UNIVERSITY OF CALIFORNIA, SAN DIEGO

Nonproliferation Through Delegation

A Dissertation submitted in partial satisfaction of the
Requirements for the Degree of Doctor of Philosophy

in

Political Science

by

Robert Louis Brown

Committee in Charge:

Professor David A. Lake, Chair
Professor Kristian S. Gleditsch
Professor Miles Kahler
Professor Robert Powell
Professor Philip G. Roeder

2008

The Dissertation of Robert Louis Brown is approved and it is acceptable in quality and form for publication on microfilm

Chair

University of California, San Diego
2008

DEDICATION

To my mom, wife, and daughter, who each gave in their own way so that I could write this dissertation and complete my PhD.

EPIGRAPH

So who is going to run the factory when I get too old to do it myself? *Someone's* got to keep it going – if only for the sake of the Oompa-Loompas. Mind you, there are thousands of clever men who would give anything for the chance to come in and take it over from me, but I don't *want* that sort of person. I don't want a grown-up person at all. A grownup won't listen to me, he won't learn. He will try to do things his own way and not mine. So I have to have a child. -- Mr. Willy Wonka to Mr. Charlie Bucket[1]

Two men are walking down the street when they encounter a street show with a man and his bear: the man plays music poorly, the bear dances to the music clumsily, and a hat lies on the ground to solicit donations, however paltry. As the first man reaches for his wallet, the second man stops him, saying, "I wouldn't give money to see anyone dance who is that clumsy." To which the first man replies, "It isn't that he dances well, because he certainly doesn't, the amazing thing is that he can dance at all."

The Gulf War emphasized again that nuclear weapons are the ultimate coin of power. In the final analysis, they could go in because the United States had nuclear weapons and Iraq didn't. -- Former Indian Army Chief of Staff, General K. Sundarji[2]

[1] (Dahl 1964:155).
[2] http://www.globalsecurity.org/wmd/library/congress/1998_h/s980331kp.htm

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

AP: IAEA Additional Protocol
BW: biological weapon
BWC: Biological and Toxin Weapons Convention (also BTWC)
CBW: chemical and biological weapon
CPPNM: Convention for the Physical Protection of Nuclear Materials
CTBT: Comprehensive Test Ban Treaty
CTBTO: CTBT Organization
CTBT PTS: CTBT Provisional Technical Secretariat
CW: chemical weapon
CWC: Chemical Weapons Convention
DPRK: Democratic People's Republic of Korea (North Korea)
GP: Geneva Protocol
IAEA: International Atomic Energy Agency
kt: Kilotons of TNT equivalent (nuclear weapon yield)
INFCIRC: Information Circular (IAEA document)
ISG: Iraq Survey Group
LTBT: Limited Test Ban Treaty (also PTBT)
mt: Megatons of TNT equivalent (nuclear weapon yield)
NBCW(s): Nuclear, biological and chemical weapon(s)
NPT: Nuclear Non-Proliferation Treaty
NWS: Nuclear Weapon State (defined by NPT)
NNWS: Non-Nuclear Weapon State (defined by NPT)
NSG: Nuclear Suppliers Group
OPCW: Organization for the Prohibition of Chemical Weapons
PNET: Peaceful Nuclear Explosive Treaty
PTBT: Partial Test Ban Treaty (also LTBT)
ROK: Republic of Korea (South Korea)
TTBT: Threshold Test Ban Treaty
UN: United Nations
UNGA: UN General Assembly
UNMOVIC: UN Monitoring, Verification and Inspection Commission for Iraq
UNSC: UN Security Council
UNSCOM: UN Special Commission for Iraq
WMD(s): Weapon(s) of mass destruction

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGEMENTS

I would especially like to thank the members of my dissertation reading group who read multiple drafts of all the chapters: Lindsay Heger, Danielle Jung, Laura Wimberly, and Wendy Wong. Sonal R. Desai, Miles Kahler, David A. Lake, Sam Seljan and Heather M. Smith also read many chapters and gave valuable feedback. Of course, the dissertation could not have been written without the advice and support of my dissertation committee: David A. Lake (chair), Miles Kahler (unofficial co-chair), Kristian S. Gleditsch, Robert Powell and Philip G. Roeder.

I would also like to thank the many people who contributed to this research by answering questions and submitting to interviews. Many of these people are mentioned in the bibliography and some remain anonymous. However, I wish to single out Susan Shirk and Bob Einhorn, who together provided many of the initial introductions that made my research possible.

Research and writing was largely supported by the UCSD Department of Political Science and the UC Institute on Global Conflict and Cooperation, the latter through multiple Public Policy and Nuclear Threats IGERT Program Fellowships and a Dissertation Research Fellowship. Research was also supported by UCSD's Office of the Dean of Social Sciences; the Institute for International, Comparative and Area Studies (IICAS); and the Center for Strategic and International Studies' Project on Nuclear Issues.

VITA

1994	Bachelor of Arts, University of California, Berkeley
1999	Master of Arts, George Washington University Elliott School of International Affairs
2008	Doctor of Philosophy, University of California, San Diego

ABSTRACT OF THE DISSERTATION

Nonproliferation Through Delegation

by

Robert Louis Brown

Doctor of Philosophy in Political Science

University of California, San Diego, 2008

Professor David A. Lake, Chair

Since 1945, states in the international system have cooperated heavily to reduce the threats from nuclear, biological and chemical weapons, but their strategies have differed significantly. For nuclear weapons, states made use of international organizations from an early point, delegating significant authority to define, monitor, and enforce a collective bargain. In contrast, such an act of delegation occurred much later for chemical weapons and not at all for biological weapons. This dissertation argues that international cooperation on nuclear, biological, or chemical weapons issues requires states to perceive significant threats from NBCWs and share general preferences over strategies for dealing with these threats. However, delegation to an international agent is costly and therefore should occur only when an international agent is valuable for overcoming the many possible barriers to cooperation. I show international organizations can be more efficient producers of information, can be safer and more reliable as informational intermediaries, and can reduce the costs of enforcing an NBCW agreement.

Chapter 1: Introduction

On the morning of 20 March 1995, sarin nerve gas was released inside the Tokyo subway system by the Aum Shinrikyo cult. Over five thousand people required treatment in local hospitals, over one thousand people were hospitalized, and twelve were killed (Moodie 1999; Smithson and Levy 2000). The results were dramatic despite the relative failure of the improvised method of delivery: plastic bags of liquid sarin punctured by sharpened umbrella tips. When the US dropped the first nuclear weapons on Japan in August 1945, there was no such failure: as many as 110,000 civilians died almost instantly in the two attacks on Hiroshima and Nagasaki, and another 65,000 died within months of the attacks from long-term radiation and other effects.[3]

International institutions – "explicit arrangements, negotiated among international actors, that prescribe, proscribe, and/or authorize behavior" (Koremenos, Lipson, and Snidal 2001:762) – have long been a facet of cooperative strategies to control dangerous military technologies. The Second Lateran Council of the Catholic Church attempted in 1139 to ban the crossbow, for example, and the use of poisoned bullets was banned by international treaty at the close of the 19th century.[4] "Modern" cooperation, to prohibit

[3] The number of individuals killed or affected by the Hiroshima and Nagasaki nuclear detonations is subject to some debate. The Japan-based Radiation Effects Research Foundation reports that as many as 220,000 died within four months of the attacks and another 280,000 may have been "exposed" to nuclear effects (RERF 2007).

[4] After the 1675 France-Germany Strassburg Agreement's Article 57 banned use of poisoned bullets, the Brussels 1874 "International Declaration Concerning the Laws and Customs of War" prohibits the use of poisons and poisoned bullets, and the Hague Conventions of 1899 and 1907 extended this ban to projectiles used to disperse toxic gasses (Bernauer 1990; Donnelly 1960).

uses in war of poison gas after World War I, possibly begins with the 1925 Geneva Protocol.[5]

The massive loss of life in World War II, capped by the introduction of nuclear weapons, created strong international pressure for complete and general disarmament, not only of nuclear weapons but also chemical, biological, and “conventional” weapons. Prospects for disarmament were soon dimmed by rising Cold War tensions with the USSR’s 1949 nuclear test, the start of the Korean War in 1950, and by awareness that the UK and others were going to pursue nuclear weapons. As the months stretched into years, disarmament strategies evolved into nonproliferation strategies. Also, the strategies to deal with NBCW threats were, and still are, increasingly characterized by cooperation through international organizations (IOs): international institutions bargained within, and then monitored and even enforced by, international bureaucracies.

Eisenhower’s 1953 “Atoms for Peace” speech to the United Nations presented a major proposal for containing the nuclear threat: international assistance would be provided for peaceful nuclear energy programs in exchange for international verification that recipients did not divert this assistance to military uses. The result, in 1957, was the international treaty chartering the International Atomic Energy Agency (IAEA). The IAEA was intended to prevent new proliferation through transparency in national nuclear programs using “safeguards” (a combination of reporting and verification inspections) while also preventing lowest-common-denominator controls on nuclear trade. It was also the first case of delegation to an international agent to facilitate this cooperation.

---

[5] The full name of the treaty is the “Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare”.

The number of safeguards agreements with the IAEA increased quickly in the early 1960s and the range of facilities and activities the IAEA could safeguard broadened, strengthening the IAEA's legitimacy as a provider of safeguarding services. However, the IAEA was a useful but incomplete solution as long as nonproliferation safeguards were applied unequally and suppliers could discriminate in requesting them. Therefore, the guarantees of detecting proliferation were only weak assurances of nonproliferation to other states. By 1966 the international community agreed on the basic elements of a more universal and less discriminatory nonproliferation treaty, including self-restraint by existing nuclear weapons states against transferring nuclear weapons or related technologies to non-nuclear weapon states and commitments by all other states to not acquire them (Barnaby 1969; Burns 1969; Ølgaard 1969; Quester 1970; Rosen 1967).

Negotiations concluded in 1968 on the Nuclear Non-Proliferation Treaty (NPT) and since its entry into force in 1970, the parties have delegated substantial authority to the IAEA to define and determine compliance with the treaty, including an effective safeguards system to monitor state behavior, and to enforce the treaty through its own actions (economic sanctions and denial of membership benefits) or by the UN General Assembly (UNGA) or UN Security Council (UNSC).

The next major NBCW agreement was the Biological and Toxin Weapons Convention (BWC), concluded in 1972. The BWC consciously supplemented the Geneva Protocol's prohibition of the use of CBWs by adding prohibitions against BW and toxin research, development, stockpiling, or acquisition (the latter a nonproliferation provision to cover providing or receiving assistance). Unlike the NPT, however, the BWC does not delegate to an IO, makes no mention of verifying compliance; enforcement is only ad hoc or by a state's petition to the UNSC or UNGA.

Despite US-Soviet arms control agreements in the late 1970s and 1980s, there were no truly collective responses to an apparently growing threat from NBCW programs in developing states. Instead, the primary response was to create discriminatory export control regimes, first for nuclear items after 1975 through the Nuclear Suppliers Group (NSG) and then for CBW items after 1984 through the Australia Group. The fall of the Soviet Union in 1991 and the end of the Cold War created new opportunities for cooperation, but also new regional insecurities and new states armed with NBCW capabilities. The US and Russia signed START II in 1993, but most bilateral accomplishments occurred under the Cooperative Threat Reduction (CTR) Program, a $400+ million per year US effort to reduce the threat from WMDs from Russia and former Soviet states.[6]

Inspection and disarmament activities in Iraq after the 1991 Gulf War also led to new cooperation on controlling future NBCW threats. First, the IAEA member states expanded the Secretariat's nuclear safeguards authority by expanding its normal inspection and information gathering authorities and through the adoption of the Additional Protocol. Second, negotiations over a Chemical Weapons Convention (CWC) were concluded in 1993 and resulted in a treaty that, like the BWC, bans developing, producing, stockpiling or otherwise acquiring CWs. Unlike the BWC, the CWC followed

---

[6] CTR maintained the $400 million annual funding level through the entire 1990s and increased to approximately $1 billion annually after 2000. It is difficult to determine exactly which funds are "CTR" because the Departments of Defense and State, as well as Energy and Commerce, all have programs they attribute to contributing to the CTR program.

the NPT-IAEA model in establishing the Organization for the Prohibition of Chemical Weapons (OPCW) to implement the transparency mechanisms.

Third, negotiations over a Comprehensive Test Ban Treaty (CTBT) were finally concluded in 1996 and provided for a real-time monitoring system to detect tests, with a centralized data collection and analysis facility, and for on-site inspections. The treaty is awaiting the ratification of several key states (including the US) to enter into force, but the CTBT Preparatory Commission has the CTBT Organization (CTBTO) up and running as a "Provisional Technical Secretariat" and has nearly completed the test-ban monitoring system. If the CTBT enters into force, the CTBTO will consist of a decentralized monitoring system (member states will make their own judgments about treaty compliance) and an international on-site inspection system, both funded through mandatory assessments. Finally, the parties to the BWC also began negotiating a legally binding verification protocol to strengthen the BWC. Progress was slow until the US stated the BWC could never be made verifiable in 2001 and withdrew from the talks, effectively killing the negotiations.

Since 1945, state have at select points in time created IOs for nuclear and then chemical weapons issues, and conditionally delegated authority to facilitate their collective attempts to limit and reduce the threats posed by NBCWs. The delegation of authority to IOs to act in support of nonproliferation and counter-proliferation goals has not been inexorable. It has proceeded in fits and starts over the past six decades with some initiatives succeeding and others floundering. It has also not been uniform. The variation in delegation for NBCW issues across time and across seemingly similar threats is inconsistent. Why do states choose to delegate deeply to the International Atomic

Energy Agency (IAEA) to create controls on nuclear energy in 1957 (and then strengthened in 1968 and again in 1996 and 1998), but create a ban on BWs with neither monitoring nor enforcement mechanisms under the BWC in 1972? With BWs and CWs perceived so similarly for much of the post-WWII period, why does a ban on CWs wait until 1995 and why, unlike the BWC, does the CWC institutionalize delegation to an international organization? Solving this puzzle is the goal of this project.

The threat of NBCW use does constitute a major factor in defining the benefits possible from international cooperation on limiting the threats posed to states' security by NBCWs. However, threat perceptions differ and the threat environment is insufficient to explain cooperation unless states share perceptions of what strategies, at a most general level, would be useful to coping with these threats. When states hold shared beliefs about the sources of and solutions to threats, they may see incentives to cooperate against these threats. However, these two variables only predict the desire to cooperate on this security issue. They do not predict whether it actually occurs or in what form.

Even when the threat of NBCW use appears high and states share preferences over those threats, we may observe cooperation only when states are able to solve the information and enforcement problems that otherwise impede collective action. While cooperation between states requires the mutual accommodation of their interests to produce better outcomes (Keohane 1984; Lake and Powell 1999), the use of IOs produces risks but also the potential for gains beyond those of non-delegating multilateralism.

I show delegation by states to IOs for NBCW issues occurs for two reasons. States delegate to IOs when information is dispersed or requires investment in expensive specific assets and IOs are valuable for producing, collecting, and reporting that information. States also delegate to IOs when IOs can directly absorb the costs of calling for enforcement or possess the resources to impose costs upon violators. In short, I demonstrate that states delegate to IOs for NBCW issues when international agents provide a lower-cost strategy for negotiating, monitoring or enforcing an international bargain on NBCW issues.

Security Cooperation and Delegation in IR Theory

I build on cartel theory to describe the barriers to cooperation on NBCW issues. I then use principal-agent (PA) theory to develop a framework that lays out the causal factors most important to explaining why and when states delegate to IOs for NBCW issues. This study explicitly focuses on NBCW issues but is generalizable to other security and non-security areas.

This study is at odds with the Realist literature and its focus on anarchy, the international distribution of power, and the interests of powerful states that together leaves institutions with no power or effects independent from that of their masters (Mearsheimer 1994). The Realist assumption is therefore that international institutions, including any delegation of authority or renunciation of sovereign power, are merely a façade for actions taken by or at the behest of powerful states. As Susan Strange argues, power is the only independent variable important to Realists in explaining state behavior: "all those international arrangements dignified by the label regime are only too easily upset when either the balance of bargaining power or the perception of national interest (or both together) change among those states who negotiate them" (Strange 1983:345).

While Mearsheimer accepts that cooperation does sometimes occur between states, he argues cooperation is hard to achieve or sustain when states are concerned about relative gains and cheating. As he states, "states are reluctant to enter into cooperative agreements for fear that the other side will cheat on the agreement and gain a relative advantage," especially for security issues where "the cheating state [can] inflict a decisive defeat on the victim state" (Mearsheimer 1994:13). While cooperation is possible for "low politics" issues such as trade, institutions are nearly impossible for security issues. As Jervis summarizes, the creation and maintenance of security institutions requires that not only all major powers accept the status quo (and know that they all do), but also that war be very costly and the risk of defection low (Jervis 1982:176-178).[7]

International institutions may be aspects of a system of global governance that powerful states create to serve their interests, and are especially likely if there is a single dominant power or hegemon (Keohane 1984). If so, as the international distribution of power changes, these institutions should not persist (Krasner 1983). The IAEA, UN, and the NATO alliance are examples of IOs that have survived the end of the Cold War and become stronger despite shifts in the international distribution of power.

Perhaps most importantly, Realist explanations do not account for the observed forms of cooperation and only minimize the significance of all international institutions. Arguing they are epiphenomenal or are only slightly removed from state power (Waltz 1979) does not explain the *choice* of using an IO to accomplish that powerful actor's goals. Why would a powerful state have an incentive to create an IO, why do other states accept and use it, and why does it persist despite the decline of its benefactors?

[7] The risk of defection is proxied by the severity of the security dilemma, which is severe when the offense is dominant and is not distinguishable from a defensive posture (Jervis 1982).

Alternatively, contemporary institutionalist or rationalist approaches begin with the assumption that because international institutions are costly and states devote resources to them, they must be of benefit to states (Axelrod and Keohane 1986). Working backwards from this functionalist logic, they reduce transaction costs of bargaining (Keohane 1982) and help solve bargaining problems arising from opportunism, uncertainty, and asymmetric information (Haggard and Simmons 1987). This literature focuses on the ability of international congresses, by providing a forum for bargaining and information sharing, to help states overcome informational deficits (Keohane and Martin 1999). The important contribution is not simply that institutions are useful to states, but a focus on the barriers to cooperation created by time-inconsistency issues, differences in problem definition, and the distributional effects created by differences in preferences. More importantly, this literature highlights the fact that that the barriers to cooperation are also variable.[8]

There remain two problems for explaining delegation to IOs for NBCW issues. First, Realists are not alone in neglecting security institutions; most of the IR literature presumes that international institutions are nonexistent in the area of security issues (Lake 2001).[9] Second, these perspectives do not distinguish between the international institutions that identify outcomes (e.g., treaties or other agreements) and the IOs empowered to implement those outcomes on states' behalf. The World Bank has been delegated the resources and authority by its state investors to lend for infrastructure

[8] Keohane and Martin argue international institutions are likely endogenous to the interests of the states who created them (Keohane and Martin 1999) and therefore evaluating their effectiveness requires answering an unknowable counterfactual.
[9] One major exception is the edited volume by Haftendorn, Keohane and Wallander (Haftendorn, Keohane, and Wallander 1999).

projects in developing states, but why was the creation and maintenance of an IO necessary? Why create the IAEA?

Most political scientists examining the conditions under which individual actors will delegate authority to other actors do so in the context of domestic politics, such as the decision by citizens of a region to create a government over them (Aoki 2001), or the decision of a representative body to delegate to ministers or committees special powers to influence policy outcomes (Kiewiet and McCubbins 1991; McCubbins, Noll, and Weingast 1987; McCubbins, Noll, and Weingast 1989; Strom 2000; Strom 2001). Studies have recently emerged on delegation in international relations that examine the delegation of broad powers to another state for foreign policy decisions (Lake 1999; Lake 2005), relations within and among European Union institutions (Pollack 1997; Pollack 2005; Pollack 2006b), and delegation to international institutions, including to courts for prosecution and adjudication (Alter 2006), to financial institutions for multilateral lending (Gould 2003; Martin 2006; Nielson and Tierney 2003), and to security structures such as alliances (Cortell and Peterson 2006) and the UNSC (Thompson 2006a; Thompson 2006b). These works use PA theory to productively explore the mechanisms for delegating to and controlling international agents. This project should be seen as a contribution to this literature.

Delegation is a costly form of cooperation because, in addition to compromising over preferences, the principals also pay costs of institutional design and risk agency slack (Cortell and Peterson 2006; Hawkins and Jacoby 2003; Hawkins et al. 2006; Kiewiet and McCubbins 1991). Current principal-agent (PA) theories of delegation to international organizations demonstrate that agency slack is not a major problem and also examine the gains from choosing delegation as the form of cooperation. Hawkins, et al. (2006), for example, list seven factors explaining delegation: specialization, managing policy externalities, facilitating collective decision making, resolving disputes, enhancing credibility, creating policy bias, and/or increasing legitimacy.

However, there is little effort given to finding empirical evidence of these arguments in institution creation and change. Until this is accomplished, these studies will be disconnected from the theories required to understand why states use IOs when most of their goals can be achieved without them and how IOs affect state behavior. IOs for security issues should present particularly important cases for understanding the stark trade-offs, and the important variables, necessary to explain the choice between non-cooperative behavior, cooperation, and delegation.

Realists, and most institutionalists, are possibly right not to expect international institutions and organizations for security issues because cooperation is so difficult and so risky. Because cooperation is so hard, the empirics point to two extreme forms of collective responses to what Jervis terms the security dilemma (Jervis 1978). Only one extreme is characterized by the anarchic institutions recognized by Realists and represented by alliances among two or more states who each possess full and autonomous decision-making authority. At the other extreme are the forms of security cooperation so neglected in IR. State formation, for example, is often seen as a solution to security dilemmas at the individual and social level (Downing 1992; Finer 1975; Spruyt 1994; Spruyt 2002; Tilly 1975; Tilly 1990). Among states, the possible solutions are the various forms of hierarchy, in which one state accepts another state's authority in an issue area by accepting incorporation into its sphere of influence or its empire (Lake 1999). To many these compromises are losses of sovereignty that do not challenge traditional conceptions of sovereignty (Krasner 1999).

An alternative set of solutions entails, not delegation laterally to another state, but upwards to supranational institutions or downwards to non-governmental organizations. This study therefore also fulfills a key step towards understanding the nature of sovereignty and the conditions under which states will abdicate sovereign authorities.[10] In many ways, I also take Mearsheimer's (1994) challenge head-on, showing *how* these IOs reduce cheating by creating information that is different than that produced by states and then aid enforcement of agreements by adding costs for defection that are different than those imposed by states.

Delegation and Security Threats

The existing sovereignty, international institutions, and delegation literatures have a difficult time explaining the creation and evolution of institutions. To explain the decision to delegate authority over NBCW issues heavily in one case (NWs), less for another (CWs), and nearly not at all for a third (BWs), I build from basic principles. First, cooperation on security issues is hard because of the risks from cheating. For NCBW issues, defecting from cooperation – proliferating – can have tremendous effects upon the balance of power in strategic confrontations. Second, the set of feasible forms of cooperation is limited by the nature of the collective action problem.

In this section I lay the framework for why states delegate to international organizations. I begin by describing the cooperation problem and deriving the barriers to

[10] Sovereignty is a contested subject of late (Bueno de Mesquita 2000; Buzan and Little 2000; Hancock 2001; Krasner 1999; Lake 2007; Osiander 2001; Spruyt 2002).

cooperation. I argue that cooperation in NBCW issues is analogous to cooperation in cartels, which provides traction in deriving the variables of importance. This exercise focuses explicitly on NBCW issues, but the variables of significance are no different than those present in other cooperative endeavors. After developing the cartel analogy to derive the cooperation problems, I introduce a second analogy: the principal-agent (PA) model. Adapted from studies of American politics and the European Union, a PA model helps to formalize the advantages – and costs – to an actor or actors (the principals) of hiring an agent to provide services they could potentially accomplish themselves (unilaterally) or through non-delegating multilateralism.

Cartels and Cooperation Problems

From the beginning of the nuclear age, US policy makers believed that they could prevent the spread of nuclear weapons to other states if they could keep several key technologies secret. While individual states have worked to reduce demand by offering arms, alliances, and other assurances, international cooperation confronted the spread of NBCWs by focusing on the supply-side of the problem: by blocking access to the needed equipment, knowledge, and materials. The first nonproliferation agreement for nuclear technologies, the Quebec Agreement of September 1943 between Canada, the UK and the US, prohibited any of the three from communicating any information about nuclear technology without the consent of the others. In the six decades since, many collaborative nonproliferation policies were explicitly conceived to raise the cost of acquiring NBCWs to all other states.

