory over the Norwegians in 1940. An advantage of employing indigenous team is that they had knowledge of the area and terrain that the MI6-directed British mission had lacked. The plan called for the skiers to land near the plant, dispense of the eighteen cells of heavy water, then proceed by skis to Sweden. In terms of execution, the operation was a partial success and the Norwegian saboteurs dynamited the heavy water facility's electrolysis chambers and delayed production by two months, with no loss of life on either side and no damage to the hydroelectric station itself, which was central to Norway's civilian economy.

A third incident involving Norway occurred in 1944. En route to Germany, a Norwegian saboteur, tipped off by British intelligence on timing and route, intercepted the ferry *Hydro*. All of Germany's heavy water, apparatus, catalyzers, and concentrates involved in the production of heavy water sank in Norway's Lake Tinnsjoe.

Sources: Knut Haukelid, *Skis against the Atom: The Exciting, First-Hand Account of Heroism and Daring Sabotage during the Nazi Occupation of Norway* (Minot, N.D.: North American Heritage Press, 1989); Lesley Groves, *Now It Can Be Told: The Story of the Manhattan Project*, new ed. (New York: Da Capo, 1983), pp. 188–189; and Thomas Powers, *The Secret History of the German Bomb* (New York: Penguin, 1993), pp. 195–202.

•**Pakistan – India (1984)**

Although India was worried about potential attacks against the Bhabha Atomic Research Center during the 1971 Indo-Pakistani War, we found no evidence that Islamabad seriously considered attacks at that time. According to the public record, the first time Pakistan considered attacking Indian nuclear facilities was during the 1984 crisis. During this crisis, Pakistan was aware of India's interest in attacking Kahuta. In response, Islamabad considered attacking nuclear installations in India. Pakistani leaders "sent an explicit message to New Delhi through diplomatic channels:" the Pakistani air force would "strike every nuclear installation in India, civilian as well as military" if the crisis escalated. Pakistan also considered the possibility of preemptively attacking Indian facilities if they perceived that an attack against Kahuta was imminent. In December 1985, India and Pakistan verbally agreed not to attack each others' nuclear facilities. Although there is evidence indicating the India continued to consider this possibility

during the 1986–87 Brasstacks crisis, the public record does not reveal any evidence that Pakistan did so after 1984.

Sources: Sumit Ganguly and Devin Hagerty, *Fearful Symmetry: India-Pakistan Crises in the Shadow of Nuclear Weapons* (Seattle: University of Washington Press, 2005), pp. 57–58; William Burrows and Robert Windrem, *Critical Mass: The Dangerous Race for Superweapons in a Fragmenting World* (New York: Simon and Schuster, 1994), pp. 349–350; and Milton Benjamin, “Atomic Power; Nuclear Energy Brings Promise, Peril to Developing World,” *Washington Post*, December 3, 1978.

•*South Korea – North Korea (1991–1994)*

In April 1991, South Korean defense minister Lee Jong Koo indicated that Seoul had considered the possibility of a raid against North Korean facilities at Yongbyon. As the nuclear crisis escalated in 1993–94, the South Korean press indicated that Seoul had prepared plans for an air-raid against “nuclear facilities” in the DPRK. Any action taken at that time would likely have been coordinated with the United States. Indeed, the two countries were in close contact throughout the crisis and held frequent consultations on possible responses to ending North Korea’s nuclear program. While South Korea gave serious consideration to attacking Yongbyon, it was more cautious about this option than the United States because Seoul would have faced the brunt of any North Korean retaliation. As one American official put it, the South Koreans were not fully “prepared to be sacrificed on the altar of nonproliferation.”

Sources: Andrew Mack, “North Korea and the Bomb,” *Foreign Policy*, No. 83 (Summer 1991), p. 96; Joel Wit, Daniel Poneman and Robert Gallucci, *Going Critical: The First North Korean Nuclear Crisis* (Washington, D.C.: Brookings, 2004), pp. 210–211, 219–220, 244; and “North Korean Nuclear Issue,” *BBC Summary of World Broadcasts*, May 1, 1993.

•*Soviet Union – Israel (1967)*

In the context of the Six Day War, the Soviet Union had plans to attack Dimona, Israel’s key nuclear facility. Just prior to the war, the Soviets flew sorties over the facility and had plans to destroy it with Egyptian assistance. The war ended so quickly that there was never an appropriate opportunity to take out Israel’s nuclear infrastructure. All of this has been confirmed by the chief spokesman of the Russian Air Force, Col. Aleksandr Drobyshevsky.

