

# Causes and Consequences of Nuclear Proliferation

*Edited by*

**Robert Rauchhaus, Matthew Kroenig,  
and Erik Gartzke**



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# 1 Introduction

## The causes and consequences of nuclear proliferation

*Matthew Kroenig, Erik Gartzke, and  
Robert Rauchhaus<sup>1</sup>*

Nuclear weapons have occupied a central role in international politics ever since their introduction onto the world stage in 1945. The use of nuclear weapons by the United States on Hiroshima and Nagasaki is widely believed to have compelled the Japanese surrender and brought World War II to a close.<sup>2</sup> The vast nuclear arsenals of the United States and the Soviet Union were fundamental to the bi-polar, strategic relationship that structured international politics for over 50 years during the Cold War. And while many analysts hoped that the collapse of the Soviet Union would lead to a reduction in the influence of nuclear weapons in international affairs, it was not to be.

The threat of nuclear proliferation resurfaced as India, Pakistan, and more recently North Korea, have conducted nuclear tests. Iraq, Libya, South Africa, and other regional powers have pursued nuclear capabilities in the past, and evidence suggests that Iran is doing so at present. The September 11 attacks on the New York World Trade Center and on the Pentagon in Washington also raised concerns about the prospects for nuclear terrorism.

There is little doubt that if terrorists could acquire nuclear weapons, they would attempt to carry out mass-casualty attacks. The ease with which states or terrorists could potentially acquire sensitive nuclear materials and know-how was exemplified by the black-market nuclear proliferation ring operated by Pakistani scientist A.Q. Khan. Indeed, according to the Obama administration's 2010 National Security Strategy, nuclear proliferation poses one of the greatest threats to US national security.<sup>3</sup>

The real-world importance of nuclear weapons has led to the production of a voluminous scholarly literature on the causes and consequences of nuclear proliferation (e.g., Schelling 1966; Betts 1987; Powell 1990; Sagan and Waltz 1995; Sagan 1996/1997; Singh and Way 2004; Hymans 2006; Solingen 2007). Scholars have thoroughly examined *why* states want nuclear weapons (e.g., Sagan 1996/1997) and the broad effects of nuclear proliferation on the stability of the international system (e.g., Sagan and Waltz 1995). Missing from this debate is an analysis of *how* states acquire nuclear weapons and a systematic empirical examination of how nuclear weapons affect the security and the diplomacy of proliferators.

The chapters in this book address these twin deficits by focusing on the causes and consequences of nuclear proliferation. We aim to accelerate the development of an empirical research agenda by employing robust research methods. Quantitative studies have been underrepresented in the expansive nuclear proliferation literature, which was historically dominated by comparative, historical, and qualitative analyses of the spread of nuclear weapons and nuclear deterrence. This edited volume brings together a new generation of nuclear scholarship, advancing novel theoretical positions through models and arguments, and performing quantitative tests on both the causes and consequences of proliferation. We also include two qualitative essays, one that helps identify an underdeveloped research frontier, and another that provides a critical review of all the studies contained in this volume.

This book makes theoretical, empirical, and methodological contributions to the field by centering on two observations. First, whether states want nuclear weapons is irrelevant if they are unable to acquire them. Our basic argument, grounded in the tradition of realist and security-based approaches to nuclear proliferation and nuclear deterrence, is that nuclear weapons on average and across a broad variety of indicators enhance the security and diplomatic influence of their possessors. Because states stand to gain by possessing nuclear weapons, the supply-side factors that enable nuclear development are among the most important determinants of nuclear proliferation. Second, nuclear weapons potentially have a wide variety of effects on their possessors. Nuclear weapons alter the timing, intensity, duration, and outcome of conflicts and may also affect a state's diplomatic influence.

Our theoretical claims also mark a significant departure from the contemporary scholarly literature on the causes of nuclear proliferation. First, recent studies suggest that psychological, economic, and domestic considerations are the principal determinants of nuclear proliferation (e.g., Hymans 2006; Solingen 2007). We do not dispute that these considerations can be important, but emphasize that the strategic benefits of nuclear weapons should not be overlooked. Second, scholars have argued that what is most surprising about nuclear proliferation is how few states have acquired atomic bombs (e.g., Hymans 2006; Solingen 2007). These analysts point to countries like Japan and Germany that have the technical capability to produce nuclear weapons but have refrained from doing so. This leads these scholars to conclude that a state's demand for nuclear weapons, and not the capability to produce nuclear weapons, is the key to explaining nuclear proliferation. We agree that there are countries that can produce nuclear weapons, but have not, just as there are countries like Egypt, Libya, and Iraq that have wanted nuclear weapons, but were unable to produce them. Therefore, the causal significance of either demand-side or supply-side factors cannot be dismissed by offering counterexamples. We advocate for a more careful scholarly analysis of the

supply-side of nuclear proliferation. We emphasize that the ability to produce nuclear weapons is a necessary condition for nuclear proliferation to occur.