I argue that a cartel is a useful analogy for international cooperation on NBCW issues because cartels form when otherwise independent producers agree to collude in order to increase their individual and collective security by raising the price to others of becoming NBCW threats (Browning and Zupan 1996; Carlton and Perloff 1994). Collusion can create rents by simply increasing prices (i.e., 19th century US railroad owners), or by restricting output (i.e., the Organization of Petroleum Exporting Countries or OPEC) or “bid rigging, allocation of consumers, allocation of sales by product or territory, establishment of trade practices, or common sales agencies” (Shy 1995). In NBCW markets, states forbid trade in some items, require licenses and safeguards to acquire others, and even then may use coercion or force to retard or rollback national programs. The NSG, Australia Group and OCPW explicitly limit items tradable by the participating states in order to prevent the transfer of some goods and technologies to potential proliferators. Other strategies may not explicitly resemble cartels but still raise the price to potential proliferators, such as the NPT’s requirement for IAEA safeguards on nuclear activities.

Cartels are most likely to form in industries where production is highly concentrated, barriers to entry are high, few significant producers are outside the cartel, and the resulting good exhibits little substitutability or differentiation (Spar 1994). However, cartels rarely form for four basic reasons. First, producers with sufficient market power to affect the price must agree upon a mutually acceptable bargain. Producers differ because they have different market shares, exist at different points in the distribution chain, face different fixed costs and/or marginal cost elasticities, and/or make products that are not perfectly substitutable (Carlton and Perloff 1994). While the choice of a US or French nuclear reactor design may simply come down to cost, France has differentiated itself by selling fuel reprocessing technologies that the US has until recently resisted. These nuclear suppliers also remain states, with broad security and economic interests at stake. This preference heterogeneity has distributional consequences that complicates negotiating an acceptable collusive bargain (Browning and Zupan 1996), a problem that can only worsen with every additional actor included in the bargaining process (Koremenos, Lipson, and Snidal 2001; Tsebelis 2002).

Bargaining also may be impeded by the production function specific to a common or public good. "Best shot" public goods production holds whenever a single actor's contribution is sufficient to produce a good (Hirschleifer 1987). Nonproliferation is best described, though, as a "weakest link" production function because it is provided at the level of the minimum or lowest contributor, irrespective of the level of others' contributions. Reaching an acceptable and effective bargain is, therefore, more difficult when the lowest common denominator can reduce the cartel's effectiveness to their level of compliance with the bargain.

Cooperation is the mutual adjustment of individual policies to produce greater gains than could be achieved through non-strategic behavior (Keohane 1984:51). If we assume states value independent decision-making and freedom of action, which most international relations theory assumes underlies the formal-legal conception of sovereignty (Bueno de Mesquita 2000; Kahler 2000; Krasner 1999; Lake 2005; Spruyt 2002), committing to a cooperative outcome compromises state sovereignty by requiring them to adjust their policies. Agreements that impose limits on future foreign or domestic policy decisions or commit the state to accepting intrusive inspections of its territory as part of the monitoring process constrain or transgress a state's sovereignty. Cooperation should be less likely as the preferences of cartel members become more heterogeneous.

Identifying acceptable bargains will become harder, bargains will be further from most individual state's most-preferred outcomes, and actors will require greater assurances that others are fulfilling their obligations.

Therefore, second, states with a critical mass of market power arriving at a bargain must also be able to verify compliance with the bargain because of the long-run strategic effects of proliferation.[11] Some aspects of NBCW programs are easily observed, but many are not. The "dual-use" problem exists whenever a material or technology needed to produce a weapon also has legitimate civilian uses: nuclear reactors produce plutonium for NWs but also produce electricity, and the large-scale culturing of anthrax may occur for weaponization or inoculation.[12] Even if intent were clear, monitoring compliance is further complicated when there is uncertainty about what constitutes cheating. Such uncertainty can result from incomplete policy information: "Does transfer of item X contribute to proliferation or not?" Prospective cartel members must be able to monitor relevant behavior and distinguish cheating from cooperation. Cooperation should be less likely as uncertainty about compliance increases because of bad information.

Third, incentives to cheat exist when states initially have different interests, their interests change, or when cartel success means higher prices and new incentives for members to cheat and for new actors to enter the market. Cartel members must be able to enforce the bargain. Enforceability requires the participation of actors able and willing to

[11] Fearon argues strategic actors view bargaining and enforcement of that bargain as simultaneous and not sequential problems (Fearon 1998). However, that is not to say these problems are not analytically distinct when dealing with anything other than a self-enforcing equilibrium. There is an increasing literature on the effects of proliferation (Beardsley and Asal 2007; Gartzke and Jo 2007; Rauchhaus 2007; Waltz and Sagan 2002).

[12] Dual-use is an important aspect of nonproliferation debates (Albright and Hinderstein 2004; Beck 2004; Bertsch, Cuppitt, and Elliott-Grower 1994; NSG 1997; Stratford 1999; Thorne 1997).

impose costs upon defectors with sufficient credibility and security that violations are *deterred*. Relying on after-the-fact punishment is difficult for NBCW proliferation because transfers result in long-term changes in the market structure. Reciprocal defection (a "grim trigger" or "tit-for-tat" strategy) would also leave all actors worse off. Cooperation should become less likely as the cost of enforcement rises.

Fourth, prospective cartel members must consider the responses of suppliers outside the cartel. Known also as fringe producers, they do not necessarily break the cartel but they limit the cartel's power over the market to the extent they reduce its ability to control supply (Browning and Zupan 1996; Carlton and Perloff 1994). Alternatively, larger memberships usually results in a more diverse (heterogeneous) membership and worsens the bargaining problems (Koremenos, Lipson, and Snidal 2001).

If current members are not adverse to new members joining the cartel, then when will states outside the regime choose to come inside by ratifying the bargain, demonstrating compliance, and contributing resources to monitoring and enforcement? Why would states outside the core try to join the collective nonproliferation effort? While the direct benefits to fringe states of joining the nonproliferation core are generally limited to access to flows of the controlled goods and technology, the costs to the core states is likely to be high if fringe states dissemble their preferences long enough to develop a latent capacity. A nonproliferation regime *is* weakened when a state joins the cartel to gain access to NBCW-relevant materials or technologies and then defects.

Nonproliferation cartels are especially interesting because they incorporate non-producers into the bargain. States that are not themselves NBCW possessors may provide all participants with clear benefits by forgoing their pursuit and providing additional resources for monitoring and enforcement of the cartel's chosen equilibrium outcome. This is a security-enhancing strategy for non-producers when they lack the capabilities necessary to be proliferators, they do not find proliferation beneficial given the credibility of their current security guarantees (internal or external), or they fear proliferation could precipitate arms racing with existing rivals that will leave them less secure. For them, the cartel maintains the security conditions that reduce the incentives to non-producers to acquire NBCWs and to prevent their acquisition by states outside the cartel.[13]

In short, when actors collude to raise the market price of a good, they have formed a cartel. In order to be effective, prospective members must negotiate a bargain that sufficiently accounts for their individual interests. This bargaining process should include as many potential producers as possible to be effective but is also more difficult as expansion includes producers with more heterogeneous preferences. The members must also have information about compliance (monitoring) and the ability to punish defectors (enforcement). As the costs of information and the costs of enforcement increase, the chance defection will go unnoticed or unpunished increases, the risk of cooperation (self-restraint in proliferation) also increases.

Cooperation on Nonproliferation Through Delegation

The cartel analogy is useful in focusing the analysis on specific cooperation problems – bargaining, monitoring, and enforcement – but does not by itself explain when states will use delegation to overcome the obstacles to cooperation. I therefore

---

[13] As the Proliferation Security Initiative launched by the US exemplifies, even non-producers can play an important direct role in the cartel's attempts to raise the barriers to entry for producers.

introduce a second analogy, the principal-agent (PA) relationship, to explain when and how states use international agents to provide services its members could potentially accomplish in other ways. "Delegation is a conditional grant of authority from a principal to an agent that empowers the latter to act on behalf of the former" (Hawkins et al. 2006:7). Delegation, as I argue below, can be a solution to the problems of bargaining, monitoring, and enforcement potentially present in NBCW cartels. Agents solve these problems when they provide functional services that provide information and increase the credibility of commitments.[14]

However, the costs of delegation, especially those resulting from the characteristics and motivations of the agent as a strategic actor in the PA relationship, set the foundation for discussing the benefits. States should expect to pay costs when delegating whenever states must organize and/or provide resources to an agent to enable it to fulfill its delegated responsibilities. Fiscal and human resources are scarce and their employment by an international agent necessarily diminishes their availability to its principals. While financial contributions to an international agent for many actors may replace national activities directed towards the same purpose, many states continue duplicative national efforts.

States also face the probability of costs from opportunistic behavior by the agent. While a non-delegating agreement imposes a compromise of a state's preference hierarchy with near certainty, using an agent means relying on an actor with independent

[14] Most analyses approach delegation to an international organization as a solution to problems with credible commitments and private information otherwise present when acting unilaterally or acting multilaterally in non-delegating institutions. While this analysis incorporates these as important analytic categories, it also acknowledges that division of benefits into these two categories presents a false dichotomy as a number of agent "services" could fall into both categories (Pollack 2006a).

preferences over outcomes who could exploit the relationship in ways costly to the principal.[15] Whenever increased autonomy creates space in which an agent's preferences can diverge from the principal's, the resulting potential for agency slack from the perspective of the principal can be costly: "run-away" agents who implement policies that diverge from those the principal would implement if it had the same information.

Principals possess four primary tools to solve these problems, though none are costless (McCubbins, Noll, and Weingast 1987). One, they can screen among potential agents and select one whose preferences are most closely in line with the outcome desired. For example, the IAEA and Provisional Technical Secretariat of the Comprehensive Test Ban Treaty (CTBT-PTS) require the head of the bureaucracy, and in some cases the senior advisors and division heads, to be selected by their respective executive bodies. However, states seeking to hire an international agent face a small pool of prospective agents and creating one "from scratch" can be costly (Hawkins et al. 2006; Wallander 2000). Two, they must decide whether the agent can accomplish the tasked goals with a set of constraining rules or whether discretion is more appropriate. In general, the greater the expertise of the agent and the greater the uncertainty in the issue area, the greater the autonomy the agent must have (Martin 2000; Martin 2006). IOs are often restricted in the types of information they may gather to develop their expertise about national behavior.

Three, they may design systems to monitor the actions of the agent. These may include reporting requirements by the agent itself but also direct and indirect oversight by

[15] Kiewet and McCubbins categorize the three problems that can result when the preferences of the agent diverge from those of the principal as: hidden information, hidden action, and Madison's Dilemma (Kiewiet and McCubbins 1991).

its principals. McCubbins and Schwartz describe ongoing monitoring by the principal as "police patrols" and monitoring that empowers non-principals to trigger reviews of the agent as "fire alarm" mechanisms (McCubbins and Schwartz 1984). The former would include, for example, the OPCW Secretariat's reports to the Executive Committee detailing equipment purchases, inspections carried out under the CWC, and the status of CW destruction in possessor states. The latter includes provisions within the CWC and CTBTO for member states as individuals to accuse others of noncompliance and demand special verification inspections. Four, they could design a credible system of rewards and punishments contingent upon IO behavior and outcomes: budgets rise and fall, appointed officials are removed, and programs are approved or cut. The first Director-General of the OPCW was removed from his post by the Executive Council for financial mismanagement (Official 2005d) and the subsequent Director-General found his powers substantially constrained.

In short, delegation describes a relationship between two strategic actors – a principal and an agent – who each have independent preferences and identities. The PA relationship is costly to create and maintain for the principal. Mechanisms can at least limit agency slack even if it cannot be eliminated. Importantly, the agent autonomy that generates the risks of agency slack is also responsible for many of the benefits to principal in the areas of bargaining, monitoring, and enforcement. I argue states will delegate to IOs to overcome the information and enforcement cost barriers to cooperation: when IOs can solve technical problems in producing proliferation-related information; when IOs which have been organized and motivated to have public, moderate, and narrow preferences can reduce the risks from search bias and sovereignty costs; or when IOs can reduce the costs to states of proposing (triggering) and implementing cartel enforcement.

Bargaining

Cooperation on NBCW issues requires negotiation among prospective cartel members to identify a policy solution and can be impeded by two phenomena.[16] First, the more divergent states' preferences, the less likely they are to perceive gains from the same nonproliferation policies. Even when states broadly share convergent preferences, slight differences in preference ordering produces distributional effects that can impede agreement on a single policy outcome. When collectively intransitive preferences of the principals results in cycling among policies, known as Condorcet's Paradox, delegation of decision making to another actor is one solution.[17] By delegating decision-making to an agent that has been selected and otherwise motivated to take the principals' interests to heart, the principals are able to achieve a Pareto-improving outcome even if that outcome is not the most-preferred outcome for each and every principal.[18]

Second, states may be close to agreeing on a collective goal but are unable to be sufficiently specific in what policies will produce that outcome. Contracts between negotiating actors are commonly incomplete to the extent that the negotiators are unable

[16] If states must only communicate their intentions and do not need to adjust their behavior to achieve their most preferred outcomes, this is coordination rather than cooperation (Stein 1983).
[17] An individual has intransitive preferences if they rank outcomes A, B, and C as A>B>C>A. Collectively intransitive preferences can result if three individuals rank outcomes, respectively, as A>B>C>D, B>C>A>D, and C>A>B>D. The potential for cycling increases in likelihood as the number of potential equilibrium outcomes or the number of "voting" actors increases. An alternative solution to Condorcet's Paradox is the introduction of decision rules that constrict voting choices, which significantly reduces the probability of encountering the Paradox. Discussed above in the context of "pooled sovereignty," this does not necessitate delegation to an agent unless an agent is also to propose policies or select decision rules.
[18] In the example in the previous note, delegation is beneficial to all if the agent helps them to avoid "D" as an outcome.

to plan for certain outcomes or do not anticipate their occurring with a sufficiently large probability (Barzel 1997). The original IAEA safeguards system, for example, was designed to detect diversions from public programs and not clandestine nuclear programs. Actors can also find it too expensive to either produce relevant information or to make the information they possess credible to others. Because of the incentives to misrepresent the private information they hold, proposals by individual principals may strategically shift the rules, regulations, or mission to advantage themselves in ways indistinguishable from those constructive to the intent of the other actors. For example, did the USSR want enforcement of NBCW agreements to reside in the UN Security Council to improve enforcement or to improve its control over enforcement decisions?

A specialized agent can produce policy-relevant information important to defining and measuring aspects of the problem cooperation seeks to solve. Also, when the process by which the information is produced is public, and the agent's underlying motivations are known, the policy information produced by an agent may be more credible than information from other, potentially biased sources. The greater the importance of the agent's specialization as a source of expertise and information revelation, the more likely the agent will be granted some authority to use that information to facilitate bargaining between the principals. Specific roles include reporting information relevant to questions before the principal, drafting or initiating proposals to change the status quo delegation contract, or the authority to set new rules and regulations consistent with the agent's mission. For example, negotiators of the NPT found it too costly to fully specify how states were to prove their compliance with the treaty and delegated this responsibility to the IAEA.

Delegation facilitates bargaining to the extent that the principal can rely upon the expertise of the agent to revise, expand upon, or renegotiate aspects of the bargain to better achieve the principals' interests. The authority derived from an agent's expertise has two sources. There are technical reasons that an agent's capacity to invest in information results in expertise more efficiently than the principal without delegation. States seeking information about useful nonproliferation policies and the proliferation behavior of other states pay search costs to acquire this information. Search costs are greater when producing information on proliferation requires greater investment in assets specific to proliferation behavior and as the information itself becomes more distributed such that few actors can encounter, draw conclusions about, and report the information.

Economies of scale to the production of information exist when individuals lack the resources to produce information separately but can produce information when pooled collectively.[19] For example, despite the US interest in gathering proliferation-related information via national technical means and providing large budgets for intelligence collection, declassified United States government documents show that throughout the Cold War the US feared NBCW proliferation to new states but often had quite poor intelligence regarding these states' real activities or intentions (Burr 2005; Burr and Richelson 2000). Pooling resources can allow investments in information production capacities that individually would produce little value added. For example, Canada, the UK, and the US pooled their nuclear expertise in the Manhattan Project in just this way.

[19] Economies of scale exist when actors can increase output more than in direct proportion to cost of increasing inputs, i.e., when the per unit cost of production decreases (Browning and Zupan 1996)

Delegation is not intrinsically necessary to take advantage of economies of scale.[20] Rather, delegation allows the IO to structure contributions of the individual principals such that economies of scale can be exploited given the existing barriers to cooperation. While fully non-delegating monitoring systems are possible, they can expose states to "hold up" problems that will prevent actual investments from occurring. A hold up problem is one type of commitment problem and occurs when an actor promises to make an otherwise efficient asset-specific investment in information but stalls because it fears being exploited by others' time-inconsistency problems (Joskow 1985). A credible commitment problem exists in a strategic interaction whenever it is in one actor's interest to promise to behave in certain ways at some point in the future when it may not actually be in their interest to fulfill that promise when they are called upon to do so (Fearon 1995). As in the Manhattan Project example above, the US benefited from the investments made by Canada and the UK during the war and then immediately cut them off after the war, denying them access to the technologies that their contributions facilitated. The hold-up problem that arises when states cannot independently afford to invest in assets specific to information production, and must first wait for clear investment by others, explains why states promoting nonproliferation are often unable to make non-delegating forms of information revelation work.

In addition to technical incentives, there are political incentives to delegate to an IO for information production. On the one hand, reliance on other states with divergent preferences for information on NBCW issues – a fact of life in pooling independent

---

[20] States often collaborate on issues by convening scientific conferences or international research laboratories. For example, US President Carter convened in 1977 the International Nuclear Fuel Cycle Evaluation conference to identify proliferation-resistant alternatives (Gummett 1981).

national capabilities – creates a risk that national interests will bias their collection and reporting of that information (Milner 1997). On the other hand, states fear that revealing information relevant to the bargain also reveals unrelated but valuable commercial or national security secrets.[21] States therefore perceive political costs – the risks of search bias and sovereignty costs – when relying for information collection and reporting on actors with divergent or uncertain preferences. Delegation can be valuable for information production when it is to an agent who has been designed and motivated to have preferences that are publicly known and moderate on proliferation issues but also to lack preferences on other issue dimensions.

Monitoring

Cartels, once formed, must be able to determine if their agreement is working and whether states are complying with the agreement. Cartels therefore confront a monitoring problem. Revealing private information about states' specific interests or capabilities is necessary to evaluate their commitments and is a problem distinct from producing policy information (Hawkins et al. 2006; Kiewiet and McCubbins 1991; Thompson 2006a). Commitments can be made more credible when other actors have better information about each others' preferences and behavior.

Monitoring entails identifying observable indicators of a behavior, making these observations, and then reporting the results. Monitoring itself does not require delegation to an agent and often unilateral or multilateral non-delegating systems are used. As discussed above, when states self-report the information they possess about the NBCW-relevant behavior of themselves or others, they may face incentives to misrepresent that

[21] States face many sovereignty costs from delegation; this is one specific sovereignty cost.

information. France and Germany expressed doubt regarding US evidence that Iraq had ongoing NBCW programs prior to the US-led invasion in 2003 because they believed US analysis was predisposed to interpreting the data in the worst light possible. Therefore, when one actor self-reports information, other states often prefer to have corroboration of that information, either through its own efforts (national technical means or NTM) or by an agent that it can trust to report accurately through "police patrols" or "fire alarms" (Kiewiet and McCubbins 1991). National reporting can therefore suffer from bias in the information that is made public.

Paralleling its ability to produce policy information, the agent's technical advantages for policy specialization combine with its public, moderate and narrow preferences to create utility for monitoring to reveal private information. Agents can improve the quality of information to the benefit of states seeking to cooperate (Martin 2002a), such as by monitoring and reporting on issue-relevant behavior. Agent expertise may be exploited by delegating other implementation tasks to the agent. For example, if an agent is responsible for monitoring compliance with particular rules and regulations, the principals may benefit from delegating to that agent the responsibility to also aid the parties in implementation of those rules and regulations through training or technical assistance.

In summary, delegation to an external or international agent can be beneficial to states when it is necessary to monitor contract-relevant behavior to overcome commitment problems. Delegation will be greater, as at the bargaining stage, when search costs are high and there are larger risks of search bias and sovereignty costs from non-delegating solutions.

Enforcement

Whenever states select a policy bargain, they consider whether the bargain is self-enforcing or requires additional enforcement devices to ensure compliance (Fearon 1998). While states will seek to make a bargain as incentive-compatible as possible to reduce the costs of enforcement, states may dissemble their interests or their interests may change. Monitoring may reveal defections but sanctions of various kinds may be necessary to align the negotiating parties' incentives towards contract fulfillment.

Sanctions are costs that one or more actors decide to impose upon others in order to change the violator's decision-making calculus. Ideally, the threat of costs has a deterrent effect, but the actual imposition of costs may be necessary to return a state to compliance. States are internally organized for enforcement and regularly determine when violations to agreements have occurred, decide upon an appropriate punishment mechanism that will be (probabilistically) useful to bring the violator back into compliance, and then implement that punishment.

At the international level, this implies a two-stage process. First, an actor must determine non-compliance has occurred and recommend enforcement. Proposing enforcement on the international agenda – "triggering enforcement" – is costly because it requires costly investments in information on behavior. It is also risky for the triggering actor because it invites retaliation as well as being domestically risky if enforcement is a bad policy. Second, an enforcement action must be implemented. Enforcement actions are usually costly to the sender, creating a second-order collective action problem for the cartel: agreeing to enforce the original bargain creates new distributional effects and new incentives to free-ride on the investments of others.

The pre-delegation of the authority to propose or make compliance decisions and/or pursue enforcement provides benefits similar to other institutional arrangements by reducing the transaction costs of implementing multilateral enforcement. The delegation of agenda setting powers to other actors is a powerful commitment because agenda setters can force actors to discuss or negotiate issues that they would otherwise avoid. An agent can provide both a process for selecting and implementing enforcement measures and legitimacy to extra-delegation, unilateral enforcement measures.

The pre-delegation of enforcement authority does exist at the international level. The Chemical Weapons Convention pre-delegates to the Executive Council of the OPCW the authority to recommend "measures to redress the situation and to ensure compliance" (Art.8 Sec.C Para.36). Even when enforcement authority is limited to compliance decision-making, the incentives of potential violators are altered when enforcement by private actors is made more likely by an agent's politically neutral judgment that enforcement is warranted.

Project Outline and Methodology

I began with the cartel analogy to describe the cooperation problems facing states attempting to collude to cope with the threats from nuclear, biological, and chemical weapons. States may want to cooperate to reduce the threats posed by NBCWs if they perceive benefits from cooperation and they share preferences over those benefits. Severe threats of NBCW use and similar perspectives on the solutions to these threats are therefore causal for NBCW cooperation but cannot explain whether cooperation will be observed or in what form. The unpacking of cartel theory demonstrates that collusion can encounter problems with bargaining, monitoring and enforcement.

I argue states will delegate to IOs to overcome the information and enforcement cost barriers to cooperation. One, delegation to IOs for NBCW issues can solve some of the technical problems in producing proliferation-related policy and private information created by high search costs. Two, delegation to IOs which have been organized and motivated to have public, moderate, and narrow preferences can reduce the risks from search bias and sovereignty costs. Three, delegation to IOs with the ability to impose costs on violators can reduce the costs to states of proposing (triggering) and implementing cartel enforcement.

Delegation, threats, preferences, the costs of information, and the costs of enforcement are all abstract concepts that have theoretical meaning in Political Science and International Relations theory, but the concepts themselves cannot be directly observed. Other analysts have sometimes described these concepts and attempted to differentiate them from other constructs, but not always successfully and rarely in a manner that facilitates empirical testing. For each causal variable – threats, preferences, costs of information, costs of enforcement – I begin by analyzing the historical evidence for its value in explaining delegation. In most cases, this qualitative analysis is then used to develop quantitative indicators of the variable to be tested for its power to cause delegation. This quantitative proxy will be shown to be a strong analogy for the theoretical constructs developed in the hypotheses (which themselves are analogies for the real world). Due to the fact that any test is a second- or even third-order analogy for the real world, in the course of generating these proxies I take particular pains to demonstrate they possess construct validity. In particular, I demonstrate that they have translation validity: they appear plausible on face value given the available, often qualitative, evidence.