Sources: Isabella Ginor and Gideon Remez, *Foxbats Over Dimona: The Soviets’ Nuclear Gamble in the Six Day War* (New Haven, Conn.: Yale University Press, 2007), pp. 121–137; and David Horovitz, “Russia Confirms Soviet Sorties over Dimona in ’67,” *Jerusalem Post*, August 23, 2007.

•*Soviet Union – South Africa (1976)*

In 1976, the Soviet Union approached the United States and asked for assistance in attacking the Y Plant, one of South Africa’s key nuclear installations. In 1977, Soviet satellites detect preparations for a nuclear test in South Africa and continued to explore options (including the use of force) to prevent it from crossing the nuclear weapon threshold. It is plausible that the Soviets continued the consideration of force between 1977 and 1979, but an exhaustive search of primary and secondary documents failed to

yield any evidence of this. Thus, we code the Soviet Union as considering targeting South African nuclear facilities only for 1976.

Sources: Davis Albright, "South Africa and the Affordable Bomb," *Bulletin of the Atomic Scientists*, July/August 1994; and Mitchell B. Reiss, "South Africa: Castles in the Air," in Reiss, *Bridled Ambition: Why Countries Constrain Their Nuclear Capabilities* (Washington, D.C.: Woodrow Wilson Center Press, 1995).

•**Taiwan – China (1961–1964)**

Taiwan considered joint operations with the United States to infiltrate, sabotage, or attack Chinese nuclear facilities between 1961 and 1964 (see United States – China below).

Sources: William Burr and Jeffrey Richelson, "Whether to Strangle the Baby in the Cradle," *International Security*, Vol. 25, No. 3 (Winter 2000/01), pp. 54–99; and Gen. Curtis LeMay, acting chairman, Joint Chiefs of Staff, to Secretary of Defense, April 29, 1963, "Study of Chinese Communist Vulnerability," Office of the Country Director for the Republic of China, 1954–1965.

•**United Kingdom – Germany (1942–1945)**

The United Kingdom was involved in three attempts to destroy German nuclear infrastructure during World War II. These incidents are described above (see Norway – Germany).

Sources: John S. Craig, *Peculiar Liaisons in War, Espionage, and Terrorism in the 20th Century* (New York: Algora, 2005), p. 119; Richard Rhodes, *The Making of the Atomic Bomb* (New York: Simon and Schuster, 1986); and Thomas Powers, *The Secret History of the German Bomb* (New York: Penguin, 1993), pp. 195–202.

•**United States – China (1961–1964)**

The United States was aware of Chinese intentions as early as June 1955 and consistently concluded that Beijing could test a nuclear device in the period 1963–64. Beginning in 1961, Washington considered a variety of policies aimed at delaying the Chinese nuclear weapons program. Among the options considered was using force to "take out" China's nuclear program. Washington preferred to accomplish this with cooperation from the Soviet Union, which was also apprehensive about Beijing's intentions. The United States proposed a variety of forceful measures to restrain China's nuclear capability including: infiltration, sabotage, or invasion by Chinese nationalists; maritime blockades; a South Korean invasion of North Korea; conventional air attacks on nuclear facilities; the use of a tactical nuclear weapon on selected Chinese targets. President Kennedy (and to a lesser extent President Johnson) gave serious consideration to these options and ordered classified assessments of the likelihood that they could be effective in delaying the Chinese program.

Sources: William Burr and Jeffrey Richelson, "Whether to Strangle the Baby in the Cradle," *International Security*, Vol. 25, No. 3 (Winter 2000/01), pp. 54–99; Gordon Chang, "JFK, China, and the Bomb," *Journal of American History*, Vol. 74, No. 4 (March 1988), pp. 1289–1310; Central Intelligence Agency, Office of National Estimates, "Chinese Communist Capabilities for Developing an Effective Atomic Weapons Program and Weapons Delivery Program," June 24, 1955; Policy Planning Council (PPC) Director George McGhee to Secretary of State Dean Rusk, "Anticipatory Action Pending Chinese Demonstration of a Nuclear Capability," September 13, 1961, Digital National Security Archive.

•**United States – Germany (1942–1945)**

The United States considered attacking facilities relevant to the German nuclear program as early as 1942. After the joint British-Norwegian operations (described above) failed, the United States conducted airstrikes against the German heavy water production facility. On 16 November 1943, the RAF and American Eighth Air Force and the allies dropped over seven hundred 500-pound bombs at the Vemork plant and one hundred 250-pound bombs at the town of Rjukan. Many missed and the operation only inflicted light damage on the hydroelectric plant's pipelines, power station, and adjacent hydrogen-electrolysis plant, but enough to set back production for a few months.