### Common objectives and baselines

Our main goal is to offer a systematic account of the process of nuclear proliferation and its consequences. We explore – theoretically and empirically – our basic assumptions that nuclear weapons, on average and across a broad variety of indicators, have beneficial effects for their possessors and that, partly for this reason, supply-side factors are among the most important causes of nuclear proliferation.

For all of the chapters in this edited volume, a key variable will be the same: nuclear weapons possession. Six chapters in this edited volume treat nuclear weapons possession as a dependent variable and seek to explain the factors that lead states to acquire nuclear weapons. Six other chapters treat nuclear weapons possession as the key independent variable. These chapters seek to understand how the possession of nuclear weapons influences state behavior. Due to the centrality of proliferation to the studies, it is necessary to define and measure nuclear proliferation carefully. The chapters in this edited volume focus on the process of horizontal nuclear proliferation. By horizontal, we mean the spread of nuclear weapons to new states as opposed to the multiplication of nuclear warheads within existing nuclear-armed states.

To create consistency across studies, all of the chapters in this volume use a common set of nuclear proliferation dates (listed in Table 1.1). States are defined as having acquired nuclear weapons when they first

*Table 1.1* Nuclear weapons proliferation,  
1945–present

<i>Country</i>	<i>Date</i>
United States	1945
Soviet Union/Russia	1949
United Kingdom	1952
France	1960
China	1964
Israel	1967 <sup>4</sup>
India	1988 <sup>5</sup>
South Africa	1982–1990 <sup>6</sup>
Pakistan	1990 <sup>7</sup>
Belarus	Never <sup>8</sup>
Kazakhstan	Never <sup>9</sup>
North Korea	Never <sup>10</sup>
Uzbekistan	Never <sup>11</sup>

assemble a nuclear weapon that could be delivered against an enemy target. The first five nuclear weapon states, the United States, the Soviet Union, Great Britain, France, and China, immediately tested their nuclear weapons. Measuring when these states crossed the nuclear threshold is as simple as recording the date of the first nuclear test. The subsequent nuclear powers, however, have either never conducted a nuclear test, or have waited a significant period of time before weaponizing a potential nuclear capability. For example, North Korea is believed to have possessed enough separated plutonium to build one or two nuclear bombs by 1994, yet it is not known when North Korea assembled its first nuclear device. North Korea conducted nuclear tests in October 2006 and May 2009, but some experts considered these tests to be failures and question whether North Korea actually has a functioning nuclear weapons arsenal to this day. North Korea could plausibly be coded as acquiring nuclear weapons in 1994, 2006, 2009, or never. Similarly, India conducted a “peaceful nuclear explosion” in 1974, but it is not believed to have fashioned a deliverable nuclear warhead until 1988. Should India be coded as a nuclear power beginning in 1974 or in 1988? To code the remaining nuclear powers, we scoured historical, archival, and policy materials to determine when the country first assembled a deliverable nuclear device. Because there may be disputes about the precise date at which some countries acquired nuclear weapons, and because critics may question how the choice of dates influences the results, the authors employ a variety of robustness checks to test the sensitivity of their findings to the coding decisions.

The text addresses nine nuclear proliferation-related dependent variables:

- nuclear proliferation
- nuclear cooperation
- nuclear disarmament
- probability of conflict
- frequency of conflict
- timing of conflict
- intensity of conflict
- outcome of conflict
- diplomatic influence

We examine why states acquire nuclear weapons, under what conditions they give them up, why they engage in nuclear cooperation, and explore the relationship between nuclear status and a variety of security and diplomatic outcomes. This list does not cover the full range of possible nuclear proliferation issues that could be subjected to scholarly scrutiny, but a focus on these seven critical variables does offer several advantages. First, these outcomes are substantively important. Second, they can be

measured, allowing us to quantitatively analyze nuclear proliferation across cases and over time. Third, this list covers a broader range of outcomes than are considered in the existing literature. Indeed, some of these relationships are conceptualized and subjected to empirical scrutiny for the first time in this book.