In Chapter 2, I measure delegation. I develop a unique measure of delegation based upon the range of services an agent can provide to its principal(s), the resources available to provide these services, and the level of obligation of the principal(s) to abide by the result. I apply this metric to the NBCW relationships identified in the history to arrive at time-series cross-sectional data on NBCW delegation. This metric is applicable to identifying and measuring delegation across the empirical range of international and domestic relationships and therefore fills a current gap in the literature.

I establish the baseline incentives to cooperate in Chapters 3 and 4. Chapter 3 examines how the severity and source of threats posed by NBCWs has evolved since 1945. I develop quantitative indicators of state NBCW capabilities (latency) and then incorporate the opportunities for NBCW use to develop separate measures of the annual threat level for nuclear, biological and chemical weapons. Analyzing the temporal relationship between threat levels and delegation to help mitigate these threats, I find there is a strong and significant relationship between nuclear threats and delegation on nuclear issues, but also significant unexplained variation in delegation. I find that there is strong delegation for chemical weapons yet none for biological weapons despite the finding that the threat from BWs appears greater than that for CWs. I also find no evidence to support arguments that IOs exist because the most powerful states demand or create them. Despite their consistent diffuse support for nonproliferation efforts, delegation for nuclear and CW issues does not correlate with measures of US or USSR power.

In Chapter 4, I examine how the distribution of preferences among actors in an issue area, and their market power over the issue area, affects the willingness to cooperate. I analyze the history of the Statute of the IAEA and of the Chemical Weapons Convention for the importance of the distribution of preferences. I then analyze the distribution of preferences quantitatively using "S" or similarity scores of states (Signorino and Ritter 1999) based on UN General Assembly roll-call votes on NBCW issues and participation in major multilateral NBCW treaties. I find that when states' NBCW preferences are more similar, they are more likely to delegate to an international agent on nuclear issues. I also find support for the cartel analogy for nonproliferation: the preferences of states with greater nuclear capabilities are more strongly related to nuclear delegation. The relationship between NBCW preferences and CBW delegation is less clear.

I then turn in Chapters 5, 6 and 7 to the core tests of the reasons I argue states delegate to IOs for NBCW issues to enable cooperation. Chapter 5 examines whether an international agent is valuable because information requires investment in expensive specific assets. Search costs may be high for NBCW issues because information is inaccessible to low cost monitors and is highly dispersed. I analyze nuclear test ban negotiations between 1953-2004 and compiled data on the number of potential monitoring targets for nuclear, biological, and chemical industries. This cross-case comparison shows that the diffusion of the number of potential monitoring targets (and other qualities) makes cooperation more efficient but also can present a large barrier to entry into the market for an informational agent. Monitoring of the nuclear industry for nonproliferation purposes began when the industry was very small, but it remained clear that multiple independent and overlapping monitoring systems were more costly, less efficient, and subject to gaps in coverage relative to a coordinated system. By comparison, chemical and biological industries were already very large by the point states identified an interest in cooperating to reduce the threats from these weapons.

Chapter 6 examines whether an international agent is valuable when gathering information risks revealing commercial or national security information (sovereignty costs) or when information collection and reporting is subject to political manipulation (search bias). Analysis of differences in NBCW strategy preferences (using data generated in Chapter 5), of data on the economic significance and technological dynamism of the nuclear, biological, and chemical industries, and of intelligence on Iraqi NBCW programs from 1991 to 2003 supports these hypotheses. Whenever states must cooperate on the production of information, the risk of search bias from other states (the United States in particular) induces states to choose to rely on international agents. Whenever industries are economically important, there is value to relying on agents with known and narrow preferences to produce information.

Chapter 7 analyzes the enforcement functions IOs may serve. I demonstrate that international agents facilitate enforcement when they are empowered to make formal proposals for enforcement or they posses the capacity to impose costs independent of their principals. A quantitative analysis is unable to solve the problem of selection effects in measuring enforcement advantages as a cause of delegation. I therefore conduct a time-series qualitative study of the role of IOs in enforcing the nuclear nonproliferation regime in two similar cases that each were the subject of multiple enforcement events: North Korea and South Korea.

The body of the dissertation demonstrates the independent effects of the causal variable upon delegation to IOs for NBCW issues. In Chapter 8, the conclusion, I bring together these arguments to demonstrate the validity of the general hypothesis: delegation to an agent occurs only when doing so is a less costly strategy for producing private or policy information about NBCWs or for enforcing a NBCW bargain. I then extrapolate from current NBCW trends to predict when, how, and under what conditions additional delegation – or its retraction – is likely to occur in the near future.

I explicitly employ a quasi-experimental research design similar to Mill's "method of difference" to test the hypothesized relationships. Specifically, I use a particular type of quasi-experiment, an interrupted time-series design with multiple non-equivalent comparison groups. The research design is quasi-experimental because the cases for analysis were selected non-randomly and because I lack full control over changes in the independent variables (the "treatments"). The three cases of nuclear, chemical, and biological weapons, though selected non-randomly, are sufficiently similar for meaningful cross-case comparison. First, they are similar to each other in their destructive power relative to contemporary conventional weapons, in the uniqueness of their basic developmental (technological and input) requirements, and in the difficulty of their detection and monitoring. They are also similar in the actors who (first) were capable of producing and stockpiling them, which allows me to control for the influence of relative national power in explaining the form of cooperation across institutions. Finally, they are considered similar because of the enormous power of the convention that holds that they are all "weapons of mass destruction" (WMDs). Each of the three regimes are observed over time from 1945-2003, the interrupted time-series aspect of the design, which allows for the use of multiple pre- and post-treatment measures to estimate the effects upon the outcome variable of interest: international delegation.

The method of comparison used in this project to evaluate the causal power of these variables for the observed levels of delegation is a primarily large-N quantitative analysis supported by thick description. As a quasi-experimental design, changes in the causal variables caused by exogenous events occurring in the world should be temporally related to changes in delegation to the individual institutions within each regime. Changes in the causal variables that are temporally connected to changes in the dependent variable as hypothesized are interpreted as support for the validity of the hypotheses. Similarly, changes in the dependent variable should not be observed to occur without changes in the causal variable.

Two notes on the quantitative methods. First, the correlation between the causal variables (search bias, sovereignty costs) and the outcome variable (delegation to IOs) is measured throughout this project using an OLS finite distributed lag model. Woolridge argues adding the coefficients of the lagged independent variables on time-series data should provide a good indicator of the long-run effect of changes in the independent variable upon the dependent variable (Woolridge 2000:314). This is especially useful when the effect of the independent variable is not expected to be immediate but is expected to be somewhat cumulative. The effect can be expected to be delayed (lagged) because of informational problems that delay decision-making, psychological factors (habit), contractual or other institutional barriers to change, or technical delays in implementing changes (Capps 2006:Section 5). All of these factors are likely present in decisions to delegate to IOs for NBCW issues, so it is reasonable to include a lag on the order of several years to allow the effect to manifest.

To be explicit, the model is specified for each test as:

$$y = \alpha + \beta_1 x_{t-1} + \beta_2 x_{t-2} + \beta_3 x_{t-3} + \varepsilon_t$$

Second, distributed lag models do not require the inclusion of a lag of the dependent variable unless it is necessary to correct for an autoregressive process, or AR1 (see Woolridge, 2000:313). The construction of the proxy for delegation used in Chapter 2 attempts to correct for autoregressive processes, such as by using constant budget dollars. Still, the observations in the dependent variable are not truly independent because of the same causes of path dependence in other analyses of institutions: large set-up costs to new institutions, learning effects of existing institutions, coordination gains as more actors adopt the institution, and the expectation of future learning and coordination effects (Arthur 1994:112). This same problem exists for the independent variables and, therefore, the inclusion of additional lags provides a better estimate of the effect of the independent variables but reduces their individual significance. However, the analysis presented here is not to maximize the ability to predict changes in the dependent variable, delegation, but to evaluate the effect of a particular set of variables upon delegation.

Conclusions

International organizations (IOs) have been a salient feature of international security strategies to cope with the threats posed by nuclear, biological and chemical weapons (NBCWs). Despite the common conflation of these weapon types into "weapons of mass destruction", the varied approaches, across time and across seemingly similar threats, is puzzling. Why do states delegate for some nuclear, biological, and chemical weapons issues at some points in time, but not for other issues or at other times? Why do states choose to delegate deeply to the IAEA in 1957 and through the NPT in 1968 but cooperate superficially for BWs under the 1972 BWC? Why does a ban on CWs not emerge until 1995 but delegate substantial authority to an IO?

Using an analogy to trade cartels, I first demonstrated that cooperation on NBCW issues requires states to negotiate, monitor, and enforce a bargain that can produce security gains for states on proliferation threats. I then built upon principal-agent theory to derive the basic conditions under which states, facing significant barriers to cooperation, choose to delegate to IOs rather than forgo cooperation and forgo effective nonproliferation and counter-proliferation strategies. More severe threats of NBCW use and converging preferences regarding these threats provide the baseline incentives to cooperate but cannot explain the form of cooperation. I argue states will delegate to reduce NBCW threats when the baseline conditions hold and when the IOs can reduce search costs for NBCW-relevant information, pose lower political risks of search bias and sovereignty costs in the production of that information, and can reduce the costs of enforcing compliance with a NBCW bargain.

This dissertation examines the power of IOs as agents of their state principals. This power comes primarily from the information they wield but also from their ability to translate informational agency into enforcement power. While they have real power to affect state behavior, IOs remain agents of and subject to the constraints maintained by their state principals. That IOs are agents of states, employed to further a collective purpose, does not demean them. IOs are agents of states just as states are agents of their citizens, one further link in the chain of delegation between the interests of individual people and the outcomes we observe. This dissertation is therefore not only an analysis of *international* organizations. It is also a study of the nature of sovereignty and of *political* organization more broadly conceived.

This dissertation also is about NBCWs, the threats they pose to states from states and non-state actors (NSAs), and how states work together to cope. This research project is, therefore, also significant because it confirms that, even in the high politics of security, states do delegate to other actors at least partial responsibility for their security. This research will help connect known cases of security cooperation to each other and demonstrate the full range along which actors can cooperate to produce their security.

Chapter 2: Delegation Metrics and Measures

Delegation is one solution to the problems that sometimes impede cooperation among international cartels, made necessary because of its ability to reveal policy and private information and constrain the behavior of the delegating actors more cheaply than alternative strategies (Hawkins et al. 2006). Delegation occurs "when a principal conditionally grants authority to an agent to act on his or her behalf" (Hawkins et al. 2006:7). What has been less well articulated is a method for observing or measuring delegation, especially in international politics and even more so for security issues such as the proliferation of nuclear, biological, and chemical weapons. Most authors make simple assumptions about the level of delegation, use the number of clauses or words in the delegating document, or measure along a single dimension relevant to the outcome they seek to explain. Such analyses do not provide traction for broader tests of principal-agent theories or comparisons across issues and institutions.

After reviewing previous attempts at measurement, I develop a generalizable operationalization of delegation. This new metric quantifies eight indicators of an agent's contracted authority and autonomy as well as the resources the agent possesses to fulfill its responsibilities. This method of operationalizing delegation is applied to two international organizations (IOs) to demonstrate the face validity of the metric. The first case is the International Atomic Energy Agency (IAEA); the case is well known, well discussed in the literature, and the breadth of its historical experience lends itself quite usefully to the task of comparing delegation across time. The Provisional Technical Secretariat of the Comprehensive Test Ban Treaty Organization (CTBTO-PTS) is chosen as the second case to facilitate a comprehensive comparison. The CTBTO-PTS is interesting not only because elements of its structure differ from the IAEA, but also as a stand-alone case because there are differences between its current, provisional form and the future form it will take if the CTBT enters into force. The measurements are then briefly summarized for other international institutions, including several "observed zero" cases.

The operationalization of delegation provides a new and unique contribution to the study of PA relationships. Further, the operationalization will provide a means of measuring delegation to allow empirical tests of my hypotheses. The unique data I generate on delegation to NBCW IOs is the missing ingredient to analyzing why states use IOs.

Delegation Measures?

Delegated authorities generally include the authority "to make decisions or take actions that bind the [principal] or commit its resources" (Bradley and Kelley 2006), the specifics of which are defined in a contract. Explicit delegation, such as ratification of an international treaty, is described by some as institutional legalization (Goldstein et al. 2001) and can be said to have occurred when states have regularized their relations through obligation, precision and/or delegation (Abbott et al. 2001).[22] This approach often restricts analysis to institutions created by formal treaties. However, implicit delegation also occurs, as in government foreign aid grants to nongovernmental organizations, when one actor grants another actor the authority to make decisions or take

[22] Obligation occurs when states accept rules and commitments in a legally-binding manner such that states can assert established international mechanisms and processes when another actor does not fulfill their stated obligations. States impose precision through unambiguous and noncontradictory rules that specify clear metrics for compliant behavior, though the level of precision varies by the degree of discretion granted to the actors in interpreting these metrics (Abbott et al. 2001).

actions outside of formal institutions or provides another with the practical resources that create the capacity to act.

Delegation requires the transfer of decision-making authority from a principal (singular or collective) to either a subset of the principal or to an external agent.[23] The UN Charter, for example, created the United Nations General Assembly, an act of legalization that institutionalized bargaining among states and pooled sovereignty, but was not an act of delegation. Meanwhile, the Charter's grant of authorities and resources to the UN Secretariat and the UN Security Council are both cases of delegation. Of course, delegation "upwards" to an IO is not the only option. States may also delegate laterally to other states (as in Japan's reliance on the US for security guarantees) or "downwards" to nongovernmental organizations (Cooper et al. 2005).

Complicating any individual delegation contract is the fact that principals can be single, multiple or collective (Lyne, Nielson, and Tierney 2006b). An agent has a single principal if it has contracted to provide services to only one principal for the contract's duration, and multiple principals if the agent has multiple contracts with multiple, independent principals. The literature on institutions has long focused on the ability of domestic legislatures and international congresses to serve as negotiating bodies, more efficient than decentralized coordination because they provide rules and processes for moving past non-substantive logistical decisions.[24] While international decision-making bodies may pool the sovereignty of the participating states, this is not delegation by states

[23] C.f. Cooper et al. argue delegation to an international legislature occurs when a group of actors agrees to accept decisions made according to less-than-consensus rules (Cooper et al. 2005).
[24] Non-substantive decisions might include where to meet, at what level to participate in negotiations, who speaks and in what order, and how negotiations are terminated and issues resolved. Of course these decisions are also substantive in that they may privilege specific actors' interests or outcomes.

to an agent (Lake and McCubbins 2006). A group of individual actors form a collective principal if they agree to decision rules by which a contract with an agent will be established and maintained.

However, most work on delegation has either neglected to measure delegation or has done so poorly. Some authors simply assume delegation has occurred in certain contexts. For example, Huber and Shipan argue that the discretion granted in a piece of domestic legislation is inversely proportional to the length of the legislation: longer legislation “typically places greater limits on the actions of other actors” (Huber and Shipan 2002). Similarly, Milner’s analysis of when states will delegate foreign aid delivery to an IO only differentiates bilateral lending between states from multilateral lending through the World Bank and International Monetary Fund (Milner 2006). The existence of delegation is assumed, even though nothing about collaborative lending necessarily requires the employment of an agent.

To be useful, measures of delegation should possess two forms of construct validity. First, the measure should differentiate between similar but alternative conceptualizations. That is, a measure of delegation should differentiate acts of delegation from other forms of cooperation (discriminant validity). Second, the measure should have strong face validity in that it is demonstrated to be a good translation of expectations into measurements, as indicated by its congruence with extant qualitative observations of delegation.

A simple indicator used by some is a comparison of the number of clauses in the delegating instrument that grant authority to the number that impose constraints. Epstein and O’Halloran measure the discretion in individual acts of domestic delegation by the

US Congress to the President by comparing the proportion of provisions that grant and constrain the President's authority (Epstein and O'Halloran 1999). Similarly, to measure delegation by European states to the European Commission, Pollack creates a ratio of "treaty provisions delegating executive powers" to "total provisions in the issue chapter" (Pollack 2003). The technique assumes that all possible delegations of authority – and the constraints upon that authority – are created equal and therefore lacks construct validity.

While the measures are problematic, the criteria for identifying clauses that contain or limit delegation do identify elements which are useful to a more discriminating measure. First, agents vary in the services they provide to their principals. Pollack argues an international organization can monitor compliance, solve problems of incomplete contracting (structuring or mediating negotiations; policy making), serve as a regulatory body that translates an agreement into practical regulations, and/or play a role in selecting or modifying an equilibrium policy (Pollack 1997). Epstein and O'Halloran include the discretion to make rules or regulations, modify decision-making criteria behind rules and regulation, allocate resources, apply regulations selectively, and extend existing discretionary authorities that would otherwise lapse (Epstein and O'Halloran 1999).

Epstein and O'Halloran also differentiate fourteen categories of constraints often present in the legislation, which usefully include: limits on agent's power to expend resources, actions that require pre-approval by another actor, legislative veto power over regulatory changes, *ex ante* consultation (including approval) or *ex post* reporting requirements, and specified processes for rulemaking. Huber and Shipan highlight additional constraints on an agent by focusing on the procedural requirements that constrain agents before policy decisions are made (preapproval of proposals by legislature and consultation or study requirements) or after implementation of a policy (reporting requirements and establishment of an appeals process). Other constraints on agent actions concern imposing time horizons, retaining proposal and oversight powers over the agent, imposing staffing requirements and specifications, and limiting the creation of new agents (Huber and Shipan 2002).

The literature does include a number of authors who discriminate using institutional characteristics, though they generally focus on a single dimension along which there is some variation for the cases they examine. For example, Koremenos measures delegation only as dispute resolution provisions of treaties (Koremenos ND). While all international dispute resolution provisions may entail delegation, the reverse is not true and delegation cannot be captured with a single dimension. Similarly, delegation to the International Monetary Fund is more than the IO's power to set conditions for international lending (Gould 2006; Martin 2006). Delegation to the World Health Organization and the World Trade Organization is more than voting rules among the principals and whether the staff is seconded from national governments or not (Cortell and Peterson 2006). Individual measures permit discrimination among cases by that single dimension but fail the broader requirement for discrimination useful across institutions, issue areas, and time.

Similar problems pervade most of the IR literature. However, the IR literature does pay attention to differentiating the goals of delegation. These works show that agents vary in the autonomy they possess to provide these services. This autonomy is indicated by the extent of oversight by the principal(s) and the resources available to provide the requested services. Martin's discussion of delegation to the IMF suggests three powers of agents useful to measuring their autonomy: the ability to propose policies that are costly for the principal to amend or reject, the freedom to collect information and to keep some information private, and the size of the staff (Martin 2002a).[25] Cortell and Peterson's analysis of IO independence captures the concepts of "agent autonomy" and "agent influence" with three indicators: whether IO staff decisions face detailed criteria and require approval by the principal or the staff has significant leeway in its behavior; whether the staff of the IO are independently recruited international civil servants or seconded from national governments; and whether decisions in the collective principal require a consensus or permit majority or even minority decisions (Cortell and Peterson 2006). [26] Thompson (2006), for example, uses staff recruitment as an indicator of agent autonomy in his analysis of UNSCOM.

While the measures employed in the various analyses are incomplete and therefore lack construct validity, they collectively illustrate the range of elements that should be included in a valid measure. Still, at least two key elements are not yet considered. First, there must be variation in the commitment by the principal(s) to the delegation contract. Under what conditions may principals – individually or collectively – rewrite or revoke delegation? The legalization literature's concept of "obligation" (Abbott et al. 2001) can also be applied to delegation because the contracts that contain delegation also bind the parties to the purpose expressed in the agreement (Koremenos ND). Second, there is no consideration of the resources possessed by the agent that are

---

[25] Martin measures delegation to the IMF by tracking changes in internal conditionality procedures, treatment of confidential information, and use of preconditions the staff requires a state to make before a program will be presented for approval (Martin 2002a).
[26] A minority decision rule can exist through weighted voting or when a subset of the principals is empowered to make decisions (Cortell and Peterson 2006).

necessary to fulfill its mission. Without staff and a budget, there is no “organization” and therefore no IO agent to receive delegated authority.

Measuring Delegation

The reviews of the literature in the previous section suggest a laundry list of variation in delegation. To operationalize delegation, I first separate these variables into one of three meta-categories: agent services, agent autonomy, and principal obligations. This section elaborates upon the significance of these dimensions of delegation and translates them into numerical indicators. In this metric, a number of indicators are combined to produce a single indicator of delegation. Not only do higher scores indicate greater delegation, but completely dissimilar acts of delegation should be comparable. The resulting metric is therefore applicable to any IO, from the WTO and ICC to the UN and the EU. This metric does leave out most variation in the characteristics of the principal; these characteristics are important to the specific functioning of the IO (and may influence institutional design) but are not characteristics of the delegation contract or the resulting processes.[27]

Whenever translating abstract concepts, even highly legalized ones, into quantitative measures there are likely to be some disagreements regarding the meaning of a provision for a particular act of delegation or its importance relative to other elements of the delegation contract. Therefore, while data for the metric is derived from official documents (government statements and the treaty documents themselves, when they exist), secondary sources, and interviews, any known controversies are noted. The

[27] A number of authors discuss the importance of the nature of the principal (Lyne, Nielson, and Tierney 2006a; Thompson 2006b; Tierney 2006)

process is aided by the attempts of states to have their formal interactions conform with international legal and diplomatic conventions to reduce the potential for misinterpreting the intended meaning of treaty provisions.

Agent Services

Actors become principals – delegate – when they hire an agent to perform services that the principal would find inefficient or impossible to accomplish on their own. Following the cartel model, agents may be able to assist states with bargaining, monitoring, and enforcing a NBCW agreement.

Bargaining

Putting aside the need to monitor and possibly enforce a NBCW bargain, states may lack information about the issue area relevant to decision-making or they may experience problems in proposing and selecting among policy options. Agents may therefore vary in their power to generate policy information and use it to solve problems that arise from incomplete contracting or changes in exogenous costs. This variation is reflected in differences in the formal and informal power to recommend and/or implement changes in the constitutional and/or regulatory structure and by the agent's ability to act without the specific approval of the principal. Less autonomous agents may assist policy negotiations and mediate in conflicts but must implement policies selected by the principal. More autonomous agents set regulations within their mandate without approval from the principal and make what amount to take-it-or-leave-it proposals to the principal to amend their mandate (Cortell and Peterson 2006; Martin 2002a).

Following this range, delegation for policy information starts at "0", where there is no delegation to produce policy information, and increases to "1" when the agent has the authority to recommend regulations and influence policy, “2” when it may set regulations and recommend policy changes (including negotiation of subsidiary contracts), “3” when it may recommend changes to the basic contract, and “4” when it can unilaterally alter its mandate. This range creates a 0-4 scale for policy information authorities.

For example, through the text of the CWC, states formally delegate to the OPCW the authority to negotiate subsidiary contracts and train national agents to implement the CWC inspection requirements (“1”) but also to influence major policy decisions (a “2”) through the OPCW Technical Secretariat’s Scientific Advisory Board, drafting of inspection selection protocols, and drafting of the budget (Grossi 2005; Reeps 2005; Trapp 2005).

Monitoring

Though prospective members of a cartel may negotiate a bargain in the present, they may dissemble their current interests or their interests may change in the future. Either possibility makes it useful to states to monitor each other’s behavior relative to the cartel agreement. Agents therefore vary in their authority to produce private information about the behavior and interests of principals and relevant non-principals. Routine monitoring systems generally describe a negotiated process that the principals have accepted as providing an acceptable probability of detecting violations of the agreement. In addition to generally requiring that inspections be limited to declared facilities, guidelines often limit the size of inspection teams, the information they may gather, the equipment they may use, and the duration of the inspection.

Endemic to any monitoring system is a process of reporting the results in some form, such that a single point is assigned for the presence of any baseline monitoring system that goes beyond self-reporting. Delegation of monitoring therefore occurs when an IO is empowered to select the time (length of notice), place, and/or intrusiveness of routine monitoring activities. For each of these three routine monitoring authorities possessed, the agent receives one additional point (+1) in measuring delegation.

Some agreements provide for monitoring processes that go beyond routine monitoring. Special investigation procedures (including challenge inspections) generally relax many of the limits negotiated for routine monitoring and therefore increase the delegation score by one point when such procedures can be initiated by a principal, by two points when procedures can be initiated by the agent, and by three when a non-principal, non-agent actor can initiate the procedures.

Therefore, a human rights court with the authority to hear and report a case would be a case of a baseline monitoring system (1 point); further authorizing such a court to investigate a case initiated by a non-principal, non-agent actor (+3) would receive a 4 out of a possible 6 in monitoring authority. As a second example, the CWC text provides for "challenge inspections" conducted by OPCW staff, but which must be requested by a principal. Including routine monitoring, the OPCW receives a "3".