Sources: Lesley Groves, *Now It Can be Told: The Story of the Manhattan Project*, new ed. (Cambridge, Mass.: Da Capo, 1983); John S. Craig, *Peculiar Liaisons in War, Espionage, and Terrorism in the 20th Century* (New York: Algora, 2005), p. 119; Richard Rhodes, *The Making of the Atomic Bomb* (New York: Simon and Schuster, 1986); and Thomas Powers, *The Secret History of the German Bomb* (New York: Penguin, 1993), pp. 195–202.

•**United States – Iraq (1990–2003)**

The United States seriously considered attacking Iraqi nuclear facilities for the first time in 1990, when it drew up plans specifically for this purpose and considered them at the highest levels of government. During the Gulf War, the United States attacked several facilities thought to be key components of the Iraqi nuclear program. During the early stages of the campaign, American F-16s struck the well-known Tuwaitha Research Facility near Baghdad, and F-117s made repeated visits to target the site on February 18, 19, and 23, 1991. F-111Es and F-16s struck suspected a nuclear target later known as Al Jesira near Mosul. In the twenty-five strikes launched over the period of the airwar, four F-111Es equipped with four 2,000 pound bombs targeted the facility at night, four F-16s equipped with two 2,000 pound bombs or six 500-pound bombs during the day, producing substantial damage to Jesira. That said, most of these bombs were unguided and few actually hit their intended targets. Following the Gulf War, the United States attacked Iraqi nuclear infrastructure on two occasions. In January 1993 the United States launched roughly 40 cruise missiles against the Zaa'faraniya nuclear complex and similar attacks occurred in 1998. Although our analysis ends in 2000, it is worth pointing out that U.S. attacks against nuclear-related targets occurred in 2003 during Operation Iraqi Freedom.

Sources: Gulf War Air Power Survey, Vol. 1, Planning and Command and Control (Washington, D.C.: Government Printing Office, 1993), Vol. 5, p. 16; Alfred Prados, "Iraq: Former and Recent Military Confrontations with the U.S.," Issue Brief (Washington, D.C.: Congressional Research Service, October 2002); and Dan Reiter, "Preventive Attacks against Nuclear, Biological, and Chemical Weapons Programs: The Track Record," in William W. Keller and Gordon R. Mitchell, eds., *Hitting First: Preventive Force in U.S. Security Strategy* (Pittsburgh, Pa.: University of Pittsburgh Press, 2006), pp. 27–44.

•**United States – North Korea (1993–1994)**

In 1993 and 1994, the United States seriously considered attacking North Korea's nuclear infrastructure to prevent Pyongyang from building nuclear weapons. In the fall of 1993, Secretary of Defense William Perry ordered the Joint Chiefs John Shalikashvili to draw

up plans for “destroying key components of the reactor site with a military attack.” Attacking nuclear facilities was an operation that received serious attention. Perry referred to internal deliberations on whether to use force as “the most serious during my tenure...we knew that we were poised on the brink of a war.” In 1994 the United States reached a political/diplomatic agreement with North Korea and did not seriously consider force after that time (although strikes may have been considered beginning in 2001, which is temporally beyond the scope of our analysis).

Sources: Joel Wit, Daniel Poneman, and Robert Gallucci, *Going Critical: The First North Korean Nuclear Crisis* (Washington, D.C.: Brookings, 2004), pp. 210–211, 219–220, 244; Bennett Ramberg, “Preemption Paradox,” *Bulletin of the Atomic Scientists*, Vol. 62, No. 4 (July/August 2006), pp. 48–56; Lyle Goldstein, *Preventive Attack and Weapons of Mass Destruction: A Comparative Historical Analysis* (Stanford, Calif: Stanford University Press, 2006), pp. 133–135; and Ashton Carter and William Perry, *Preventive Defense: A New Security Strategy for America* (Washington, D.C.: Brookings, 1999), pp. 123, 131.

•**United States – Pakistan (1978–1979)**

In the late 1970s, the United States considered attacking Kahuta, Pakistan’s uranium enrichment facility. Secretary of State Cyrus Vance directed the State Department to conduct a study assessing the costs and benefits of launching air strikes against the Pakistani facility. Joseph Nye, who prepared the State Department report, stated “it would be very difficult to pull off successfully.” Further, a paper prepared by Ambassador Gerard Smith outlined how the United States could attack Kahuta and analyzed the value of doing so. These analyses were reviewed at the highest levels. By 1980s Washington had given up serious consideration of attacking and may have warned the Pakistanis of joint Israeli-Indian plans to attack Kahuta in the early 1980s.

Sources: Douglas Frantz and Catherine Collins, *The Nuclear Jihadist* (New York: Twelve, 2007), pp. 88–89, 100–101; “Pakistan Reaction to Alleged U.S. Threat to Nuclear Plants,” *BBC Summary of World Broadcasts*, August 15, 1979; and Gordon Corera, *Shopping for Bombs: Nuclear Proliferation, Global Insecurity, and the Rise and Fall of the A.Q. Khan Network* (Oxford: Oxford University Press, 2006).