The authors in this volume generally situate their research in the tradition of realist and security-based approaches to nuclear proliferation and nuclear deterrence. The authors build on earlier work to develop theoretical propositions that are then evaluated in the chapters of this volume. Our view is that a strategic, security-based approach can explain much about the causes and consequences of nuclear proliferation, though certainly it does not explain everything.

As Sonali Singh and Christopher Way (2004) have argued, statistical analysis is particularly appropriate for the study of nuclear proliferation for three reasons. First, statistical studies can examine the entire universe of cases, avoiding the problems associated with selecting cases on the dependent variable. Second, most of the claims made by theorists of nuclear proliferation are probabilistic, making statistical analysis the most appropriate research tool for their examination. Large sample studies can help to avoid the deterministic conclusions implied by some case-based research. Third, the causes and consequences of nuclear proliferation are multi-causal. Statistical analysis can help the researcher to test and control for complex relationships and interactions that interfere with simple inference.

To this list, we add a fourth reason. The monadic and dyadic units of analysis that form the backbone of datasets in international relations mesh well with our research focus on the causes and consequences of nuclear proliferation on the part of individual states.

These studies are not the first to employ quantitative analysis to examine nuclear proliferation issues. Quantitative research on nuclear proliferation traces its roots to earlier work by Kegley (1980) and Meyer (1984). Unfortunately, the methodological tools available to these pioneering efforts were insufficient to test more complex theories of interest. In recent years, scholars (Geller 1990; Singh and Way 2004; Jo and Gartzke 2007; Asal and Beardsley 2007; Fuhrmann 2008a) have begun to quantitatively analyze the causes and consequences of nuclear proliferation. Still, this research has not yet generated the critical mass of scholarship that has proven necessary for productive research in other fields.

We are advocating for a broad empirical research approach that sharpens and tests theories of nuclear proliferation by conducting systematic tests using large statistical samples. We view this endeavor as complementary to other research approaches. Statistics are a tool that, in combination with other research methods, can help scholars to resolve important puzzles concerning nuclear proliferation and to identify critical sources of variation.

This book offers a systematic account of the process of nuclear proliferation and its consequences. The 13 chapters that follow are organized into three parts. Part I contains six chapters that focus on the causes of nuclear proliferation. Part II contains six chapters on the consequences of the spread of nuclear weapons. Part III consists of an analytical review essay that offers a critique of the substantive chapters.

### **The causes of nuclear proliferation**

The six chapters in Part I offer explanations for why states acquire nuclear weapons. These authors expand on, and refine, recent quantitative work on nuclear proliferation by Singh and Way (2004) and Jo and Gartzke (2007), focusing in particular on the supply-side of nuclear proliferation. In Chapter 2, Robert Brown discusses the disagreement among policymakers about the importance of international institutions and international organizations (IOs) for achieving cooperation on international non-proliferation goals. IR scholars share a parallel concern about why non-proliferation institutions exist and whether (or for whom) they serve functional interests. As with other issue areas, the persistence of these arguments reflects the fact that rigorous empirical studies of international cooperation have lagged behind the development of diverse theoretical claims. Brown argues that we can learn from the broader study of IOs, which have applied principal-agent (PA) theories of delegation. Using new quantitative measures of delegation, Brown's chapter tests competing realist, institutionalist, and constructivist explanations for why we observe an increase in the delegation to an important non-proliferation IO, the International Atomic Energy Agency (IAEA). His analysis indicates that power, purpose, and beliefs are all important for a complete explanation of why the IAEA intervenes in international nuclear non-proliferation efforts.

In Chapter 3, Jennifer Erickson and Christopher Way focus on the Nuclear Non-Proliferation Treaty. The authors begin with a puzzle: if the NPT entails high costs for non-nuclear countries, why have so many countries joined and done so relatively quickly? The authors argue that NPT leaders may have helped to reduce the costs of signing the NPT by providing alternative means of protecting members' security – namely, enhanced access to conventional arms. The authors explore the idea through a statistical analysis of conventional weapons transfers from the United States and the Soviet Union/Russia from 1970 to 2001, as well as from the United Kingdom, France, and (West) Germany. Their results reveal that informal inducements provided a “signing bonus” to states that join the NPT.