Enforcement

A bargain is not fully self-enforcing if cartel members may benefit from cheating on the agreement. Enforcement measures may be necessary to align all cartel members' interests with the collectively selected goals. Enforcement activities at the domestic level can be usefully applied at the international level to distinguish between the prosecution or proposal for enforcement phase, and the implementation or sanctioning phase.

First, agents who are sources of expertise on issue-area specific information may be asked to apply this expertise towards evaluating compliance. States draw a clear distinction between the authority to (1) monitor and report on behavior and (2) judge behavior by issuing a legal declaration of compliance or non-compliance with an agreement (Official 2004b). An agent receives one point for the ability to verify compliance (+1). Verification powers vary not only in the authority to make such decisions, but also whether compliance decisions may be based upon alternative sources of information (+1 for information not revealed through institutional monitoring and reporting mechanisms), whether it is allowed to withhold from the principal some information upon which compliance decisions are based (+1), and whether the agent may use alternative information sources (+1). Delegation for compliance decisions therefore ranges from 0-3. The OPCW does not possess the legal authority to judge compliance but must inform the Executive Council when it has "doubts, ambiguities or uncertainties about compliance" (OPCW 1993:Art.8.C.40) and can withhold information obtained during inspections from the principals when doing so.

Second, unlike most domestic enforcement actions, where sanctions are usually prohibited without a legal judgment of guilt, international enforcement does not require the legal authority to determine an actor is violating its commitments. Enforcement is the application of costs by a sending actor upon a target actor to align the target's interests with those of the sender. An agent lacks enforcement powers if it possesses neither enforcement capacity nor pre-delegation of the authority to impose costs and would receive a "0" on a scale from 0-5. Delegation increases with the authority and capacity to deny membership benefits such as voting rights or access to the agent's services ("2"). Delegation increases for enforcement if the agent is empowered to recommend specific sanctions to its principals ("3"), decree compulsory sanctions by its principals ("4"), or employ an international coercive apparatus ("5"). Enforcement skips from zero to two to weight the importance of an agent's enforcement powers relative to other authorities.

Agent Autonomy

IOs with greater resources can better accomplish their tasks and are harder for principals to monitor. As Levi notes, "Revenue enhances the ability of rulers to elaborate the institutions…to bring more people within the domain of those institutions, and to increase the number and variety of the collective goods provided" (Levi 1988). The volume of resources committed through the delegation contract therefore provides an important indicator of the level of delegation.

One indicator of the level of resources is the number of staff at the IO. To put the staffing score into a scale comparable to the other delegation scores, the log of the number of regular staff as reported by the IO is the staff resource score. Therefore, when the CTBT-PTS was created in 1997 with only 9 personnel it received a score of 0.95, though this grew to 2.26 in 1998 (184 personnel) and it currently receives about 2.4 with 250-270 employees. For NBCW institutions, the effective range of this indicator is 0-4 but could be larger for institutions such as the World Bank or EU.

The size of the budget is also important. Here, I use the sum of percentage change in the formal budget in constant US dollars, beginning with the first full year of operation. While the absolute budget level does matter, normalizing all IO budgets to "1" for the first observation permits better comparison across time within the institution and facilitates comparison of growth in delegation across institutions by holding constant their initial starting points. For NBCW IOs, the budget size indicator ranges 0-6. Measuring only the formal budget likely understates the resources available to many IOs. This particularly is true for NBCW IOs where the volume of voluntary contributions is significant but are also difficult to reliably assess over time.[28]

While the volume of an IO's resources are important to its ability to provide the contracted services to its principal(s), these indicators are deliberately undervalued because they do not convey information about the autonomy to employ these resources.

Staffing

Principals prefer agents whose preferences are closer to their own. Before applying mechanisms to control their agents (designing rules and monitoring) or motivate them, principals screen and select among potential agents to ensure their preferences are aligned. Principals use this control to constrain policy outcomes and to target domestic constituencies, which I term the permeability of the IO.[29] The autonomy of the staff is reduced by the ability of principals and non-principals to influence staff behavior. IO permeability is high when major functions are carried out by officials from national governments on loan or appointed to the IO. It is expected that seconded staff will put the

[28] Figure 1 shows that formal voluntary contributions to the IAEA routinely amount to 10% or more of the Regular Budget. Most IOs, though, are unable to price cost-free experts, in-kind contributions of equipment, or other non-monetary assistance.

[29] This is essentially international patronage politics. Many states, especially poorer and less developed ones, use these international organizations to provide relatively high-paying positions to domestic supporters. Sometimes this is simply to justify the expense of membership in an international organization joined for other reasons (coercion, for example, by powerful states).

interests of their governments first and will consult it for instructions.[30] Staff autonomy therefore increases as the principals, both collectively and individually, lose influence over staff selection and later tenure employment prospects.

Very few IOs are likely to be comprised 100% of seconded or independent staff. At the highest levels of delegation over staffing, the organization's principals must usually approve the appointment of the head of the organization but the states have limited powers to influence staff appointments at lower levels. Therefore, executive directors will nearly always be subject to principal approval while the employment of individual janitorial, clerical, and security staff will nearly never be. Therefore, a two-thirds threshold is used for assigning points for staffing independence (e.g., an IO receives a "1" if >2/3 of the staff is not seconded).[31] The IO receives a point for staff that is not seconded (+1), a half point each (+0.5) for the absence of two staff appointment approval procedures, and a point for independent recruitment (no requirement to recruit from government-provided lists; +1). The maximum staff selection autonomy would be three for an IO with no seconded staff, no principal approval procedure and completely independent recruitment.

Even IOs that are highly autonomous in their powers of staff screening and selection may be required to balance the "geographic distribution" of the staff to prevent the agent's domination by any minority of states. There may also be some positions that

---

[30] Thompson (2006) highlights an interesting dilemma with UNSCOM, relative to UNMOVIC, in which an IO relying extensively on seconded staff may actually have access to greater (human) resources than one relying on independently recruited staff.

[31] The two-thirds (2/3) threshold was chosen because it is difficult to determine the exact number of seconded staff at an IO; both the IOs and the host governments face incentives to hide the relationship to avoid the appearance of bias (Buchanan 2005; Official 2005c). Further, almost all IOs will make some use of seconded staff, even if on a short-term basis as external contractors to train staff or provide other consulting services (Official 2005e; Reeps 2005).

are traditionally filled by a national of a particular state or region. Just as the head of the World Bank is traditionally an American and the head of the IMF is a European, the Deputy Director-General positions for Administration and On-Site Verification of the CTBTO are each traditionally allocated to a specific nationality, an American and Russian respectively, while the other senior positions are allocated to particular regions (Africa, Asia, Europe, or Latin America).

Financial Autonomy

When principals delegate to IOs, they must choose from a range of financing models. One key distinction in financing models is the degree of obligation for the financier: voluntary or compulsory? A financial commitment to delegation does not exist when states spend in a decentralized fashion based on collectively identified goals, such as when G8 states volunteer levels of debt reduction for developing states. At the lowest level of financial commitment to delegation, states may authorize actors to undertake specific acts for which they will reimburse costs, often according to an agreed upon scale or division among the principals. This is the case in a number of UN sanctioned uses of force.

The level of delegation increases as states empower an agent with quasi-taxation powers. There are a number of international organizations, especially the United Nations and its affiliated organizations, in which states by virtue of their ratification of the international treaty gain membership in the IO and a commitment to paying their share of the collectively determined annual assessment. This power is only quasi-taxation, as the contributions are practically voluntary because IOs often have little recourse if states choose to pay less than their assessment. IOs generally lack the “concentrated means of violence" (Levi 1988) to enforce a true taxation system but can deny membership benefits and shame states.[32]

While most scholars focus on the evolution of the power to tax as being crucial to the formation of the state, they overlook the presence of alternative financing relationships. Most religious institutions, for example, have used a combination of income sources to finance their activities: the Church received rents for property it owned (Braddick 2000) but also extracted tithes and received donations to pursue particular activities. Tithing evolved over time into a quasi-taxation system in which congregants were coerced through social pressures into making their donations, but it again has become a decidedly more voluntary endeavor. Other organizations that finance their activities through a mix of donations and for-profit services include the Red Cross and the Salvation Army.

The score for financial autonomy of IOs ranges from 0-5 overall and is "0" for IOs with decentralized and reimbursed spending by principals. IOs subsisting on voluntary contributions alone (such as UNSCOM 1991-1996) receive a "1", IOs with non-binding member assessments receive a "2", and those with quasi-taxation powers (legally obligatory assessments) receive a "3". Because they allow the IO to access resources outside those provided by the collective principal, IOs also are more autonomous when they have the authority to offer a la carte services for a fee (+1) and can accept voluntary/in-kind contributions beyond its assessment or quasi-tax levels (+1).

[32] The EU has the power to levy taxes directly upon the constituent states' citizens.

Management Autonomy

Delegation to an agent increases as the ability of principals to change the status quo decreases. Similar to public corporations, where oversight is largely by the shareholder-elected Board of Directors, many IOs include a management body comprised of a numerical minority of the principals. The Board of Governors of the IAEA, for example, is a sub-committee of the full Conference of States Parties and makes most decisions by simple majority using a one-state, one-vote rule. By comparison, the International Monetary Fund uses super-majority weighted voting and a small numerical minority of states can change (or block changes to) the status quo (Gould 2006).

The autonomy of the agent from management by the principals is inversely proportional to the percentage of principals who can formally modify policy decisions (including change the delegation relationship). In most cases, the number of principals required to change the status quo is fewest on an IO's Board and greatest in meetings of its full membership. Therefore, the indicator is the percentage of the total membership who can implement a substantive change through the executive body, subtracted from one (1 - %). An extra point is awarded if there is a role (standing) for non-principals (+1). Therefore, the UN Security Council would receive a "0" as policy decisions require a consensus among the permanent members. The IAEA receives "0.82" in 1958 when as few as 18% of the total membership could implement changes through the Board. For an agent with multiple principals (as opposed to a single collective principal), then each individual principal could change the delegation contract and the IO would receive a "0" (Nielson and Tierney 2003).

Principal Obligations

Obligation occurs when a state accepts rules and commitments in a legally-binding manner such that other actors can assert established international mechanisms and processes when it does not fulfill stated obligations (Abbott et al. 2001). The obligation decreases to the extent that an agreement permits escape temporarily from the treaty obligations or from a specific clause, withdrawal from the treaty, the ability to opt out of treaty requirements, or reservations that exclude or modify the legal effect of specified provisions of a treaty in their application to that state (Koremenos ND). The delegation score decreases by one point (-1) for each such class of clause because such clauses can erode the credibility of commitments (Rosendorf and Milner 2001:829) to the act of delegation. Obligation increases to the extent the agreement includes specific guidelines for domestic implementing legislation, including enforcement mechanisms, implementing bodies, and deadlines for passing such legislation. The delegation score increases by one point (+1) for each such class of clause.

Summary of indicators

These indicators are different than what one would expect if the concept being measured (or translated) were "cooperation". The legalization literature examines, in addition to delegation, the role of precision and obligation in legalized interactions between states (Abbott et al. 2001; Kahler 2001; Koremenos ND). The depth of cooperation could also be indicated by the extent of compromise (differences between ideal points and outcomes).

This operationalization of delegation focuses instead on the interaction between state principals and their agents: the breadth of the services the agent offers, the discretion to provide those services as it sees fit (resource and management autonomy), and the extent to which the principals are legally obligated to maintain the commitments established in the delegation contract. (The indicators are summarized in Table 2.1.) In this manner, this metric theoretically discriminates delegation from other similar concepts. The remainder of this chapter presents the result of applying these indicators to the selected cases of nonproliferation institutions.

Application

I argue in Chapter 1 that states use IOs for NBCW issues because they facilitate bargaining, monitoring and enforcement of their NBCW agreements. Testing these arguments requires data on delegation, and the existing literature provides neither the framework nor data for doing so. Having offered a new operationalization of delegation, I present two applications of the measure to NBCW IOs to gather data for testing and to demonstrate that the measure is a useful translation of the delegation concept (e.g., it possesses face validity). Data for the indicators were gathered from published IO reports, supplemented by interviews with IO and government officials and by secondary sources. The results also demonstrate the discriminant validity of the metric. The substantial variation not only across institutions but also within institutions across time shows the metric's ability to capture institutional change with respect to delegation.

The first application examines delegation to the International Atomic Energy Agency (IAEA) by two treaties (the Statute of the IAEA, creating the IAEA in 1956, and the Nuclear Non-Proliferation Treaty, which expands the IAEA's authority in 1970) and substantial extensions of the IAEA's authority to implement its mandate by the principals' agreement to revised safeguards (INFCIRCs \26, \66, \153. and \540). The second application examines delegation by the Comprehensive Test Ban Treaty (CTBT) to the CTBT Organization (CTBTO), paying particular attention to the differences between its current form in the Provisional Technical Secretariat (PTS) and the anticipated CTBTO if the CTBT enters into force. Summary indicators for other identified cases of delegation are reported at the end of this section.

The International Atomic Energy Agency (IAEA)

The Statute of the International Atomic Energy Agency came into force on 29 July 1957, establishing the IAEA. The IAEA was created to help divert scarce nuclear materials from military uses to peaceful ones by offering assistance with costly peaceful nuclear energy programs. In exchange, the recipients would accept IAEA verification, or "safeguards", of the non-diversion of nuclear materials. Safeguards could take many forms but used on-site inspections to measure the flows of nuclear materials: differences between the measured and the expected quantities would be evidence of a diversion.[33]

The extension of safeguards over national nuclear programs was intended to occur naturally as states contracted with the IAEA for assistance. However, the IAEA never received from the major nuclear suppliers the resources necessary to become such a provider. The extension of safeguards came as a result of the major nuclear suppliers demanding them of recipient states as a condition for trade in nuclear materials and technologies. The major extension of IAEA safeguards occurred under delegation by the 1968 Nuclear Non-Proliferation Treaty and by various nuclear weapons-free zones.[34]

---

[33] The Board of Governors chose to measure flows of nuclear materials to keep inspectors from being able to learn trade secrets. As long as quantities matched at two points, there was no need for the IAEA to know the technical details of what transpired between.

[34] Nuclear weapon-free zones (NWFZs) are regional treaties abolishing nuclear weapons programs or possession in the territories controlled by their member states but are not discussed

To tell a more natural story about the IAEA's history and powers, the discussion begins with the structure of the Agency to describe how its bodies relate to each other and its collective principal. The discussion then turns to the IAEA's ability to reveal private and policy information, the autonomy to provide these services, and states' obligation to comply with policy outcomes set by the Agency.

Management Autonomy

As established by international treaty, the IAEA includes the General Conference, the Board of Governors, and the Technical Secretariat. The General Conference is the collective principal: it is the top-level policy body of the IAEA, composed of all member states. It approves the Board of Governor's annual report, elects the Board of Governors (subject to constraints), and approves amendments to the Statute, applications for membership, and the Agency's annual budget (IAEA 2002). The General Conference also must approve the appointment of the Director General (Fischer 1997).

As a committee of the whole, the Board of Governors is the agent of the General Conference, but its autonomy makes it more powerful. The Board is responsible for oversight of the day-to-day operations of the secretariat, approving safeguards agreements, appointing inspectors, and judging safeguards compliance (Fischer 1997). The Board traditionally makes these decisions by consensus, though the Statute calls for a two-thirds majority to approve the budget and a simple majority for any other issues. The General Conference approves the budget but may not amend it; it can only return it to the

---

in this project. They generally follow the same pattern of delegating to the IAEA the authority to implement safeguards, similar to the language used in the NPT (Jensen 1974; McKnight 1971; Pilat 2005; Quester 1973; US Senate 1978; Wittner 1997).

Board for revision. The Secretariat is the bureaucratic arm of the Board and implements its policies.

While a number of collective and individual principals utilize the IAEA as their agent, the Agency is only accountable to a single, collective principal: the General Conference. The IAEA may submit reports to the UN like the UN's specialized agencies, but it is not a specialized agency (US Senate 1969a). Likewise, regional NWFZ agreements and the NPT do not provide the IAEA with guidance in implementing its delegated safeguards responsibilities. Given that the Statute does not provide for principals or non-principals to individually renegotiate aspects of the contract or initiate any process other negotiation of safeguards agreements, the minimum number of principals who can initiate major changes to the mandate or ongoing operations of the treaty is a simple majority of the Board of Governors. As an indicator of delegation, "Management Autonomy" increased from 0.818 in 1958 to 0.843 in 1971 as the number of states members increased but Board seats did not. Autonomy decreased sharply in 1972 to 0.777 with the expansion of the Board. This expansion occurred explicitly to reduce the autonomy of the Secretariat from those states who would bear the weight of safeguards under the NPT (Fischer 1997:90-93). Management autonomy has since slowly increased with a growing membership but a constant number of representatives, reaching 0.827 in 2005. Without comparable data on other IOs, this number may appear meaningless. However, that the score is relatively high reflects the agent's autonomy from its collective principal and the change over time well reflects the relative ability of a small proportion of states to impose a change in the status quo upon the broader membership.

Agent Services

The IAEA was created to provide many services to its members related to the exploitation of peaceful nuclear energy, but the Agency is primarily known for its safeguards: defining what constitutes assurance that nuclear materials are not diverted from peaceful to military applications (policy information), implementing these rules by monitoring state nuclear activities (private information), and issuing legal rulings on rule compliance (enforcement).

1. Bargaining

The authority of the IAEA includes implementation of safeguards over any nuclear arrangement between states "at the request of the parties" and also over aspects of a state's various nuclear activities "at the request of a state" (McKnight 1970). The first such safeguards were requested by Japan in 1956 and a bilateral agreement was negotiated within the Board by 1959. The process was so delayed by contentious politics that the Board resolved to avoid such political battles in the future by issuing a generic or "model" agreement that would be the framework for all future bilateral (IAEA-state) safeguards agreements. However, the resulting Information Circular #26 (INFCIRC/26) was not approved until 1961 (McKnight 1971).[35]

Though not consulted on INFCIRC/26, the INFCIRC/26/Add.1 (1964) and subsequent INFCIRC/66 (1965) and /66/Rev.2 (1968) model agreements were negotiated among the Board members with minimal advice provided by the secretariat. The decision to delegate to the IAEA the implementation of NPT safeguards by the parties to the NPT,

---

[35] IAEA official documents, including model safeguards, are announced through "Information Circulars", hence the "INFCIRC/" designation.

many of which were already transferring their bilateral agreements to the agency, reflected their trust in the agency (Official 2005e).[36] The Safeguards Committee was created by the Board of Governors in 1970 to advise it on designing a safeguards model to implement the 1968 NPT (Jensen 1974), establishing a formal and significant role for the Secretariat to provide advice. In this year, delegation for policy information authority increases from “0” to “1”.

Little changed for many years until after the Gulf War, when what the IAEA found in Iraq created new opportunities for the IAEA to assert its policy expertise as “the backbone of the non-proliferation regime” (Muller, Fischer, and Kotter 1994). An *ad hoc* Safeguards Committee was reestablished in 1991 that determined that some solutions were possible within the existing INFCIRC/153 framework while others were not, and the Agency took the lead in translating the guidelines into a legal text (Official 2005d).[37] The Board also established in June 2005 a standing Committee on Safeguards and Verification to examine further strengthening of safeguards. Previous committees on safeguards were *ad hoc*; this permanence facilitates future proposals for change to the status quo (Official 2005b). This change also provided a formal role for the Secretariat in recommending major policy changes, increasing its policy information authority to “2” in 1995. This authority was further expanded as the Secretariat altered the scope of its authority with Board acceptance of the Additional Protocol and with its leadership role in international negotiations to amend the Convention on the Physical Protection of Nuclear

[36] As Lawrence Scheinman states, delegation to the IAEA under the NPT “was a vote of confidence in its ability to undertake even weightier responsibilities with important arms control overtones…catapulting it from the periphery to the center of the international political system” (Scheinman 1985:29).
[37] The Secretariat may have also had greater freedom in writing INFCIRC/540 than INFCIRC/153 because of the end of the Cold War (Official 2005d).

Materials, both in 1998. In this year the IAEA earned a “3” for policy information authority.

The IAEA also provides policy expertise in other areas. The Agency interprets its responsibilities under the NPT (Article III.2) as including the specification of national export controls so that states are aware when safeguards are required as a precondition for supply. The IAEA’s Nuclear Exporters (or Zangger) Committee defines which nuclear-related exports would require states to accept IAEA safeguards (Bertsch, Cuppitt, and Elliott-Grower 1994) and later agreed to exchange information about exports or licenses for exports to any NNWS not a party to NPT through confidential reports circulated among members (Schmidt 1999). The IAEA also provides advice on health and safety practices, on fissile material protection measures, and on conversion of reactors from highly enriched to low-enriched or natural uranium. In some cases this advice is designed to make nuclear energy safer to use, and in others the advice fosters nonproliferation goals. The IAEA therefore leveraged its expertise to increase its policy information authority from an initial “0” in 1957 to a “3” after 1998.

2. Monitoring

The early model safeguards agreements, INFCIRC/26 (1963), INFCIRC/66 (1965) and INFCIRC/66/Rev.2 (1968), incrementally expanded the facilities the IAEA could safeguard but also included an “Inspectors’ Document” that placed restrictive conditions upon the selection and behavior of inspectors: states had to approve individuals as inspectors for their territory; inspectors had to provide advanced notice regarding the details of the intended inspection, and were subject to significant constraints on their movements during inspections (Fischer 1997). The capacity to reveal private information was present but very limited, earning the Agency a "1" for possessing a basic monitoring system.

The NPT requires all non-nuclear weapons states (NNWS) to accept IAEA safeguards against the non-diversion of "all source or special fissionable material in all peaceful nuclear activities within the territory of such State, under its jurisdiction, or carried out under its control anywhere" (NPT Art.III Para.1). The IAEA determined that to implement this requirement, safeguards should be extended over nuclear materials (but not facilities) beginning in the fuel cycle when materials were sufficiently pure for nuclear uses. The resulting INFCIRC/153 limited routine inspections to predetermined points and placed limits on the transmission of information by the IAEA. However, INFCIRC/153 also created safeguards that were far more technical, systematic, and quantitative than INFCIRC/66's broad and often optional statements (Muller, Fischer, and Kotter 1994). The broad routine access to facilities is sufficient to increase the private information (monitoring) authority score from "1" to "2".

However, INFCIRC/153 also empowers the agency to conduct any-time, any-place "special inspections" if required by extraordinary circumstances. This power was significant – Muller, et al. state "special inspections require the consent of the state concerned but if it is not given, the IAEA may command the state to comply". Prior to 1990 the Agency had few occasions important enough to suffer the political risks of using them (Rockwood 2002). Delegation for monitoring increases to a "3" in 1970 with the addition of the Secretariat's authority to select the time of inspections and to trigger special inspections under the NPT-related responsibilities.

The INFCIRC/153 safeguards system remained in place and largely unchanged for two decades but were designed only to verify the accuracy of declared activities and that diversions had not occurred from those declared activities (Official 2005e).[38] The embarrassing finding that Iraq had constructed an entire parallel but covert nuclear program, undetected by the IAEA, led to a "tectonic shift" in the IAEA's mandate (Official 2005f). Even before the IAEA and UNSCOM were in Iraq, it was clear Western intelligence agencies knew more about Iraq's nuclear program than the IAEA. Talks within the IAEA began in 1993 to identify the problems and potential solutions.[39] A Safeguards Committee determined that some proposals could be adopted within the existing INFCIRC/153 framework, including requiring additional declarations of information, broader use of unannounced or "no notice" inspections, improved remote monitoring of facilities, and the adoption of environmental sampling as an authorized technique (Rockwood 2002).

To implement the other proposed safeguards enhancements, the Board negotiated and approved INFCIRC/540 on 11 June 1998, establishing the Additional Protocol (IAEA 1998).[40] States choosing to accede to the INFCIRC/540 are required to provide greater information about and access to the entire nuclear fuel cycle, permit short-notice access to all buildings on declared nuclear sites, provide reports on their nuclear exports and imports in order to permit the IAEA to compare lists to develop a fuller

[38] Only four NNWS (Cuba, India, Israel and Pakistan) are currently covered only under INFCIRC/66/Rev.2; all NPT states with any significant nuclear activities have accepted INFCIRC/153 safeguards or better and the IAEA is unlikely to conclude additional safeguards under INFCIRC/66/Rev.2 (IAEA 1998).
[39] The talks were expected to last two years and hence were named the "93+2 Programme".
[40] The full name of the model agreement is "The Model Protocol Additional to the Agreements between States and the International Atomic Energy Agency".

understanding of states' nuclear trade, accept an expanded right to environmental sampling, and recognize the right to multiple-entry visas and access to satellite communications technology during inspections (IAEA 2002; Rockwood 2002; Schmidt 1997).[41] To balance the increased reporting requirements, the IAEA adopted stronger confidentiality policies under Article 15 of INFCIRC/540 (Corr.) and under GOV/2897 (Rockwood 2002). The right to any-time, any-place inspections and to no "managed" access during special inspections corresponds to delegated monitoring authority increasing under INFCIRC/153/Rev.1 to "4" in 1995 and to a "5" under INFCIRC/540 in 1998.