II. Well-known Cases NOT Constituting Attacks and Considered Attacks of Nuclear Infrastructure

•**Soviet Union – China (1969)**

During the 1969 border crisis, the Soviet Union seriously contemplated strikes against Chinese nuclear facilities and American intelligence detected preparations for such an attack. We do not include this case because we are interested in attacks against nonnuclear weapons states; China had conducted its first nuclear test five years previously.

Sources: Lyle Goldstein, *Preventive Attack and Weapons of Mass Destruction: A Comparative Historical Analysis* (Stanford, Calif.: Stanford University Press, 2006), pp. 80–83; Arkady Shevchenko, *Breaking with Moscow* (New York: Alfred Knopf, 1985); Scott Sagan and Kenneth Waltz, *The Spread of Nuclear Weapons: A Debate Renewed* (New York: W.W. Norton, 2003); and Elizabeth Wishnick, *Mending Fences: The Evolution of Moscow’s China Policy from Brezhnev to Yeltsin* (Seattle: University of Washington Press, 2001), pp. 34–36.

•***United States – Cuba (1962)***

During the Cuban Missile Crisis, the United States considered a preemptive attack against Soviet nuclear warheads stationed in Cuba. We exclude this case from our analysis because the attack was not intended to delay Cuba’s ability to produce nuclear bombs (since Cuba did not even have a nuclear weapons program). Further, missiles—not reactors or other nuclear facilities—were the intended target.

•***United States – Japan (1945)***

In raids on Tokyo during April 1945, the United States destroyed facilities related to the Japanese nuclear program. We do not include this in our analysis since the United States was not aware of the program’s existence and did not intend to explicitly target nuclear facilities.

Sources: Richard Rhodes, *The Making of the Atomic Bomb* (New York: Simon and Schuster, 1986), p. 612; and Dan Reiter, “Preventive Attacks against Nuclear, Biological, and Chemical Weapons Programs: The Track Record,” in William W. Keller and Gordon R. Mitchell, eds., *Hitting First: Preventive Force in U.S. Security Strategy* (Pittsburgh, Pa.: University of Pittsburgh Press, 2006), pp. 27–44.

•***United States – South Africa (1976)***

In 1976, Soviet officials requested assistance from the United States in attacking the Y Plant, one of South Africa’s key nuclear facilities. We exclude this case because we find no evidence that the United States took this request seriously. As far as the available public record indicates, Washington never called for a study of the costs and benefits of attacking, had detailed deliberations about the merits of attacking, issued a threat to attack, or seriously thought about the operational feasibility of such a mission.

Sources: Davis Albright, “South Africa and the Affordable Bomb,” *Bulletin of the Atomic Scientists*, July/August 1994, <http://www.bullatomsci.org/issues/1994/a94/a94Albright.html>; “South Africa Profile: Nuclear Chronology, 1970–1978,” *Nuclear Threat Initiative Website*: http://www.nti.org/e_research/profiles/SAfrica/Nuclear/2149_3274.html.

•***United States – Soviet Union (1940s and 1950s)***

Beginning in 1945, influential officials in the United States began calling for preventive action against the Soviet Union to limit its ability to produce nuclear weapons. General Leslie Groves, who had supervised the Manhattan Project, argued that the United States should strike Soviet research facilities to “guarantee American supremacy” in the area of nuclear weapons. Other senior military leaders such as Generals Carl Spaatz, Henry Arnold, Ira Eaker, Ely Culberton and Frank Everest all made similar arguments in the late 1940s. There is no evidence to suggest that decision makers at the highest levels shared these sentiments or even seriously considered preventive action against the Soviet Union prior to Moscow’s acquisition of nuclear weapons. It was not until April 1950—after the Soviet Union became a nuclear power—when National Security Council Document 68 was completed that President Truman and others in his cabinet thoroughly addressed this issue. Preventive strikes received further attention during the early years of the

Eisenhower administration but, again, this was after Moscow had assembled nuclear weapons.

Sources: Lyle Goldstein, *Preventive Attack and Weapons of Mass Destruction: A Comparative Historical Analysis* (Stanford, Calif.: Stanford University Press, 2006), pp. 37–42; Scott Sagan and Kenneth Waltz, *The Spread of Nuclear Weapons: A Debate Renewed* (New York: W.W. Norton, 2003), pp. 56–57; and Scott Sagan, “The Perils of Proliferation in South Asia,” *Asian Survey*, Vol. 41, No. 6 (November/December 2001), p. 1067.

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