Matthew Kroenig's analysis in Chapter 4 examines the relationship between the international transfer of nuclear materials and technology and the proliferation of nuclear weapons. He notes that policy analysts

have frequently claimed a link between nuclear assistance and nuclear proliferation, but that academic studies of nuclear proliferation have not treated international assistance as a potential cause of the spread of nuclear weapons. Kroenig argues that international nuclear transfers can help states to overcome the common technical and strategic obstacles that they encounter as they attempt to develop nuclear weapons. Applying nonparametric matching techniques and event-history models to a new dataset on international nuclear transfers, he finds that states that receive nuclear assistance are more likely to acquire nuclear weapons than are similar states that do not receive such help. More broadly, Kroenig finds overwhelming support for a supply-side approach to nuclear proliferation. Controlling for demand-side factors, he finds that states that have the ability to produce nuclear weapons, either through domestic capacity or international assistance, are at a greater risk of acquiring the bomb.

The demonstration of a link between nuclear assistance and nuclear proliferation begs for an explanation of the sources of nuclear assistance. This question has been largely unexplored in the vast literature on nuclear proliferation. Scholars have strained to explain why states want nuclear weapons, but very few (e.g., Kroenig 2010; Fuhrmann 2008b) have examined what is arguably the more puzzling question: why do states provide nuclear assistance? In Chapter 5, Matthew Fuhrmann uses new data on civilian nuclear cooperation agreements to examine this question. Contrary to the claims of many pundits and policy analysts, he finds only mixed support for the idea that economic considerations drive nuclear cooperation. Instead, his study finds that states offer civilian nuclear assistance for mainly strategic reasons. These include assisting allies, helping the enemies of one's enemies, and efforts by democracies to strengthen other democracies.

In Chapter 6, Brett Benson and Quan Wen develop a game-theoretic model that examines bargaining over nuclear weapons. The model examines the interdependent decision-making that occurs between states attempting to acquire nuclear weapons and those engaged in counter-proliferation efforts. The authors identify conditions that determine when, and under what conditions, different counter-proliferation strategies are most appropriate. Their analysis suggests that when verification is possible, pure disarming strategies (e.g., bribery and use of force) always exist. The authors also show that ambiguous development can be an effective policy for extracting concessions from concerned counter-proliferators.

The analysis of the causes of nuclear proliferation concludes with an analytic essay which points to a relatively unexplored research frontier. In Chapter 7, James Wirtz suggests that, although there are both necessary and sufficient conditions behind national decisions to acquire, sustain, or discard a nuclear arsenal, scholars often ignore nuclear politics. His analysis shows that analysts frequently fail to recognize that nuclear deterrence represents an ongoing national commitment that is constantly being

adapted, modified, and revised. For sustaining national nuclear capabilities over decades there must be a favorable climate of nuclear politics. As the only qualitative analysis in this volume, Wirtz's chapter captures important nuances that can be lost in quantitative analyses.

### **The consequences of nuclear proliferation**

The six chapters contained in Part II focus on the consequences of nuclear proliferation. The chapters provide considerable support for the argument that nuclear weapons enhance the security and diplomatic power of their possessors. While nuclear weapons do not always reduce the frequency of conflict, they appear to affect the timing, duration, severity, and outcomes of conflicts. The evidence suggests that nuclear weapon states engage in conflicts that are shorter and less intense, and they tend to emerge victorious from them. Furthermore, nuclear powers enjoy enhanced international bargaining power.

In Chapter 8, Gartzke and Jo's study examines the effects of nuclear weapons possession on the probability of conflict and international bargaining. They find that nuclear weapons states are neither more nor less likely to be involved in international disputes. However, their study suggests that even if nuclear weapons do not directly affect the likelihood of conflict, nuclear weapons status can still increase the influence of nuclear capable states. To test the hypothesis that nuclear weapon states enjoy greater international influence, Gartzke and Jo examine whether nuclear possession affects patterns of diplomatic missions. Important states send and attract diplomatic missions to and from other nations. The authors build on previous research on diplomatic missions and carefully control for other relevant factors including population and economic size. They find that states with nuclear weapons tend to host (and send) greater numbers of diplomatic missions. The primary effect of nuclear proliferation on international politics is not a reduction or increase in the probability of conflict, but to produce greater diplomatic leverage for their possessors.

The subject of experience with nuclear weapons is addressed in Chapter 9 by Michael Horowitz. Does the length of time states have nuclear weapons influence their behavior and the behavior of opponents in militarized disputes? If a state's capabilities and resolve, and the way in which a state's capabilities and resolve are perceived by adversaries, influence the probability of conflict, then the probability of conflict may change over time as nuclear learning occurs. Using multiple statistical models, Horowitz finds that when states acquire nuclear weapons they are more likely to reciprocate international disputes and are also more likely to have their disputes reciprocated. Over time, however, the effect of nuclear weapons reverses. Inexperienced nuclear states are more dispute-prone, while experienced nuclear states are less so. Consistent with the theme of