Among the gaps identified were that suppliers in the NPT were required to report their exports of nuclear materials but not exports of nuclear reprocessing or enrichment plants, that safeguards could not detect parallel clandestine nuclear programs, and that the IAEA needed greater support from national intelligence agencies (IAEA 1998; Rockwood 2002). The Board of Governors, therefore, permitted the Secretariat to establish an internal "intelligence" group to collect and use IAEA, open-source, and national intelligence information (Official 2005f) to better determine whether undisclosed nuclear activities may be occurring (Official 2005d; Scheinman 2005). The expanded ability to incorporate non-inspection information, in combination with the discovery that national intelligence services knew more about Iraq's weapons programs than the IAEA, has made the Agency more willing to make use of national intelligence in performing its

[41] While some argue that, "without the Additional Protocol, the traditional safeguards system is pretty useless" (Official 2004b), accession to INFCIRC/540 is not currently considered by the IAEA to be necessary for compliance with NPT commitments, though the IAEA is considering seeking the approval to make it mandatory (Official 2005b).

responsibilities (Traub 2004).[42] The expanded intelligence capacity is currently used to better target inspections. However, there are proposals to shift to an "integrated safeguards" system that would allow compliance decisions to be based upon these broader sources of information and thereby minimize inspections of some states (Scheinman 2004).[43]

In addition to safeguards responsibilities delegated to it by the NPT, the IAEA has been delegated authorities by several international organizations. Similar to the arrangement under the NPT, the IAEA oversees safeguards required by the 1967 Treaty of Tlatelolco (a NWFZ, for Latin America) and the 1986 Rarotonga Treaty (a NWFZ for the South Pacific). In 1991, the IAEA (along with UNSCOM, see below) was delegated responsibility to verify the disarmament of Iraq under UN Security Council Resolution #687. While the monitoring powers of the IAEA have expanded significantly over the past five decades, one notable abdication of its statutory powers and therefore abdication of delegated authorities occurred in 1963 when the Board removed Health and Safety monitoring from safeguards with the first model safeguards (McKnight 1971). The Board could reintroduce these requirements but has chosen to pursue this aspect of its mandate through its technical assistance program.

3. Enforcement

A technical report on national noncompliance originates in the Secretariat and is transmitted through the Director-General to the Board of Governors, which makes the

---

[42] While the legal environment may have shifted to permit the use of national technical means (NTM) in determining when to request more information from a state or seek special inspections, the Iraq experience also increased the willingness of states to share intelligence.
[43] This change is welcomed by "safe" states that bear a large safeguards burden, such as Japan and Germany, but rejected by states whose compliance is more suspect, such as Iran.

legal judgment regarding noncompliance. The IAEA, empowered to make the legal declaration that parties are violating their obligations under their safeguards agreements and/or the NPT, is among the few actors empowered to declare that a sovereign state is in violation of their international commitments. The Secretariat's reports are transmitted simultaneously to the Board, the UN General Assembly and UN Security Council. As IAEA Director General Mohammad El Baradei stated, "I have the right to sit in judgment, where [UN Secretary-General] Kofi Annan does not. And that makes many countries uncomfortable. We're in the driver's seat, and they're not." (Traub 2004) The DPRK's noncompliance created the IAEA's first opportunity to exploit an agenda setting power that is reserved for recognized states (whether UN members or not), and UN organs (the UN Secretary General, the UN General Assembly, and other bodies), but does not otherwise provide standing to NSAs.[44]

The legal authority to determine compliance earns the IAEA +1 point for compliance authority.[45] The Secretariat was also expected, from the outset, to withhold some information from its principals and the public in order to protect confidential business information gathered during the monitoring process that was not relevant for reporting on compliance, earning it an additional +1. Finally, in 1995, the Agency was allowed to base compliance decisions on non-inspection sources of information, bringing compliance authority from a "2" to a "3" (out of "3").

---

[44] Other independent international organizations with an official relationship with the UN include the WTO, which has connections to the International Court of Justice (ICJ), and the OPCW and CTBTO, which both report to the UN General Assembly (see: http://www.un.org/aboutun/unchart.pdf; accessed 28 February 2005).
[45] Some may doubt the efficacy of this authority. Compliance and enforcement powers of IOs are discussed in depth in Chapter 7.

The enforcement powers of the Board are limited to "direct curtailment or suspension of assistance being provided by the Agency or by a member, and call for the return of materials and equipment made available to the recipient member or group of members" (Art. XII Para. 7C). It may also "suspend any non-complying member from the exercise of the privileges and rights of membership" (ibid.). The enforcement power of the IAEA is that it "serves as a trigger mechanism. It can tell the world and should tell the world when the possibility of proliferation is something we should be worried about in a particular country." (US Senate 1977a) When it determines whether states are in violation of their obligations, it may enforce compliance by denying membership benefits and reporting such violations to the UN. The IAEA therefore receives a "2" out of "5" for enforcement.[46]

Agent Resource Autonomy

1. Budget Autonomy

Member states are required to contribute to the budget of the IAEA according to a scale of assessment guided by the assessment process used in the UN system. Paying a centrally determined assessment is required to remain in full compliance with a member's obligations, earning the IAEA a "3" for its quasi-taxation budget authority. The negotiators believed assessments would be minimal as regular budget costs from implementing safeguards were to be offset significantly by profits from IAEA ownership of nuclear facilities, the loaning of fissile materials, and the provision of other services. This belief ended when the first commercial nuclear power reactors came on-line because

[46] Chapter 7 (Enforcement) discusses the IAEA's enforcement power to terminate nuclear assistance between members, which comes close to quasi-public enforcement (a "4").

they proved the feasibility of a private market in peaceful nuclear technology (Official 2005d). From its inception then, the IAEA would receive +1 point for financial autonomy from its authority to offer services for a fee.

The Board also decided at the outset that the Agency would fund technical cooperation projects through voluntary contributions rather than assessments. The Board has kept safeguards spending in rough balance with the promised voluntary contributions for technical cooperation, though resistance by advanced states to developing states' demands for technical cooperation beginning in 1970 with the expansion of the Board resulted in a zero-growth policy for the regular budget that began in the early 1980s (Moore 2004). This left the safeguards mission underfunded, especially once the growth in the nuclear industry was taken into account (Scheinman 2004) and states seeking to support safeguards did so through voluntary (and off-voluntary) contributions outside the regular budget (Bunn 2004).[47]

Extrabudgetary contributions allow these states to provide support for programs beyond that which the Board or the General Conference are willing to support (Official 2005b). Western states, especially the US but also USSR/Russia, have provided significant support through voluntary contributions and through off-voluntary contributions such as cost-free experts, staff training, equipment, and research and development (Official 2005b).[48] The IAEA therefore receives +1 point for its ability to

---

[47] The voluntary contributions reported in the budget, which does not include many "in-kind" contributions of goods and services, exceeded 20% of the amount assessed on the member states in 11 years and was less than 10% in only 2 years.
[48] The effect of this is discussed in Chapter 6.

accept voluntary contributions. In short, the IAEA has high resource autonomy and receives a “5” for budget autonomy for all years in existence.

2. Size of budget

The Regular Budget grew steadily from the 1960s as it took on increasing safeguards duties (see Figure 2.1). Correspondingly, the delegation indicator for the size of the budget, the sum of the annual percentage change in the budget in constant dollars, increased from 0.84 in 1958 (in its second year in operation the Regular Budget declined) to 5.59 in 1995. It is interesting that there are a number of years in which the IAEA budget either did not increase sufficiently to keep pace with inflation or actually declined, representing a decrease in delegation. In particular, the completion of denuclearization activities in Iraq and South Africa allowed reduced spending. The budget declined during 1996-2001 to 5.32 before again increasing after 2001 (Figure 2.1). Following six straight years of budget declines, in 2004 a major budget increase of 20% over three years was approved to cope with the increased burden of implementing expanded safeguards over a larger population of states (Official 2005b).

3. Staffing

The Statute describes the Board in detail but not the bureaucracy. It only provides for a Director General to be the “chief administrative officer” of the agency responsible for “the appointment, organization, and functioning of the staff” under the control of the Board (Art. VII Para. A,B). The Board therefore has wide latitude in constructing the agency. The Board recommends the Director General to the General Conference for confirmation, but also approves the appointment of his most senior advisors: the Deputy Director Generals and department heads. The Board apparently only rarely objects to the

Director General's choices (Official 2005c), but this does not mean their preferences are not taken into account by the Director General.

Like many other international organizations, the appointment of these senior positions is somewhat constrained by the expectation that certain positions be held by particular nationalities. For example, the position of Assistant Director General for Administration in the Agency goes to an American (same is true at the CTBTO), the reactor technology position to a Soviet (now Russian), the technical cooperation and assistance position to a person from a developing state, and the verification position to a developed state that is also a NNWS "because the NWS are not being inspected and it would be like the fox guarding the chicken coop" (Official 2005d; Scheinman 2005). Finally, the Board retains the right to appoint individuals as inspectors.

The influence of states over the selection of individual staff continues below the senior staff. Open positions are publicly announced at all levels prior to the Secretariat filling them; if states wish to promote an individual for that position they will communicate their interest on that person's behalf to the staff. Some states do apply pressure to see their nationals appointed to the extent "entitled" by their assessed share of the budget or norms of equitable geographic representation, including making "veiled threats or promises of side-payments through voluntary contributions" in order to see their national be put into a desired position (Official 2005c). More powerful states tend to concentrate on positions at only the most senior levels or simply notify the appropriate people when their nationals are interested in a position (Official 2005c).

In general, however, nearly all positions are independently recruited international civil servants and few of the Agency's positions require explicit principal approval for appointments. The IAEA therefore receives a “2.5” for staff selection autonomy from 1957 to the mid-1990s, after which delegation for staffing increases to “3” with the Board ending the right of states to oppose the appointment of their own nationals. Seconded personnel have always been important to the Agency’s ability to fulfill both its safeguards and technical cooperation missions, but their number was never great (always <1/3) and has decreased over time. Their purpose has also appeared to have changed from a means of influence to simply facilitating the agency’s goals.

The Agency took steps in the mid-1990s to further reduce the influence of states over the selection process by eliminating a government veto over the appointment of their nationals (Official 2005f). Of course, one primary example of this change was when El Baradei ran for and won the Director-Generalship without the approval of Egypt, which had nominated another person (Scheinman 2005).

The influence of individual states over the day-to-day activities of the agency through staff screening and selection is not uniform. In areas where the Agency has less of a mandate, staff must work more closely with states to accomplish Agency goals (Official 2005b). The Director-General wants to do things that the great powers will support and provides multiple institutionalized avenues for the Agency to receive advice from member states and from experts, including permanent standing advisory committees at all bureaucratic levels. Nevertheless, the Agency does actively attempt to constrain national influence (“permeability”) through its philosophy of unbiased service, limits on the number of a state’s nationals in each area of operations, and increased regulation of staff interactions with the outside world (Official 2005d). The staff is careful to point out that the Agency does not ask for permission to pursue new policies if the authority is already there to do so (Official 2005b).

The size of the staff has increased over the past fifty years (see Figure 2.1). In general, this growth has been incremental but also occasionally negative.[49] The size of staffing indicator is 2.59 in 1958 (log of 393) and grows to 3.35 in 2002 (log of 2,229).

Obligation

Membership is not a precondition for accepting safeguards or vice-versa. Therefore, some safeguarded states are not members and some members have no significant nuclear materials to safeguard. However, once a safeguards agreement is negotiated and accepted by both the IAEA and the state to be safeguarded, the obligation is in force until the state withdraws from whatever treaties require IAEA safeguards, such as the NPT or NWFZs. Member states "may withdraw from the Agency by notice in writing to that effect given to the depositary Government", though withdrawal "shall not affect its contractual obligations entered into…or its budgetary obligations for the year in which it withdraws" (Art. XVIII Para. D,E). Some have argued that even after withdrawal from the NPT, a state (e.g., North Korea) may be obligated to prove compliance with its commitment up to the point of withdrawal. The Statute does not require domestic implementing legislation and does not include releases from the treaty's obligations described as reservations and escape or opt-out clauses. The IAEA receives a "3" because the Statute permits withdrawal (-1) and does not mention other provisions noted as increasing or reducing obligation to the agent.

[49] The data indicate a jump in staffing in the late 1980s, however the spike in staffing is an artifact of changes in the IAEA's reporting of staff; beginning in the late 1970s the IAEA reported conflicting numbers in its Annual Report and its annual Budget Report.

IAEA Summary

The combined delegation score for the IAEA is 18.76 at its formation in 1958 and this increases over the subsequent decades to 23.60 in 1970 and 32.60 in 1998. The delegation score increases as the IAEA itself grows in size and acquires greater contracting and monitoring authorities over time. These numbers appear to be an accurate translation of the historical evidence for delegation to the IAEA. In particular, these indicators reflect the extent to which the successes of the IAEA over time transformed it from a purely technical agency to one with important effects upon international politics (Scheinman 1985). These results are summarized in Table 2.2 and Figure 2.2.

The Comprehensive Test Ban Treaty (CTBT)

Negotiations in earnest for a comprehensive nuclear test ban began in the early 1990s and the Comprehensive Test Ban Treaty (CTBT) was opened for signature in 1996. The Comprehensive Test Ban Treaty (CTBT) imposes the basic obligation upon the States Parties to not conduct, nor encourage or cause another to carry out, a nuclear explosion.

The CTBT has since been ratified by many states but it has not yet entered into force because 9 of 44 "Annex 2" states have not ratified the treaty.[50] However, the CTBT text provides for a "Preparatory Commission" of the signatory states to be created to prepare for the entry into force of the treaty. The PrepCom has therefore overseen the development of the Provisional Technical Secretariat of the Preparatory Commission of

[50] Annex 2 states are those states with significant nuclear programs whose ratification is required for the treaty to enter into force. Those eleven which have not ratified include: the PRC, the DPRK, Egypt, India, Indonesia, Iran, Israel, Pakistan, and the US (See: http://www.ctbto.org/).

the CTBT (CTBT-PTS, to differentiate from the future CTBT Organization or CTBTO) to begin developing the monitoring and verification services called for in the treaty.

The CTBT is interesting because it has not yet entered into force, and may never do so, but still creates an agent to provide services to its principals. The remainder of this discussion therefore considers both the delegation as is currently occurring to the CTBT-PTS and as provided by the CTBT to the future CTBTO. As the PrepCom anticipates the CTBTO structure as defined by the treaty, and is composed of the signatories to the CTBT, radical changes are unlikely if the CTBT enters into force. Still, key differences remain between the provisional and the prospective body as a number of CTBT processes have yet to be activated.

Obligation

In addition to the basic prohibition against nuclear testing, the CTBT creates the CTBT Organization (CTBTO) to build, operate, and maintain a global nuclear test monitoring and inspection system. The CTBT also requires national implementation measures, which include designating a National Authority to liaison with the CTBTO and other states, domestic legislation prohibiting treaty-proscribed activities, and assisting other states with treaty implementation. The treaty states that there shall be no reservations upon the basic treaty text and annexes, and that any reservations to the Protocol and its annexes shall not be incompatible with the treaty (Art.XV). The treaty provides for no escape or opt-out clauses, though parties are permitted to withdraw from this unlimited duration treaty with six month’s notice.

The CTBT in force would receive a score of “5” for obligations. Beginning with a baseline score of 4, the CTBT earns +1 for requiring domestic implementing bodies and another +1 for requiring domestic enforcement mechanisms, but also earns –1 for permitting treaty withdrawal. Until entry into force, however, it does not impose obligations and receives a “0”.[51]

Management Autonomy

The CTBT provides for three bodies within the CTBTO: the Conference of the States Parties, the Executive Council, and the Technical Secretariat. The Conference of the States Parties is the collective principal and “shall oversee the implementation of, and review compliance with, the treaty”. Practically, the Conference elects the Executive Council, approves the reports and the budget recommended by the Council, approves the appointment of the Director-General of the Technical Secretariat upon recommendation of the Council, and, in cases of noncompliance with the CTBT, recommends to the States Parties “collective measures which are in conformity with international law” and/or will “bring the issue to the attention of the United Nations” (Albright 1999).

However, as the Conference of the States Parties meets only annually,[52] the Executive Council is the “executive organ” of the CTBTO and is comprised of 51 States Parties elected from the Conference. It shall supervise the Technical Secretariat “in conformity with the recommendations, decisions and guidelines of the Conference”, recommend budgets, negotiate and supervise arrangements with states and other

[51] The Vienna Convention on the Law of Treaties (1969) obligates states to fulfill the provisions of treaties they have signed which have not entered into force unless they take positive steps to renounce the treaty. However, this aspect of international law is apparently less clear when it comes to treaties whose “entry into force is not unduly delayed” (1969).
[52] The Conference may also meet when a Special Conference is requested, including an Amendment or Review Conference, according to their specific processes: s Special Conference occurs when the CSP during a meeting votes to hold one, when the Executive Council requests one, or when a majority of the States Parties requests one (Art.II). A Review Conference shall occur every ten years unless otherwise decided by a majority of the States Parties (Art.VIII).

international organizations (including verification agreements), recommend changes to the treaty, and act on requests for reports and challenge inspections (SAROV 2004). Decisions on all matters of substance brought before the Council shall be by a two-thirds majority. Amending the text and Annexes of the CTBT requires a majority of parties to approve an Amendment Conference, at which a majority of them must approve the amendment with no states voting in the negative, and then all States voting in favor must ratify the amendment before it can enter into force (Art.VII). The Technical Secretariat is managed directly by the Director-General, who is nominated by the Executive Council for approval by the Conference. If the CTBT were in force, the structure of the EC combined with voting rules and the number of "members" would earn the CTBTO a management autonomy score of 0.26 in 2005.

While the PrepCom exists as a temporary body to implement the CTBT until its entry into force, delegation to PrepCom differs substantially from that envisioned for the CTBTO. The PrepCom consists of two organs: a plenary body of the States Signatories and the Provisional Technical Secretariat (PTS). The plenary body oversees the PTS, just as the Conference would the CTBTO, but it lacks the power to contemplate amendments or raise questions regarding compliance.

Oversight of the Secretariat is primarily through three subsidiary committees of the whole that make recommendations to the PrepCom on administrative issues such as budgets and personnel issues (Working Group A) and on verification issues (Working Group B). The two Working Groups are issue-cluster groups composed of interested state delegations but have no fixed membership; usually about 30-40 of the 175 signatory states are active. There is also the Advisory Group, which includes about a dozen individual experts nominated by states but working in a private capacity on a wide range of budgetary and administrative issues; any recommendations are voiced to Working Group A (Corden 2005). These three groups propose recommendations to the PrepCom for approval before the change becomes a mandate for the Secretariat (Ballon de Amezaga 2005). The PTS, because of its provisional nature, has remained ad hoc (Official 2005g) and can only assist the States Parties in their negotiations (Kvok 2005). This permits the States Parties greater ability to interfere in how the Secretariat accomplishes its limited mandate (Ballon de Amezaga 2005). In reality then, the CTBT-PTS has little or no autonomy from its collective principal, the PrepCom, and earns a “0” for management autonomy.

Agent Services

The CTBTO is the dominant mechanism for implementing the CTBT, as signified by the importance in the text relative to national implementation (2 pages) given to the CTBTO’s basic organs (22 pages), structure of verification mechanisms (34 pages), dispute settlement procedures (4 pages), International Monitoring System (12 pages), On-Site Inspection process (48 pages), and the preselection of its International Monitoring System’s monitoring stations and analysis laboratories (30 pages).

1. Bargaining

Most of the processes in the IAEA Statute that were left to the Board of Governors to decide after treaty creation are specified within the CTBT. For example, changes to parts of the Protocol that describes the International Monitoring System, On-Site Inspection System, and Confidence Building Measures require proposals be approved by the Executive Council and stand if no State Party objects within ninety days;

if a state party objects then the proposal is tabled at the next Conference of the States Parties. While the Technical Secretariat does have the authority to negotiate verification-related agreements with States Parties, the most important details (locations and limits on capabilities) have already been defined in the treaty. However, the CTBT does provide the Technical Secretariat with the authority to create internal regulations, negotiate subsidiary contracts with external actors, and formally recommend policy changes to the collective principal; it therefore receives a “2” for policy information authority.

2. Monitoring

The CTBT allows the Technical Secretariat to reveal private information through its authority to supervise, coordinate, and ensure successful operation of the International Monitoring System (IMS), conduct basic and specialized analyses of IMS data (a free service to Parties through its International Data Center), make any and all IMS/IDC data available to all state parties, and conduct on-site inspections (Albright 1999; SAROV 2004). After almost ten years, construction of the IMS is nearly complete. Data are transmitted from stations to the IDC, and data and data products are being transmitted to signatory states “on a test basis” (Asada 2002). After the 9 October 2006 test by the DPRK, for example, the PTS website (www.ctbto.org) included seismograms and identified the potential area for on-site verification using satellite photos.

On-site inspections can only be requested by a state party and states should first seek to resolve compliance questions bilaterally or with the assistance of the CTBTO. On-site inspections are permitted within specific parameters for verification purposes (only to clarify whether a nuclear explosion occurred that violates the treaty) and requests can be based on IMS findings or “any relevant technical information obtained by national technical means of verification" (Art.IV). The CTBT provides detailed and obligatory procedures for the request and sets clear and short deadlines for each subsequent step of the process.[53] The On-Site Inspection system is also being designed, but the process is unlikely to be activated without the treaty's entry into force.

The monitoring system envisioned under the CTBTO receives a "1" and the existence of the on-site special inspection process, triggered only at the request of another principal, adds +1 to bring the CTBTO to a "2". The CTBT-PTS currently operates the IMS and IDC but has not been authorized by the PrepCom to offer on-site inspections; it therefore receives only a "1" at this time.

3. Enforcement

The CTBTO's authority for determining noncompliance with the treaty is unclear. The treaty text describing the powers and functions of the Conference and of the Executive Council in Article 2 include the prescription that they should "ensure compliance", consider concerns raised by "possible non-compliance", and act to "redress" compliance concerns. However, there is no mention of a process or power for determining compliance. Considerations of compliance questions are to be in accordance with Article 5, which empowers the *Conference* to "restrict or suspend the…rights and privileges" of a Party, "recommend to States Parties collective measures", or bring the issue to the attention of the UN. However, this is a coercive power of the collective principal only and not of the agent. It also lacks the authority of a legal decision regarding noncompliance. Therefore, neither the Executive Council nor the Technical

[53] Once the Director-General receives a request by a State Party, the State to be inspected must be notified within 6 hours and the Executive Council within 24 hours, which then has 72 hours to vote to approve or reject the request.

Secretariat possesses the authority to determine compliance or coerce a Party when there are concerns about compliance. It therefore receives a "0" for compliance and enforcement powers.

Agent Resource Autonomy

1. Staffing

The CTBT states that the Director-General shall recruit staff as necessary for their expertise (with due consideration to geographic representation) and can establish temporary working groups for scientific advice. The treaty also entreats the parties to respect the "international character" of the Secretariat staff. The staff is independently recruited and does not require official state support or sponsorship. Some candidates do receive state support, but a formal hiring process and review panels ensure individuals are hired by their own merit. Similar to other international organizations, there is the phenomenon that senior positions – especially the directors of the groups – are traditionally held by a particular nationality or region. However, as one senior PTS official stated, this tradition is to ensure the major contributors and regions are each represented at the senior levels and not necessarily that a particular Directorship is the property of a particular state (Rozgonova 2005). Therefore, the CTBTO, and by all appearances the CTBT-PTS, receive a "3" for staff selection autonomy: non-seconded international civil service (+1) that is independently recruited (+1) and over whose appointment is almost entirely without requirement for collective or individual principal approval (+1).

However, the principals have imposed a term limit on individual service: after seven years individuals must leave the PTS.[54] States sought this limit to maintain control over the organization and it is apparently also being incorporated into the IAEA staffing system (Corden 2004). While this improves the ability to screen out undesirable employees, the short rotation cycles constrain the development of expertise and shrink the pool of prospective staff that may already be too small (Corden 2004). The shortened tenure may also force individuals to be more receptive to their state governments than would otherwise be apparent in order to maximize their future employment prospects. Whereas in other IOs states may put regular pressure upon the staff for particularistic benefits, according to interviews states do not appear to take this overt step with the CTBT-PTS (Kvok 2005).

The size of the staff is small relative to the IAEA but still a significant source of expertise and capacity; the staffing size score (log of staff) increased from 0.95 in 1997 (first year of operation) to 2.42 in 2004.

2. Budget autonomy

Similar to the IAEA and CWC, the CTBT calls for the full cost of the organization to be met by the States Parties in accordance with the UN scale, making adjustments for their differing membership. Further, the Technical Secretariat drafts the budget for the Executive Council (Albright 1999; SAROV 2004). The CTBTO therefore is to subsist financially upon member assessments and any States Parties in arrears in their payments may lose their vote in the organization. However, there is also a system of

---

[54] Limiting tenure is most attractive to states that fear the organization could become a refuge for unqualified individuals.

decentralized spending in which IMS station costs can be deducted from their assessed contributions, subject to limits, but this does reduce its financial autonomy to some extent.

While the CTBT makes assessments by the CTBTO legally binding quasi-taxation, the PrepCom process and the PTS lacks these formal assessment powers. The treaty only states, "Financial contributions…to the Preparatory Commission shall be deducted in an appropriate way from their contributions to the regular budget" (Art.II.B). Contributions are legally voluntary until the treaty enters into force, though the PTS does treat them as assessments. The CTBTO, and the PTS, may also accept voluntary contributions. Therefore, the future CTBTO would receive a "4" for budget autonomy for its legally binding assessments and ability to accept voluntary contributions. The current CTBT-PTS, though, receives only "1" for the technically voluntary nature of its contributions. The size of the budget has grown significantly in the CTBT-PTS's short lifetime, growing from $51.74m (2003 US$) in 1998 to $110m in 2005. The size of budget indicator was 0.3 in 1999 and increased to 0.82 in 2005.

<u>CTBT Summary</u>

The CTBT, because it has yet to enter into force, presents an interesting case of a temporary IO created by a formal treaty. It also permits an easy counterfactual analysis to compare delegation to two institutions holding constant variables that could confound comparisons between other IOs. The CTBT-PTS earns a modest 6.95 in 1997 that increases to 9.24 in 2005. If the CTBT were in force, the CTBTO would have received an 18.95 in 1997 and 19.69 in 2005, reflecting the significantly greater authority the CTBTO would possess to monitor member behavior, assess resources to ensure monitoring is effective (fiscal autonomy), and otherwise act with some autonomy from its collective principal (management autonomy), not to mention the significant treaty-proscribed obligations. The delegation measures for the CTBT PTS and the CTBTO are summarized in Table 2.3 and Figure 2.2.

The numbers are comparable to the IAEA in its early years, which is a fair comparison given the IAEA's limited safeguarding and other activities in those years. As the CTBT calls for many structures similar to that of the IAEA, it is useful to highlight four areas in which delegation differs between the two IOs. First, the IAEA is empowered to make decisions regarding compliance while the CTBTO stipulates explicitly that compliance decisions are the purview of the individual states that are parties to the treaty. Second, and somewhat ironic in light of the first point, the CTBT delegates to the CTBTO enforcement powers for violations of treaty obligations in that it can recommend specific sanctions for collective implementation. These implementation powers are greater than those present under the IAEA Statute, but the CTBTO is not granted the same direct access to the UN Security Council as the IAEA. Third, the monitoring process envisioned for the CTBT subjects the parties to continuous monitoring and is in that sense more invasive, but is also more constrained in that the elements of the monitoring system are specifically defined in the treaty with any revisions requiring treaty amendment. Finally, the CTBT entails a greater level of obligation than the IAEA Statute because it specifies domestic implementing legislation and provides for enforcement mechanisms.

Additional Results and Discussion

Additional case studies contained in the appendix provide evidence for the coding decisions for the NPT and the CWC's Organization for the Prohibition of Chemical Weapons, as well as for additional observed "zero" cases such as the Geneva Protocol, BWC, Convention on the Physical Protection of Nuclear Materials, and the Nuclear Suppliers and Australia Groups. These latter cases, as observed zeros, represent changes in cooperation within the nuclear, biological, or chemical weapon nonproliferation regimes, but not delegation to an agent. The results for the non-zero cases of delegation are summarized in Tables 5 and 6, and graphically represented in Figure 2.2.

This "rank ordering" of the NBCW agents corresponds to expectations created by the wealth of information on these agents. It is no surprise that the IAEA, "the backbone of the non-proliferation regime" (Muller, Fischer, and Kotter 1994), reflects the greatest delegation. Second to the IAEA is the OPCW, which institutionally has some inspection and enforcement powers that are broader (and a mandate for disarmament that the IAEA lacks) but also which is smaller and lacks compliance authority. As the OPCW moves beyond disarmament into more active verification of CW-related activities, the political nature of its activities will elevate its public status. In the meantime, while it does represent significant delegation, it has less authority than the IAEA and runs a distant second.

The NPT is admittedly an unusual case to compare with the other institutions. While it is legalized and clearly delegates powerful responsibilities to an agent (the IAEA) the NPT itself does not constitute an agent, and therefore suffers from zero scores in these areas (budget and staffing indicators), and does not mention enforcement or other obligation-enhancing mechanisms. On the other hand, the utility of the metric is again demonstrated: the authorities delegated to the IAEA both directly and indirectly are separable. Furthermore, the scores are not redundant, allowing them to be combined to measure cumulative delegation to the nuclear nonproliferation regime and then compared to any observed delegation to the CW and BW regimes.

Conclusions

This chapter has attempted to improve measurement of delegation by operationalizing delegation with a simple metric. This metric translates into numeric indicators the legal authority to provide services, the fiscal and operational autonomy from the principals possessed by the agent, and the resources available to the agent to fulfill its contractual responsibilities. The metric was then applied using in-depth case studies of principal-agent relationships in two NBCW institutions. Differences in NBCW institutions discussed in the literature were reflected well by the quantitative measures of delegation proposed in this project. Importantly, the metric also appears to be useful for comparison across NBCW institutions and across time. For example, the metric appears to capture the increase in delegation to the IAEA across its history and the differences in delegation between the temporary CTBT-PTS and the future CTBTO.

This correspondence between qualitative and quantitative evidence demonstrates the metric's face validity, at least for NBCW institutions. This metric should be useful for measuring delegation to non-NBCW institutions that also make use of non-national agents to facilitate policy setting and implementation and behavior monitoring and enforcement, from international lending agents (IMF) to free-trade organizations (WTO) to alliances (NATO). This metric should also be useful for measuring domestic acts of delegation, such as the creation of new executive or judicial bodies. Understanding the structure of the relationship between the principals and their agents is a necessary precondition to understanding how agents serve the interests of their principals. With a metric in hand for comparing delegation to IOs across a range of issue areas, analysis can move to the next steps of explaining the causes and anticipated consequences of delegation.

Table 2.1: Delegation Indicators

Category	**Range**	**Indicator and Description**
1. Agent Services	1a. Policy Information 0 – 4	Recommend regulation (including negotiation of subsidiary contracts) and influence policy (1) Create and implement regulations; formally recommend policy changes (2) Recommend changes to mandate (3) Authority to alter mandate (4)
	1b. Private Information (Monitoring) 0 – 6	Routine monitoring: Select the time (+1) Routine monitoring: Select the place (+1) Routine monitoring: Select the level of intrusiveness (no managed access) (+1) Special investigation process triggered by principal (+1) Special investigation process triggered by agent (+2) Special investigation process triggered by non-principal, non-agent actor (+3)
	1c. Compliance 0 – 3	Compliance authority: Legal compliance decisions (+1) Compliance authority: Base compliance upon alternative sources of information (+1) Compliance authority: Withhold compliance decision-relevant information from the principal (+1)
	1d. Enforcement 0 – 5	Hortatory statements, no compellance powers (0) Denial of membership benefits (2) Recommended (private) action (3) Compulsory (quasi-private) sanctions (4) Compulsory (public) coercion (5)
2. Agent Resource Autonomy	2a. Staff selection autonomy 0 – 3	International civil service (not seconded) staff (+1 if >2/3 of total staff) No requirement for collective principle approval of staff appointments (+0.5 if >2/3 of total staff) No requirement for individual principle approval of staff appointments (+0.5 if >2/3 of total staff) Independent recruitment (+1 if >2/3 of total staff)

Table 2.1: Delegation Indicators (continued)

Category	Range	Indicator and Description
2. Agent Resource Autonomy (cont'd)	2b. Financial or budget autonomy 0 – 5	Voluntary contributions (1) Member assessments (2) Quasi-taxation or other legally obligatory assessments or tax (3) Authority to offer fee-for-services (+1) Authority to accept voluntary/in-kind contributions beyond assessment or quasi-tax levels (+1)
	2c. Size of budget 0 – 6*	Sum of annual percentage change in constant dollars; effective range is 0-6
	2d. Size of staffing 0 – 4*	Log of total number of staff (seconded or otherwise); effective range is 0-4
3. Mgt Autonomy	3a. Mgt Autonomy 0 – 2	Inverse of the percentage of principals (1-%) who can modify policy decisions (change the delegation relationship) from outside of collective principal (0 – 1) Management role for non-principals (+1)
4. Obligation	4a. Domestic obligation 0 – 7	(Baseline value is 4.) Specific guidelines for domestic implementing legislation: Deadlines (+1) Specific guidelines for domestic implementing legislation: Enforcement mechanisms (+1) Specific guidelines for domestic implementing legislation: Implementing bodies (+1) Clauses that permit: Temporary escape from the treaty obligations or from a specific clause (-1) Clauses that permit: Permanent withdrawal from the treaty (-1) Clauses that permit: Opting-out out of treaty requirements (-1) Clauses that permit: Reservations that modify the treaty's legal effects in application (-1).
Total:	**0 – 46***	

*Note: Two variables (size of budget and of staffing) have effective upper bounds for this project; other institutions may go higher.

Table 2.2: IAEA Delegation (selected years)

Category	Indicator Notes:	1958	1970	1980	1990	1995	1998
1. Agent Services	**1a. Policy Information:** Implements BOG-approved safeguards models and staff negotiates subsequent agreements; staff greater role in negotiating later models; changes to mandate recommended with safeguards and CPPNM update	0	1	1	1	2	3
	1b. Private Information: Updates of INFCIRCs provide guidance: upgrades of 153, 93+2 for 153, 540; 153 provides greater access and challenge inspections; 540 provides broader routine access.	1	3	3	3	4	5
	1c. Compliance: Authority to make legal decisions regarding compliance. Agency is expected to withhold some information from principals to protect commercial information. Basing decisions on non-inspection data possible with reinterpretation of INFCIRC/153 (1995).	2	2	2	2	3	3
	1d. Enforcement: IAEA implements safeguards agreements and may punish noncompliance through denial of membership benefits.	2	2	2	2	2	2
2. Agent Resource Autonomy	**2a. Staff selection autonomy:** IAEA end in mid-1990s policy that hires require state approval.	2.5	2.5	2.5	2.5	3	3
	2b. Budget autonomy	5	5	5	5	5	5
	2c. Size of budget	0.84	2.26	4.27	5.19	5.59	5.45
	2d. Size of staffing	2.59	3.00	3.15	3.34	3.36	3.32
3. Mgt Autonomy	Non-Budget Votes (1/2 majority of BOG)	.82	.88	.84	.84	.85	.85
4. Obligation	Withdrawal clause; no domestic legislation required	3	3	3	3	3	3
	Total:	**18.76**	**23.6**	**25.7**	**26.8**	**30.7**	**32.6**

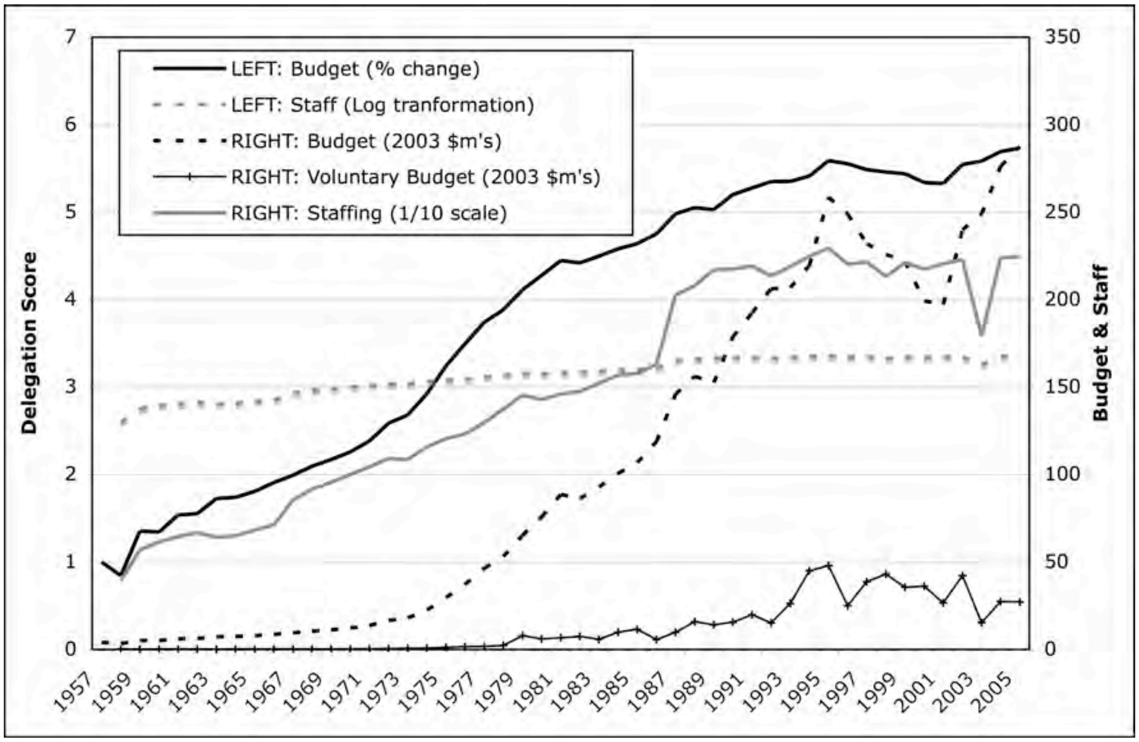


Figure 2.1: IAEA Delegation

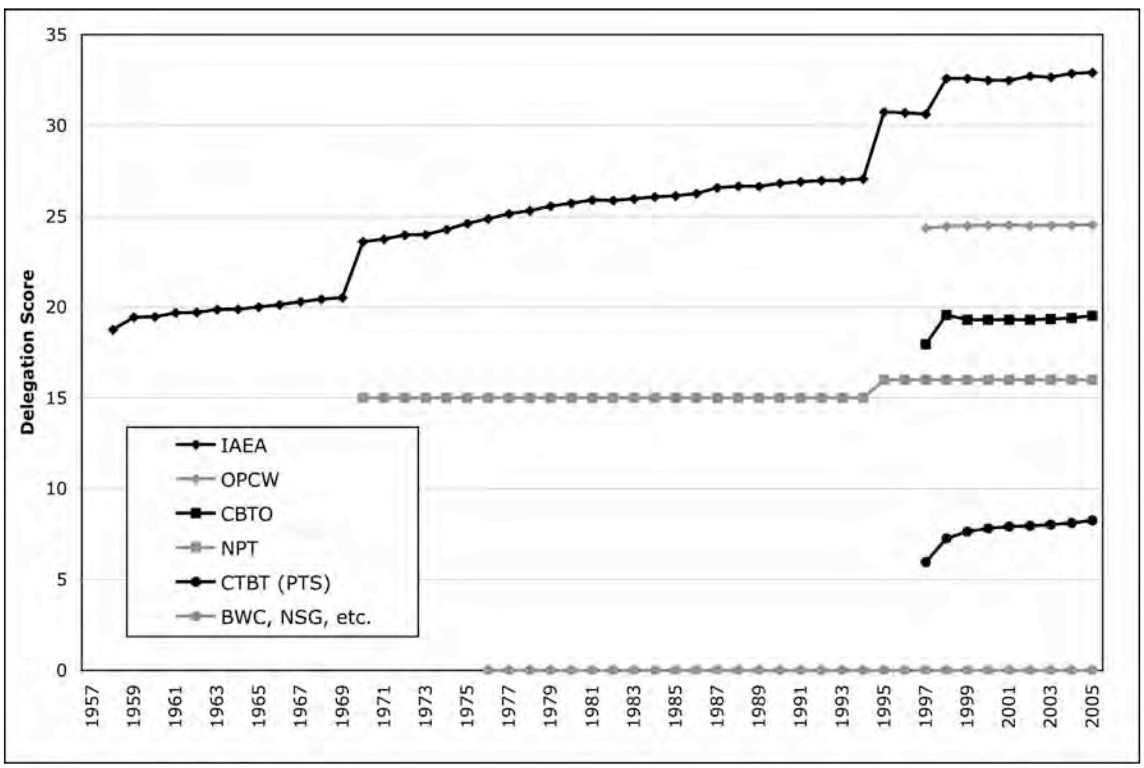


Figure 2.2: Comparing Delegation Scores Across IOs and Time

Table 2.3: CTBT-PTS and CTBTO Delegation

Category	CTBT	PTS (2005)	CTBTO (2005)
1. Agent Services	1a. Policy Information: CTBTO negotiates subsidiary agreements for verification system.	1	2
	1b. Private Info: Fixed-location monitoring (active); special inspections triggered by principals (inactive).	1	2
	1c. Compliance: CTBT does not provide the power to make compliance decisions.	0	0
	1d. Enforcement: CTBTO has no coercive powers.	0	0
2. Agent Resource Autonomy	2a. Staff selection: Independently recruited international civil service.	3	3
	2b. Budget autonomy: PTS survives on voluntary contributions; CTBTO has legally binding assessments and accepts voluntary contributions.	1	4
	2c. Budget size	0.82	0.82
	2d. Staff size	2.42	2.42
3. Mgt Autonomy		0	.26
4. Obligation	CTBT requires national implementing action but permits states to withdraw with notice.	0	5
Total:		**9.24**	**19.50**

Note: The reported values for the CTBTO assumes entry into force with the current number of staff and currently ratified states.

Table 2.4: NPT Delegation

Category	NPT	
1. Agent Services	1a. Policy Information: Amendment process gives veto to NWS and states on IAEA Board of Governors, the latter of which need not be NPT States Parties	4
	1b. Private Information: Delegated entirely to the IAEA	3
	1d. Compliance: Delegated entirely to the IAEA	3
	1c. Enforcement: Does not mention enforcement.	0
2. Agent Resource Autonomy	2a. Staff selection: Delegated to entirely to the IAEA	3
	2b. Budget autonomy: Does not have a budget.	0
	2c. Staff size: Does not create a bureaucracy.	0
	2d. Budget size: Does not have a budget.	0
3. Management Autonomy	Final Declarations require consensus. Amendments require simple majority plus other procedures if 1/3 support opening an amendment conference; only binding on those that ratify.	0
4. Obligation	Only mentions right to withdraw with notice	3
	Total:	**16**

Table 2.4: OPCW Delegation

Category	**OPCW**	**1997**	**2004**
1. Agent Services	1a. Policy Information: Implementation of regulations and negotiation of subsidiary contracts but constrained role in changing regulations or mandate.	2	2
	1b. Private Information: The OPCW staff select the time and place of inspections using a randomized process; only a State Party can initiate special inspections.	3	3
	1d. Compliance: The OPCW staff can withhold information obtained from an individual principal, but can neither determine "compliance" nor make use of external sources of information.	1	1
	1c. Enforcement: The OPCW cannot legally determine "compliance" but can recommend collective action, including referral to the UN and imposing sanctions such as denial of membership benefits.	3	3
2. Agent Resource Autonomy	2a. Staff selection: Independently recruited international civil service with little seconded staff.	3	3
	2b. Budget autonomy: Quasi-tax plus voluntary contributions	4	4
	2c. Staff size	2.61	2.68
	2d. Budget size		
3. Management Autonomy	A 2/3 majority of the EC is 28; number reported is 1-(28/number of member states).	.73	.83
4. Obligation	Treaty obligations include national implementation requirements; attenuated only by right to withdraw with notice.	5	5
	Total:	**24.34**	**24.51**

Chapter 3: The Nuclear, Biological, and Chemical Weapons Threat

Nuclear, biological, and chemical weapons share a number of commonalities that distinguish them as a class from conventional weapons. First and foremost, a relatively small volume of each of these weapons is believed to be sufficiently gruesome on a mass casualty level that they have often been described as “weapons of mass destruction”.[55] While a single conventional (high explosive) warhead may kill 50-200 people, a single warhead of plutonium (a nuclear fissile material), pasteurella turarensis (a biological agent that causes tularemia), or VX (a chemical nerve toxin) could kill thousands or even millions of persons - if properly delivered and dispersed. Second, all three require inputs that are rare in nature and require significant infrastructures for their production. Third, all three have clear but distinctly different signatures of their presence that are detectable with the appropriate monitoring techniques and which long outlive their production or stockpiling. Finally, and perhaps most significantly, these three weapons are sufficiently perceived by society as “weapons of mass destruction” that this can be treated as a social fact (Wendt 1999).

However, it is impossible to argue that these three weapons types are similar in their inputs, technological requisites, and developmental processes, or that each would inflict the same level of damage in the same manner. The threat from the proliferation of each of these weapons, therefore, presents different problems to actors seeking to mitigate the threats they pose. The threat of being attacked with nuclear, biological, or chemical weapons also presents a clear and different cost to states in the system from not

[55] The Soviet Union’s Minister of Defense, Marshal Zhukov, threatened in 1956 that “future war” would involve “various means of mass destruction such as atomic, thermonuclear, chemical, and bacteriological weapons” (Donnelly 1960).

reducing the threat from those weapons. States fear NBCW proliferation because they fear opponents will use them to solve political conflicts. As the threat of their use increases, the potential gains to reducing the threat for these weapons also increase.

NBCW threats, measured along a single scale for the system as a whole, can only increase or decrease. States, meanwhile, have mitigated the threat through a range of strategies: at some points in time through deeply cooperative strategies but at others through less institutionalized or unilateral responses. The United States responded to the Soviet CW threat in the early 1980s by developing a new CW bomb, in the mid-1980s by negotiating with the USSR a verifiable bilateral ban, and in the 1990s by negotiating a broadly multilateral ban to be verified by a dedicated international organization. If states associate increased NBCW threats with proliferation, then changes in the NBCW threat should be related to cooperative responses: collective strategies to stop and even roll back proliferation. States may cooperate in varied ways, with many cooperative strategies being unobservable without large selection bias.[56] In this chapter, I test the argument that changes in the systemic threat from nuclear, biological, and chemical weapons are sufficient to cause changes in multilateral delegation to international agents on these weapons. Establishing the relationship between threats and delegation is one of two components central to establishing the baseline against which the other hypotheses will be tests.

I first review previous attempts at comparing these threats, either across time within each class or across types. The damage inflicted by a militarily significant quantity

---

[56] For example, Robert J. Einhorn has stated that interdiction of NBCW trade began long before the United States launched its Proliferation Security Initiative (Einhorn 2004).

of each of these weapons has not changed significantly over the last six decades. Instead, the greatest changes have occurred in two areas. One, the ability to acquire these weapons has generally increased over time with changes in related non-weapons industries and in the global economy at large. Two, the greatest variation has occurred in the number and type of situations in which NBCWs could have been useful: inter- and intra-state conflicts involving latent NBCW states and the recent rise in mass casualty terrorism.

I then measure these threats at the systemic level with a model that incorporates who the threatening actors are, the expected uses of NBCWs, and the expected damage from these uses. This methodology is applied to constructing time-series data of the threat from NBCWs from 1945-2002. Time-series cross-sectional data on delegation to NBCW-related international organizations, developed and reported in Chapter 2, allows explicit tests of the causal power of changes in NBCW threats for observed NBCW delegation. I find changes in the systemic level of the NW threat to be a significant cause of international delegation for nuclear issues, but to be a poor explanation (statistically insignificant) for international delegation on CW and BW issues. These results indicate that an explanation for why states choose international delegation for NBCW issues that focuses on the threat alone is incomplete.

I also test two alternative hypotheses. One, the appearance of delegation is a response to the ability of the superpowers to demand and create such institutions. I find that a greater ability of the US or USSR to demand changes in the international system is negatively correlated with delegation for NBCW issues. Delegation may also be an artifact of the Cold War. I find that the end of the Cold War permits increased delegation but argue the theory is underspecified in ways which this project illuminates.

Delegation and Threats

Existing theories that attempt to explain delegation by states to an international agent suggest they may do so for a variety of reasons. However, most analyses are unable to gauge, even theoretically, the possible gains from cooperation. The simplest explanation is that that variation in delegation occurs because of variation in the gains from cooperation produced by the magnitude of the threat.

Walt argues that at least some international cooperation on security issues, specifically alliances, are primarily a response to the threat posed by other states and that, on a generalized level, the threat is a function of these other states' offensive capabilities and intentions (Walt 1985). More specific to NBCW proliferation, Horowitz finds that NBCW possession, and in some cases the possibility of production or R&D programs, has significant effects upon the initiation and escalation of conflicts (Horowitz 2004). Certainly NBCW possession affects how a possessor *could* fight in a conflict.

Political scientists analyzing NBCW threats have examined the incentives to proliferate and the risk states pose by proliferating. Incentive models attempt to explain why states acquire or disarm themselves of NBCWs because of changing external security conditions, internal politics, or international norms. This literature consists largely of regional or state case studies (i.e., Levite 2003; Solingen 1994; Solingen 2007), but also includes a few quantitative studies that have focused on the security conditions that are believed to drive proliferation (Jo and Gartzke 2007; Sasikumar and Way ND; Singh and Way 2004). For example, Jo and Gartzke test the role of external conventional and nuclear threats against other potential reasons. They find security concerns and technological capabilities are important determinants of the decision to begin a NW program, while security concerns and domestic politics influence the decision to take the next step and construct NWs. Risk models, alternatively, use domestic political characteristics to examine the risks from proliferation that result from differences in their domestic characteristics (Solingen 1994) and often argue that characteristics of the later entrants (less political stability, weaker command and control structures, greater proximity to likely adversaries) make their possession of NBCWs more dangerous than early possessors (Sagan 1995).

Alternatively, policy analysts often either extrapolate changes in the threat from technological changes in weapons-related industries or focus simply on an increase in the raw number of capable or latent states as decreasing global security. Doing the former rightly incorporates the technological changes that ease acquisition or use, but in these analyses the effects usually manifest themselves in worst-case scenarios of non-zero probability events without really assessing the likelihood of these events (ter Haar 1991). The most recent incarnation of this approach includes the many policy analysts warning of terrorist nuclear attacks, arguing the high effects of such an attack overwhelm the small but positive probability of their occurring (Allison 2004). Analysts focusing on the numbers were often writing in the 1950s-60s and were concerned with the damage to US-Soviet strategic stability caused by any new nuclear powers (Bowie 1961), or they are regional specialists predicting the domino effects upon others of a single state's proliferation (for example, the PRC's nuclear program led to India's which in turn led to Pakistan's). More recently, a number of US government statements and reports warn of the growing number of CW or BW states (Hogendoorn 1997; Kadlec, Zelicoff, and Vritis 1997; Shuey 2001; US Senate 1989b).

The threats likely do determine the Pareto frontier for the possible gains from cooperative threat reduction through nonproliferation and counter-proliferation strategies. The causal effect is expected to be strong. If changing threats adequately explain the level of NBCW delegation, then the theory of delegation can be parsimonious. The hypothesis that follows:

H1: The greater the systemic proliferation threat, the more likely states will delegate to an international organization for proliferation issues.

H1a: The greater the nuclear weapons threat, the more likely states will delegate to an international organization for nuclear issues.

H1b: The greater the chemical weapons threat, the more likely states will delegate to an international organization for chemical weapons issues

H1c: The greater the biological weapons threat, the more likely states will delegate to an international organization for biological weapons issues

An alternative hypothesis is that NBCW delegation occurs not because of functional incentives but is instead driven by the desires of states who are the most powerful in the international system. Mearsheimer argues institutions reflect distributions of power and serve the short-term interests of great powers (Mearsheimer 1994). Similarly, Stephen Krasner argues, "Information flows and knowledge have been less important than relative power capabilities for international communications regimes or the lack thereof" (Krasner 1991). Therefore, the essence of a counter-hypothesis is that changes in international delegation for NBCW issues should be correlated with changes in the international distribution of power:

H2: The greater the power preponderance of the super-powers, the greater will be delegation to international organizations for NBCW issues.[57]

A major change in the structure of the international system occurred, of course, with the end of the Cold War. In 1989, the system transitioned away from a bipolar one, briefly becoming multipolar until the current age of US unipolarity was established. The end of the Cold War could provide a simple historic marker for the transition to a less severe threat environment among the most powerful states. As an alternative indicator of NBCW threats, this would suggest delegation occurred because cooperation among major powers became less of a barrier to their cooperating on other threats. Therefore:

H3: The end of the Cold War reduces threats among the super-powers, making delegation more likely for NBCW issues.

Conceptualizing NBCW Threats

I attempt to derive separate measures of the aggregate threat to the system from NWs, BWs, and CWs. State-specific measures of the threats are insufficient because the behavior to be explained occurs at the systemic level: the collective choice by a multilateral coalition of states to institutionalize cooperation on NBCWs and to effect such cooperation through delegation to an international agent. Systemic level behavior that mitigates a NBCW threat should be a response to a clear change in the threat at the system level from one of these weapons. NBCW acquisition by an actor changes the strategic environment of its allies and enemies and has an effect upon crisis and conflict outcomes (Beardsley and Asal 2007; Gartzke and Jo 2007; Horowitz 2007; Rauchhaus 2007). Few of the analyses discussed above provide an idea of how each threat has

[57] Separate hypotheses for nuclear, biological, and chemical weapons threats, like for H1, are implied.

changed over time except by comparing the number of possessor states.[58] Assessing the threat from NBCWs requires incorporating not only a number of technical factors (for which there is great uncertainty), but also requires incorporating decisions about intentions of potential and actual possessors (Squassoni 2005). Unfortunately, it is notoriously difficult to distinguish stated intentions from true intentions given the incentives to misrepresent one's intentions for strategic advantage (Fearon 1995).

An appropriate model for estimating the threat posed by NBCWs begins with state capabilities. In a world of perfect information, all states would know who possesses NBCWs, who is actively seeking them, and who may not be seeking them but otherwise has the capability to do so. The US government and other primary and secondary sources do report from time to time on which states are "known" to possess NBCWs or have active NBCW programs. This data is best for NWs, with much diminished reliability for CBWs, in part because the poorer quality data on these activities and intentions provides a larger role for politicization of these estimates to justify threat assessments using other criteria.

Table 3.1 reports states with programs and weapons (and when) and Figure 3.1 summarizes the number of states with these programs. A codebook describing how decisions were made regarding each state's status is in the appendix. The number of states suspected of possessing or pursuing NBCWs is one simple indicator of the NBCW threat. Unfortunately, because states have generally poor or bad information about state

[58] The best known model of the relative threat of nuclear war is the clock used by the Bulletin of Concerned Scientists, which has oscillated between twelve and two minutes to midnight and is currently at "five minutes", their analogy for the risk of nuclear war (http://www.thebulletin.org/doomsday_clock/timeline.htm).

interests and capabilities (some states have an incentive to misrepresent their NBCW capabilities or those of others), less biased data must be devised. The face validity of these less biased proxies is demonstrated by comparison to the biased estimates produced above of the number of program and possessor states.

Jo and Gartzke (2007) examine nuclear proliferation as a two-stage problem in which actors must have both the opportunity (a technological barrier) and the willingness to proliferate. The capacity to produce or acquire these weapons requires specific skills important to their development and a broad level of technological development for production and deployment. Actors that possess NBCWs pose a greater threat of use than those that do not; states close to acquiring these weapons pose a greater threat than those for whom acquisition is more costly. There is no market for off-the-shelf usable NBCWs as there is for rifles and jet fighters, so the distance from acquisition is a technological question that goes beyond the actor’s simple ability to pay. Jo and Gartzke describe this distance as a state’s latency: the possession of necessary resources such that they surpass a minimum threshold necessary for development and deployment. While states do care about others’ intentions regarding their NBCW capabilities, actors without such capabilities cannot credibly threaten states with their use.

Second, states recognize that the strategies of other actors are affected by the opportunities for their use. NBCWs, like all weapons, are tools for achieving political goals and actors will use them if they possess them and their use has utility in a situation greater than all other available options. States have employed NBCWs to resolve inter- or intra-state conflicts (Iraq against Iran and its own Kurdish population), as have sub-state actors involved in intra-state conflicts (Chechens against Russia post-1998). NSAs employing violence for political gains similarly demonstrate an interest in acquiring NBCWs to the extent they are willing to utilize mass-casualty events as a strategy (CWs used by Aum in Japan in 1995; Al Qaeda also explored pre-9/11). The opportunities actors face to use NBCWs is most related to the violent conflicts in which they are involved.

Together, NBCW capabilities and opportunities for use determine the probability of NBCW use:

Equation 1: *Probability of use = (Capacity to use) x (Opportunity to use)*

Third, actors considering NBCW use will anticipate in their threat assessments the effects of NBCW use. Ackerman and Moran, examining the threat of a terrorist attack with BWs specifically, argue that the basic threat assessment model should scale an attack's anticipated effects (the result of a successful attack) by the potential attacker's capability and motivations to execute the attack (Ackerman and Moran 2005). Extending the threat assessment model proposed by Ackerman and Moran to a broader assessment of the threat of NBCW use, the magnitude of the threat for each is a function of the damage the respective weapon can do and the probability of their use. The probability of use is a function of an actors' capacity to produce it and the number of opportunities available to use the weapon. This yields:

Equation 2: *Threat = (Probability of use) x (Damage)*

By substitution, an appropriate model for estimating the threat of NBCW use from an individual state is therefore:

Equation 3: *Threat = (Capacity to use) x (Opportunity to use) x (Damage)*

The system-year indicator of nuclear, biological, and chemical weapons threats used in the analysis in this chapter is the annual sum of state-year threats for each weapon type. States, of course, perceive threats differently and a change in the systemic threat from NWs as measured here may not represent an increased NW threat for all individual states. Also, these weapons have been perceived as substitutes for conventional weapons and for each other. An increased systemic threat from NWs could cause nuclear-specific but also non-nuclear responses (e.g. CW proliferation, international conflict resolution mechanism, etc.). Careful readers will note the development of this model quite consciously employs the term "actor", rather than "state", in measuring the systemic threat from NBCWs. The analysis privileges states in the dependent variable only because there are no incidences of delegation for NBCWs to an international agent by NSAs. However, the source of the threat could be any actor with an NBCW capability and that capability is not necessarily limited to states.[59]

Operationalizing the threat

The basic threat assessment model argues that NBCW threats to the system are a function of who possesses (or is near possessing) them, what opportunities they have for use, and the prospective damage from their use. This section begins with an analysis of the accessibility of NBCWs to states and NSAs. I then turn to a review of post-WWII changes in the nature of warfare to examine the contexts in which actors might find NBCWs to be useful. Comparable indicators of the NBCW threat since 1945 are constructed in this section, therefore, as a function of who possesses or could quickly

---

[59] The analysis does not assume that such capabilities *are* within the reach of NSAs, only that the hurdles to NBCW acquisition by NSAs likely parallels the hurdles facing states.

possess a nuclear, biological, or chemical weapon (capacity), what situations in which that weapon could be employed (opportunity), and how much damage this use may cause.

NBCW Acquisition

NBCW capabilities are partly a function of weapon-specific skills and materials. This section develops a base skill level indicator for a state's facility with nuclear, biological, and chemical technologies. I also examine the apparent risk of NSAs, such as terrorists, acquiring NBCWs. While there are no public guesses as to the number or identity of such interested and capable actors, I endeavor to provide an answer to popularly perceived threats from terrorist NBCW attacks. However, the three skill indicators each overstate a state's ability to produce and deploy a weapon. A state's NBCW capability is also affected by the general technological infrastructure possessed by the state. An infrastructure variable is constructed and then interacted with the basic skill score to produce a capability score for each nuclear, biological, and chemical weapon type.

<u>Nuclear Weapons</u>

In a nuclear power plant, a nuclear reaction occurs and is maintained at a critical but self-sustaining level by the introduction of neutron absorbing materials. The heat is captured to produce electricity and the fuel is consumed only slowly. In a nuclear weapon, however, the goal is to achieve "super-criticality" and consume in as short a period of time as possible all fissile material present. The US uses of a NW demonstrated there were two routes to acquiring the requisite fissile material: one employing uranium 238 and uranium 235, the other using plutonium 239. Uranium occurs naturally but to be useful for nuclear weapons must be purified from its natural state (about 0.7% in uranium ore) to at least 80% (preferably >95%), though uranium at enrichment levels as low as 30% could be used for fuel in a nuclear power plant (Barnaby 1993).

The process was significantly expensive that for decades states pursuing nuclear weapons would find it easier to use natural or low enriched uranium (enriched only to 20%-30%) in a nuclear reactor and then later chemically extract plutonium from the spent fuel. For years after the basic theory of a nuclear reaction was demonstrated, indigenous uranium enrichment programs were impossible for all but a few states and plutonium reprocessing was feasible only if a state already had a nuclear power program.[60] The USSR and then France quickly developed NWs without external assistance; China followed shortly with only minimal early assistance with nuclear energy.[61]

The Atoms-for-Peace program spread nuclear energy programs around the world but proliferation was well contained through the 1980s by IAEA monitoring, superpower security guarantees, US domination of the nuclear fuel supply market, and USSR domination of its allies. An indigenous nuclear program was unnecessary to states that could accept as a substitute Soviet or US nuclear guarantees and/or the verified forbearance of others. For most others, the nuclear non-proliferation regime made it too costly to pursue nuclear weapons.

---

[60] In 1945, three methods of uranium enrichment were known: electromagnetic or calutron separation, gaseous diffusion, and centrifugation. Of the three, only gas diffusion was used by the US because the calutron method did not sufficiently enrich the uranium and the centrifuge method was limited by the quality of construction materials. Uranium was not only believed to be more scarce than is known today, but the few sources outside the USSR were controlled by the US, UK and Canada.

[61] The UK also became a nuclear power and did so independently of US assistance, but had benefited from its participation in the Manhattan Project.

There remained a small set of states, however, with the will to pay the cost of acquiring nuclear weapons nonetheless. Developing states in particular were inspired by India’s 1974 nuclear test such that Libya's Mu'ammar Khadafi announced shortly afterwards that soon “we will be able to buy an atom bomb and all of its parts” (US Senate 1977a).[62] The threat of proliferation was somewhat mitigated by these suppliers’ limited nuclear infrastructure and because many accepted safeguards under their membership in the NPT (Dunn 1985).

Through the 1990s, the ability to develop nuclear weapons is best indicated by exceeding a threshold of nuclear capabilities: a long-standing nuclear energy program that provides both experience working with nuclear technologies and access to fissile materials. However, there has been great attention to the spread of centrifuge enrichment technology since the early 1990s, beginning with Pakistan’s successful exploitation of enrichment technologies stolen in the 1970s. This has made clandestine programs harder to detect by permitting them to skip reproducing a complete fuel cycle. Second-tier nuclear states quickly began to acquire and exploit centrifuge technology (OTA 1993a; Rathjens 1995; US House of Representatives 1990) and IAEA inspectors since 2003 have uncovered evidence of a global black-market network in nuclear equipment and technologies that centered around Pakistani nuclear scientists and their intermediaries and involved states such as Iran, Libya and North Korea (Albright and Hibbs 1992; Albright and Hinderstein 2004; Braun and Chyba 2004; Broad and Sanger 2004; Frantz 2005;

[62] The Indian nuclear test was shortly followed by the start of nuclear weapons programs in Argentina, Brazil, Iran, North Korea, and Pakistan, joining ongoing programs in Iraq, Israel, South Korea, South Africa, and Taiwan.

Orberdorfer 1979). NWs may now be within reach of any state without nuclear energy but with access to uranium ore.

The feasibility of a terrorist bomb was a hotly debated issue before the September 11th attacks but has acquired greater salience since. NSAs would have to either acquire a turn-key nuclear weapons capability by buying a nuclear weapon from a state, or they would have to independently acquire fissile material and design and build a nuclear weapon; in either case, they would still face the hurdle of delivering such a weapon to their targets. While the ability to purchase a completed NW is not a zero-probability event, it is quite low and appears to be diminishing over time as nuclear forensic capabilities advance and present increasing risk of retaliation to any state that might sell a NW (May 2008).

The primary focus is therefore on the interest and ability of NSAs to construct their own weapons. Robin Frost argues that an NSA would first have to acquire fissile materials of sufficient quality and quantity and then would encounter problems similar to those confronting developing states with how to design and deliver such a weapon (Frost 2005). Frost uses data from IAEA reports of illicit trafficking in fissile materials to show that the problem of NSA access to fissile materials is orders of magnitude too small for concern. Even if an NSA were to acquire substantial fissile materials, the risk of defection would make the risk of proactively recruiting sufficient expertise very high (Berman and Laitin 2006).[63] A number of authors have noted, for example, that the

---

[63] Berman and Laitin argue all NSAs face a defection problem because the defection of any individual member could lead to exposure of the entire group's activities. The risks are especially high for NBCWs where an NSA must identify highly skilled individuals whose skills match the resources available, share the NSA's worldview, and are willing to employ their skills for mass

relatively wealthy Aum Shinrikyo, responsible for the 1995 Tokyo sarin nerve gas attacks, had pursued a nuclear weapons program and chose instead to focus on CBWs after failing to acquire the needed assistance in Russia (Linzer 2004a).

A state's likely nuclear weapon skills are therefore proxied using two dummy variables: *reactor* is 1 when a state has a nuclear research or power plant reactor operational for three years and “0” otherwise (states revert to “0” when no reactor is operational, e.g. their last reactor is shut down); *uranium* is “1” when annual uranium ore production/extraction exceeds 4 metric tons and “0” otherwise.[64] Data for both are available 1945-2002 from the IAEA’s Power Reactor Information System (PRIS), the UN Energy Statistics Database, and Stoll’s previous analysis of latency (IAEA 2007e; Stoll 2005; UN 2004). NW skills are indicated by exceeding the 4000 metric tons threshold of uranium ore production and having three or more years of reactor experience for each year during 1946-1990; after 1990 the diffusion of centrifuge enrichment technology puts nuclear weapons prerequisites within reach of technologically advanced states with uranium ore production exceeding the threshold. The NW skills variable is dichotomous (0/1) for 1946-2002.

In 1960 only 4 states appear as skilled (France, UK, US, and USSR) and by 1965 an additional 16 skilled states appear, including several European states, Brazil, China, India, Israel and Japan. The number of states with nuclear skills increases until 1972 and holds at about 38-40 capable states until 1990; after 1990 the diffusion of centrifuge

---

casualty weapons programs. If the NSA approaches the wrong individuals, an NBCW program may fail, burning scarce resources, or be exposed.

[64] Based on standard density of uranium in natural ore of 0.7%, approximately 4 metric tons of ore would be required to enrich to 80% enough for a single nuclear warhead (about 23kg).

enrichment technology allows the number of skilled states to jump and then continue to increase throughout the 1990s. The number peaks at 202 in 2000 and then declines, reflecting a number of developing states in Africa and Central Asia shutting down reactors after losing their external (Cold War-era) support. The very high number indicates that nearly every state in the dataset has either indigenous uranium production or a nuclear research or power reactor.[65] This is an indicator of nuclear knowledge and/or access to fissile material and must be interacted with the indicator of technological infrastructure to produce a meaningful NW latency indicator. Still, these indicators do produce data that matches expectations provided by history.

Chemical weapons

Chemical weapons (CWs) affect living beings through the skin, eyes, lungs, blood, nerves, or other organs. CWs are classified according to their major method of inflicting damage upon people: blistering the skin (mustard gas, arsenics, phosgene oxime, etc.), choking (phosgene, diphosgene), destroying the blood's ability to carry oxygen (hydrogen cyanide, cyanongen chloride), or impeding or destroying the functioning of the neurological system (tabun, sarin, soman, VX, etc.). Information about how to construct blood, blister, and choking weapons was widespread at the end of World War II, and by the 1950s the same could be said for most weaponized nerve agents (OTA 1993b).[66] Since the 1950s, the only significant development was the reported Soviet development of a radically more deadly nerve agent in the late 1980s or even early 1990s.

[65] Gleditsch and Ward list 212 states in the international system in 2002, though this does not include “microstates” (Gleditsch and Ward 1999).
[66] Research had continued during WWII and by 1945 many major powers had weapon prototypes but not fully weaponized versions (Dando 1999; Martin 2002b; Robinson 1971; Tucker 2002).

The WWII push for chemical industry autarchy resulted in post-war excess industrial capacity and attempts to direct excess capacity towards replacing naturally occurring products with new (often petrochemical) compounds (Bensaude-Vincent and Stengers 1996; Brock 2000). This is important because CWs differ from other chemicals only in their toxicity and therefore the CW threat has increased with the growth and spread of the chemical industry itself and of dual-use technologies (Moodie 1999).[67] The production processes are essentially the same, though CWs may require extra safety precautions during production and storage because of their toxicity (and some are also particularly corrosive). In the early days of the Cold War, many states possessed the ability to produce CWs indigenously (US Senate 1996) if they were willing to convert existing "hard piped" facilities dedicated to a single product or production process (Trapp 2005). Globalization created incentives in the 1980s for the chemical industry to break up large facilities into smaller, more flexible units, and by the late 1990s, the result was multipurpose plants and production processes with greater flexibility and safety (Trapp 2005).[68] Finally, in recent years the chemical industry has seen the introduction (but not yet broad adoption) of miniaturized, "microreactor" chemical factories (Trapp 2005).

Most analysts seem to agree that chemical weapons are within reach of any actor with a small-scale laboratory and some graduate-level education in chemistry (Donnelly 1960; Purver 1995; Smithson and Levy 2000). While some steps in CW production pose

---

[67] Spiers cites a United Nations definition of CWs as including, "chemical substances, whether gaseous, liquid, or solid, which might be employed because of their direct toxic effects on man, animals and plants" (Spiers 1994:1).

[68] Globalization of the chemical industry was preceded by states divesting themselves of state-owned chemical production facilities. Privatization is clearly important because these firms would have to justify inefficiencies (extra storage facilities, unaccounted for production, etc.) if a state wanted a covert CW program.

safety risks, analysts underscore the fact that "they would probably represent more of a nuisance than a true obstacle" (OTA 1993b). The limitation, as Smithson notes, is that a small laboratory set-up could only produce on the order of "tens of kilograms" a year (Smithson and Levy 2000). The production and use problem does scale with the quantity: 1,000 kg of sarin would be necessary to kill 3,000 people on a calm, clear night (Intriligator and Toukan 2006). However, the same quantity would be sufficient to severely incapacitate several times that number of people (at 35 mg-min/m3) and mildly incapacitate fifty times more people (at 2 mg-min/m3).[69] The quantity of CW a state would require to have a significant effect is probably hundreds of tons for a major conflict or hundreds of kilograms for limited tactical uses in a major conflict (Fängmark and Norlander 2005).

Political barriers, such as treaties and export controls, have successfully blocked many states from indigenously producing some of the key precursors (OTA 1993b). Therefore, while a cell-based or other small group of committed individuals could probably produce small quantities of a high-quality chemical weapon, "only a vertically organized, highly integrated and ideologically uniform group appears to have the capacity to set up and operate a large-volume production line for chemical or biological weapons

[69] Assuming a population density of 3,000 persons/km2, killing 1,500 persons within one minute would require equal distribution over the area of 100 metric tons of sarin. However, sarin is highly persistent in the environment and therefore significantly smaller quantities would be required to have the same effect over a longer period of time; unprotected individuals would be severely incapacitated (and some killed) by exposure levels below 35 mg-min/m3. To compare, a lethal dose in mg-min/m3 by inhalation for 50% of the population is from nerve agents is 100 for sarin (GB), 50 for VX, and 135 for GA (tabun); blister agents require between 1,300 (Lewsite) and 3,200 (phosgene-oxime), choking agents between 3,000 (chlorine, phosgene and disphosgene) and 20,000 (chloropicrin); blood agents 2-5,000 (hydrogen cyanide) to 11,000 (cyanogen chloride); and tear gas (CS) is 61,000 (http://www.stimson.org/cbw/?sn=CB2001121893; accessed 13 April 2006).

in absolute secrecy" (Zanders 2000). Just as NWs require access to fissile material, CWs require access to precursor chemicals. This implies terrorist organizations are unlikely to have a capability sufficient for mass casualty events (US Senate 1982).

The only extant example of a successful NSA attack with CWs is the 1995 Aum Shinrikyo attack in Tokyo with sarin. Aum caused significant mayhem, killed 12 and injured thousands with quantities on the order of a few kilograms that failed to properly disperse. It is important to remember that failure also occurred because Aum became aware that the Japanese government had detected their activities and acted before it was ready.[70] Defining a "militarily significant" quantity is subject to debate but for the purposes here is considered to be on the order of a hundred kilograms, making small-scale laboratory production likely to be insignificant to states in a major conflict but potentially significant for asymmetric warfare.[71]

A state probably has the skills to develop CWs if it has a developed chemical industry, given that the processes are well known and have changed little since the 1950s. A state's likely CW skill is therefore proxied using an indicator for the proliferation of dual-use chemical industry to new states. The indicator is a dummy variable equal to "1" when any of the three following commodities is produced (and "0" otherwise): cement (a chemical manufacturing process), chemical fertilizers, and any of several other chemicals (chlorine, sodium cyanide, aspirin and sulfuric and nitric acids). Cement data is available

---

[70] There was a significant delay between the Japanese government's detection and its raids on Aum because Japanese police were not trained to operate in CBW environments and were awaiting protective equipment such as gas masks. Aum detected preparations for the raid because it had members on the police force.

[71] This decision highlights a distinction in the policy literature between weapons of mass destruction or mass casualty, on the one hand, and weapons of mass effect, on the other. "WMEs" kill far fewer people and destroy less property than WMDs but have a massive effect upon the target population's economy or psychology.

for 1945-2004 (Banks 2002; UN 2005) while fertilizer and chemical production data is from 1970 onwards (UN 2005). The variable is dichotomous (0/1) for all years.

Splicing in non-cement data after 1970 does cause a small jump in the number of skilled states: in 1969 there are 105 skilled states and in 1970 there are 117, far greater numbers than the preceding rate of increase of about 3 states per year. However, the inclusion of additional indicators should also increase the validity of the indicator. The number of states with indigenous chemical industries increases steadily to 136 in 1984 and than ranges from 135-143 from 1985-2003.

Biological Weapons

Biological weapons (BWs) are microorganisms such as bacteria, viruses, or fungi that cause severe diseases sufficiently rare that few are protected against them. Classical biological agents include anthrax, smallpox, tularemia, Q fever, viral hemorrhagic fevers, and plague. Toxins, chemicals produced by or otherwise extractable from biological organisms, are often included as BWs. Classical toxins include botulinum toxin, ricin (from castor beans), tetrodotoxin (from puffer fish), tetanus, and saxitoxin (from shellfish).[72] Biological agents are inherently more dangerous than chemical agents on a weight-for-weight basis but they are sensitive to environmental factors and can therefore be much harder to deliver as a mass casualty weapon.

Identifying, acquiring and isolating a sample of a virulent strain is harder than many suppose (Smithson and Levy 2000). Microorganisms were identified as causing disease only in the late 19th century and it was not until 1926 that biological scientists

---

[72] Biochemical agents known as bioregulators could also be included in this category, including sort protein fragments used by the human body to regulate metabolic functions that are currently being explored as a new generation of medical treatments (Tucker 2008).

had differentiated bacteria from viruses (Davison 2005). Industrial techniques for growing viruses using chicken eggs were developed in the 1930s and continue to be used today for vaccine production (Davison 2005), while industrial-scale techniques for growing bacteria were not developed and perfected until the 1960s (Bud 1991). Even though BW pathogens occur naturally, there are only about thirty considered useful for BW warfare using military selection criteria (OTA 1993a) and most programs have focused on the same 10-15 organisms (US Senate 1998). [73] Once a virulent strain of a BW agent is acquired, it must also be properly handled and stored to avoid killing it (or the researchers) during its isolation, breeding, and final production (Leitenberg 2000). Weaponization is also problematic as a "wet" agent taken directly from its growth media is difficult to use without exposing it to the destructive conditions (air, light, or extreme temperatures) of the natural environment (Smithson and Levy 2000).

A key breakthrough that many analysts point to is the genetic engineering revolution. Molecular biology was commercially irrelevant in the 1960s, but with the discovery in 1973 of techniques for splicing and amplifying DNA, it was possible to engineer biological organisms either for new pharmaceutical products or against which targets are unlikely to have defenses (Hughs 2001). These techniques were within a few years applied to the development of practical applications (e.g., modifying E. Coli to produce human insulin), but there was first almost more fear than hope as other scientists

[73] Susan Martin lists the criteria as: stability, delivery, mitigating biological and physical decay after release, predictability, infectiousness, drug resistance, mutations detracting from potency or making vaccines impotent, and time-lag between infection and effects (Martin 2002b). Franz notes that US Army models developed in 1960s show that, of 395 candidate agents, 17 were possibly useful on battlefield but most too unstable or hard to produce, and that 73 could be useful only in enclosed or very high population density places (US Senate 1998).

saw the potential for deliberate or accidental misuse (Hughs 2001).[74] By the mid-1980s, investment in biotechnology had grown sharply and the efficiency of industrial production also improved (ter Haar 1991; Wright 1986). While the threat of novel biological agents appears not to have been realized - the surfeit of naturally occurring pathological organisms makes developing new ones unnecessary - advancements in the biological sciences and the proliferation of internet-based information have advanced the clinical technologies useful to identifying, cloning, and developing a BW agent (SIPRI 1999; Wilkening 1999).[75]

Leaps in biotechnology have so far posed less of a threat than horizontal proliferation within and across states of the dual-use materials, technologies, and knowledge related to BWs by chemical, pharmaceutical, biotechnology, and medical industry applications (Wilkening 1999).[76] For decades it was assumed work on the most dangerous biological agents was confined to the most sophisticated facilities in states with the best developed pharmaceutical industries (OTA 1993b): Belgium, France, Germany, Italy, Japan, Netherlands, Sweden, Switzerland, the UK, and the US. While horizontal proliferation began post-World War II to create the field of pharmacology,

---

[74] This fear has inspired a sub-genre of science fiction novels from Ben Bova's Exiled from Earth (1971) and Colony (1978), Stephen Gallagher's Chimera (1982), Dean R. Koontz's Watchers (1987) and C.J. Cherryh's Cyteen (1988) to more recently Margaret Atwood's Oryx and Crake (2003), Greg Bear's Darwin's Children (2003), Syne Mitchell's The Changeling Plague (2003), Cherryh's Forge of Heaven (2004) and John Scalzi's Old Man's War (2005).

[75] Dando & Fraser argue efforts at fully sequencing the genomes of human beings and other organisms could revolutionize both treatment and offensive use of infectious diseases (Fraser and Dando 2001). Jessica Stern points to a number of experiments whose published results could facilitate the acquisition of BWs by providing clear protocols for inserting lethal genes, enhancing antibiotic resistance or even synthesizing dangerous viruses without having samples (Stern 2002/03).

[76] See also: Epstein, Gerald. 2001. Controlling Biological Warfare Threats: Resolving Potential Tensions among the Research Community, Industry, and the National Security Community. *Critical Reviews in Microbiology* 27:4 (January 2001), pp. 321-354.

only China has managed to develop a significant pharmaceutical industry and join these ranks in the past twenty years (Ballance, Pogany, and Forstner 1992).[77] However, as is implicit in the US Office of Technology Assessment's 1993 report, excluding others assumes the goal for aspiring BW actors is novel agents (OTA 1993b).

BW skills appear to have spread to an increasing number of actors over the past 10-15 years with advances in basic biological sciences and easier access on the open market to dual-use technologies that reduce the necessary level of expertise of the handling scientists (Mintz 2004; Shea 2004). Some fear advances in prophylactic and storage measures, the greater potential for more lethal and or new BW agents, and the greater potential use for asymmetric war (especially economic) might mean an erosion of the impediments to battlefield use of BWs (ter Haar 1991). Douglas and Livingstone (1987:23) argued almost two decades ago that for “a knowledgeable person”, the processes necessary “to obtain strains or cultures of very dangerous toxins and diseases - and to produce them in sufficient quantities - are about as complicated as manufacturing beer and less dangerous than refining heroin.” Perhaps as dangerous as the proliferation of dual-use technologies exploitable for BW research is an increasing vulnerability to BW agents because of globalization, urbanization, and the diminished utility of antibiotics (Ackerman and Moran 2005).

The widely-held belief is that no states possessed deliverable BW agents at the end of WWII despite the investments in research and development during the war. By the

---

[77] The spread of the industry is important because many of the skills useful to reproducing pharmaceuticals, or at a more advanced level developing new ones, are intimately related to the ability to produce biological weapons: not only are the techniques similar, but a state seeking to employ biological weapons must also have defenses developed to be able to treat R&D as well as military forces.

early 1960s only the US was known to have an offensive biological weapons program (Miller, Engelberg, and Broad 2001) and in the early 1970s only four states were sufficiently impressed with the promise of biological weapons to pursue them (Robinson 1973). The number of states suspected of having a BW program grew to 10 in 1989 (Spiers 1994), 12 in 1997 (Leitenberg 2000) and 13 in 2001, though Cuba, Iraq, Libya and South Africa have since been removed from the US list of suspects (Leitenberg 2005). Since the 1970s, many developing countries have acquired microbiology production plants for purposes easily converted to an offensive BW production program: alcohols, vaccines, antibiotics, yeast, vitamins, food colors and flavoring, amino acids, and single-cell proteins for animal feed (OTA 1993b). Also, germ banks sold samples freely until the late 1980s; it was not until 1989 that the US Commerce Department finally blocked exports of pathogenic cultures to Iran, Iraq, Libya, and Syria.[78]

While the number of states with biological weapons programs has remained limited, the total number of actors believed interested has increased to include NSAs. Actors need not be at the cutting edge and, like CWs, BWs could be developed in a "garage laboratory" by a single individual with graduate training in biological sciences if an appropriate seed stock could be acquired directly from a research laboratory or cell-culture provider (Livingstone and Douglass 1984). The Aum had pursued biological weapons prior to the 1995 sarin attack and Al Qaeda had also explored them as a possibility, but both Aum and Al Qaeda had failed to achieve a biological weapons capability (Smithson and Levy 2000). As discussed above, terrorist interest in CBWs was debated as early as the 1970s (Livingstone and Douglass 1984) and highlighted in the US

[78] Germ banks outside US remain less controlled (Barletta, Sands, and Tucker 2002),

by the discovery that hundreds were injured in 1984 in Oregon by the Rajneeshes cult (Shea and Gottron 2004). While the estimated probability of a terrorist CBW attack increased since the 1970s with continuing globalization and changes in the nature of terrorism, prior to the 2001 Al Qaeda and anthrax letter attacks the probability of a terrorist mass casualty CBW attack was still believed to be quite low (Purver 1995; Simon 1989; Wilkening 1999). Zanders is more optimistic (for targets), arguing:

> Only a vertically organized, highly integrated and ideologically uniform group appears to have the capacity to set up and operate a large-volume production line for chemical or biological weapons in absolute secrecy. Religious sects, more than any other group, come to mind. This definitely reduces the number of candidates that could sustain such an armament programme. (Zanders 2000)

The optimistic view appears to be supported by more BW policy analysts than not (Leitenberg 2000; Roberts and Moodie 2002).[79] Leitenberg, for example, states categorically that the capabilities required for mass casualty BW attacks are beyond the present and "near term" capabilities of any known terrorist group (Leitenberg 2005).

It is difficult to ascertain how many actors at any point in time have or are pursuing biological weapons when there are few credible sources. States found it hard to assess BW threats because they generally had bad information and because US government officials (the primary international source of public information) and policy experts may have exaggerated the threat to push or reformulate US priorities (Falk 2002).

---

[79] Leitenberg notes that the US program post-WWII had extensive resources and still took years to weaponize a handful of "simple" agents. He also relates a US exercise described by William Patrick in which a US post-doctoral student was given one year to design a mass casualty event using tularemia and the final report on design was found to contain three errors that would have made project a failure. For the USSR, Ken Alibek stated the huge Biopreparat program had 60,000 people and decades but still probably only 100 individuals who knew how to fully weaponize and produce particular organisms. Finally, in the early 1990s, Aum had four years, the appropriate equipment, some scientists, and spent more than $10m but still failed.

Part of the problem, as discussed above, is that there is a wide range of facilities useful to BW production. The other aspect of the problem is that very small quantities are considered sufficient to conduct a mass effect attack. The minimum “military significant” quantity depends upon the desired effect (mass casualty or disruptions only) but even more upon the specific agent. For example, the 2001 anthrax letter attack infected eighteen and killed five but exposed potentially 10,000 people who required prophylactic treatment (Stern 2002/03).

Any state with a wide variety of industrial biological production facilities can theoretically produce BWs on a militarily significant scale if it can acquire and isolate a pathogenic microorganism. While fermenters for the production of yeast-based animal feeds or beer are obvious, the USSR reportedly used industrial dairy cream separators to grow and harvest anthrax. A state's possible skill with the production of biological weapons is proxied using two types of indicators. The first is a dummy variable that proxies biological skills and equals “1” if greater than 15 medical doctors per 1000 persons of population or (1980-2002) when a state immunizes more than 90% of the population against measles (World Development Indicators2005; Banks 2002). High values of either are indicative of a substantial domestic medical or scientific infrastructure. The second dummy variable (1970-2002) proxies production capacity of biological materials and equals “1” if the state produces beer (>50,000 hectoliters) or cheese (>10,000 tons by industrial methods, UN 2005). Industrial production of beer and cheese has strong parallels to the ability to produce biological weapons agents on a mass scale, though producing weaponized agents is significantly more difficult. The BW skill variable is dichotomous (0/1) from 1945-1969 and trichotomous (0, 0.5, or 1.0) from 1970-2002 because of limits on data.

These threshold values were chosen so that the final capability values would correspond to the numbers of BW-capable states infrequently reported (and discussed above and in earlier chapters). For example, the number of skilled states is fewer than five until 1960. Similar to the CW skill indicator, the number of BW skilled states jumps in 1970 and then increases until peaking at 96 states in 1998. This maximum is also close to US statements in 1998, by US Deputy Assistant Secretary of Defense Thomas Welch, that "more than 100" states have the capability to develop at least crude BWs (OTA 1993b). However, as I argue next, this indicator is incomplete and overstates the threat.

Infrastructure Requirements for Weaponization

The three skill variables described above provide indicators of the state's basic skills but clearly overstate the ability to translate skills into a measurable capability. For NWs, while a state may have a nuclear power program and surplus fissile material, weapons production requires additional resources and infrastructure (especially if the plant was acquired with substantial foreign assistance). One hurdle is the natural tendency of nuclear materials to spontaneously fission if too much fissile material is in too close a proximity: the crucial material at best is slowly burned up prior to use but at worst could spontaneously reach criticality. Designs that make more efficient use of nuclear materials are more demanding and require testing of their effectiveness.

In the 1960s, many believed a test ban would be effective for arms control because they projected onto other states the US-Soviet high requirements for efficiency, reliability and safety testing (Brennan 1976; US House of Representatives 1990; US

Senate 1969b; US Senate 1977b). However, by the 1990s it was clear that testing was less necessary with the growing availability in the public realm of the basic knowledge necessary for constructing NWs and of computers and computer simulation technology advanced enough to permit better testing of components with less than full-scale tests (US House of Representatives 1990).[80] The necessity of testing has returned to public debate with North Korea's fizzled first nuclear test and discussions in the US regarding how to guarantee the safety and reliability of the US nuclear stockpile.

A second hurdle is that the NW must also be small enough to fit and hardy enough to survive the chosen delivery system.[81] South Africa's first two nuclear weapons, for example, were too big to be delivered by aircraft and not until 1982 did it have one it could deliver with a bomber (Liberman 2001). Of course, a focus on advanced gravity bombs and missiles ignores slower, "low-tech" methods of delivery such as trucks or shipping containers. Even low-tech delivery system face a risk of detection. Michael Levi argues the risk of detection in shipping a complete weapon is high because of its size and required shielding; the alternative strategy of shipping in pieces has a smaller per-piece risk but a higher cumulative risk (Levi 2007). These methods rely on covertness for survivability as they are easily stopped if detected, but attention to these approaches grew after the Cold War came to a close and asymmetric warfare became a concern.

---

[80] As examples, a US DOE/DOD sponsored project in which two physics PhDs were asked in 1966 to use public sources to design a NW and apparently succeed, most design elements for the first US nuclear weapons were available in the New York City Public Library for a number of years until withdrawn after the September 11th terrorist attacks in 2001, and the PRC shared one weapon design with Pakistan, which serially shared this design with North Korea and later Libya.
[81] The storage problem is significant especially over longer periods of time. US nuclear laboratories have discussed in the open literature their arguments that the indefinite maintenance of existing US nuclear warheads exposes the arsenal to failures: the corrosive effects of lubricants and oxidation can be difficult to estimate and the fissile materials themselves can degrade over time compromising the "pit".

CBW weaponization also requires transfer of the bulk agent to a delivery vehicle safe for human handling and which can deliver the agent without exposing it to temperature and pressure conditions that can destroy it. For example, early CW munitions used explosives to disperse the agent that also destroyed much of the agent. Weaponization would require specialized facilities to prepare and then test the agent and its delivery systems (Fängmark and Norlander 2005). Many developing states seeking to incorporate chemical weapons into their arsenals must also be concerned that they generally suffer from poor weapons handling and maintenance (Pollack 2002). These steps may be less significant if the intended use of the agent is against an unprotected (non-military) target, but Aum's failure to develop effective delivery systems for its CBWs reinforces that these are not insignificant concerns for even terrorists.[82]

Moving from basic NBCW skills to an NBCW capability therefore requires additional resources for added capacity, weaponization, and deployment. The ability to satisfy these additional resource requirements are proxied by an economy exceeding threshold levels in the production of energy, university students, iron and steel, and high technology products such as televisions, automobiles and machine tools.[83] The resulting dummy variables are counted and then divided by the number of variables with data for that time period, forming a 0-1 continuous scale (a four category ordinal variable 1946-1969 with values of 0, .33, .66, and 1, and an eight-category ordinal variable 1970-2002). The infrastructure variable is interacted with the respective skill indicator to produce a

---

[82] In Aum's case, the agent evaporated without aerosolizing (Moodie 1999).
[83] Infrastructure is measured as a continuous variable using indicators for energy production (Bennett and Stam 2000), iron and steel production (Bennett and Stam 2000), number of university students (Banks 2002), and presence of high technology manufacturing (televisions, automobiles, or machine tools, see:UN 2005).

capability score for each state-year. The total, by year, of NBCW skill scores and of NBCW capability (skill * infrastructure) are reported in Figure 2. Threshold values for capability scores were then used to identify "latent" states: states judged to be of sufficient capability to produce the class of weapons.[84] The annual number of latent states is summarized in Figure 3 for comparison to other analysts' operationalizations.

As would be expected, the number of latent states in each category has generally increased with the diffusion of dual-use expertise, materials, and technologies. The number of CW capable and latent states exceeds the number for NW and for BW for most of the period, reflecting the industry's wide diffusion even before 1946. The greater constancy of the number of CW threat and latent states reflects its slower growth. The decline of latent BW states in the late 1970s corresponds to technological gambles that proved to be commercial failures (continuous flow fermentation processes and single-cell protein production, see: Bud 1991).

To demonstrate face validity, the historical numbers are close to the cumulative number of states accused of CBW programs as reported by SIPRI (see Appendix and:SIPRI 1969-2004). The large growth in the number of latent nuclear states in the 1960s directly follows the latent demand satisfied by the Atoms-for-Peace program and in the 1990s follows post-Soviet successor states achieving independence and then the expansion of the nuclear industry among developing states. The decline in the number of nuclear states at the end of the panel in part represents post-Soviet and African states

[84] A state possesses a latent CW capability if its chemical threat score is >0.6 prior to 1970 and is >0.34 after 1970, a latent BW capability if its biological threat score is >0.6, and a latent NW capability if its nuclear threat score is >0.3 or it has both domestic uranium ore sources and three years of operational nuclear reactors, for all years. Threshold values were chosen using as a guideline available isolated historical data on the number of latent states.

unable to maintain their reactors and shutting them down. These numbers are quite similar to the number of latent states reported by Stoll from 1945-1990 (the numbers correlate to .97, see:Stoll 2005)

The Nature of Warfare and Opportunities for NBCW Employment

The security environment from 1945-1990 was characterized at the systemic level by the Cold War confrontation. When the Soviets also became a nuclear power, the US lost its nuclear monopoly and the threat of Massive Retaliation lost any credibility. The threat of total war quickly became the threat of nuclear war between the USSR and the US and their respective allies. Strategic planning to avoid or survive this conflict led to refinements of deterrence theory, arms racing, and balancing (alliance) theory. Massive Retaliation was replaced by Flexible Response – promising the US could and would respond along the ladder of escalation to whatever military threats arose – and by a search for greater strategic stability through arms control (Adler 1992; Schelling 1961; Sims 1990). Plans incorporating NW use in ordinary wars dissolved because of fears of fallout (Boutwell 1983; Brown and Desai 2005; Wittner 1997) and because of concerns over escalation to total nuclear war.

Most of the Cold War, therefore, played out in attempts to control conflict between the two camps while engaging in low-intensity or unconventional conflicts. And most armies during the Cold War confined themselves to second-generation tactics of preparing to hold the front against others in essentially wars of attrition.[85] A few, however, incorporated into planning "third-generation" tactics first exemplified by

---

[85] The generations of warfare are succinctly described in:
http://www.lewrockwell.com/lind/lind26.html;
http://www.d-n-i.net/second_level/fourth_generation_warfare.htm

Germany's *blitzkrieg* warfare of World War II: the use of maneuvers to cut-off forces when on the defensive and fluidly permeating the opponent's weaknesses when on the offense (Lind et al. 1989). In either second- or third-generation warfare, however, military conflicts remained essentially high stakes engagements to directly defeat an opponent's army. That is, the barrier to setting a new distribution of gains between two actors, assuming low costs of war, is the other's military (Powell 1999).

With states confronting threats essentially limited to second- and third-generation warfare, NBCWs were similarly perceived to be useful only in limited situations. In general, it was assumed the use of NBCWs "would probably be reserved to defend the adversary's homeland or to ensure regime/state survival and likely would come late in a conflict" (Reichart 2001). NWs were viewed primarily as deterrent forces by the mid-1950s, especially when in-kind retaliation was not feasible. Nuclear deterrence evolved into a system of global crisis management while other aspects were largely ignored (Morgan 2003).

For CWs, the US, the USSR, and their respective allies anticipated that against most enemies they would not suffer direct casualties in war but only a "degradation of combat capability" as great as 30%-50% from being forced to wear chemical-resistant clothing and taking other anti-chemical measures (Spiers 1986; US House of Representatives 1980). As long as Cold War tensions were in full swing, the US and USSR and their major allies viewed the CW threat first and foremost in the Cold War, second- or third-generation warfare context (UK Ministry of Defense threat assessments, 1983-1986). It was not until Iraq's performance in the Iran-Iraq War and inferences about Soviet war-planning that it became apparent CW proliferation would translate into the military capability of minor powers to disrupt enemy offenses and attack rear logistical (staging) areas (Bernauer 1990; Pearson 2004; US Senate 1984; Wright 1995).

BWs were occasionally used for limited attempts at assassination or sabotage of combat support areas before WWII. While research during WWII was extensive (ter Haar 1991; Tucker 2002), the BW threat has always been prognosticated as a *future* threat that has not yet arrived (Bernauer 1990; Kadlec, Zelicoff, and Vritis 1997; Koblentz 2004; Robinson 1971). The US in 1969 demonstrated in secret tests BWs could be useful as a mass casualty weapon and therefore potentially valuable as strategic weapons for disrupting an enemy's ability or will to prosecute a war rather than disabling current operations (Martin 2002b). However, the tests also showed an inability to effectively limit the effects to the desired targets. The US renounced them in 1969 because they were inapplicable as counterforce weapons (and therefore not useful for the wars for which Western militaries were preparing) and to discourage and constrain others (Kadlec, Zelicoff, and Vritis 1997; McElroy 1991; Tucker 2002; US House of Representatives 1980).[86]

The end of the Cold War transformed the security environment and the utility of NBCWs. Many states that had depended on the US or USSR for external and internal security guarantees began to fear for the future. The start of new civil conflicts meant an increase that came on top of the cumulative effect of on-going civil wars from past decades (Fearon and Laitin 2003:77). Almost simultaneously, the Gulf War and then the

---

[86] Dando states that this work in the 1960s had been primarily on fungi and bacteria and did not shift to viruses (in the military's defensive programs) until the 1970s (Dando 1999). Matthew S. Messelson argues the reason the US could abandon its offensive BW program was related to the ability to retaliate with NWs because it would have several days to react to a BW attack (US Senate 1969a).

intervention in (now former) Yugoslavia demonstrated the huge gap that existed between the capabilities of the US military (and to some extent its Western allies) and those of all others.

States viewing Iraq's post-1991 experiences are now likely to determine that CWs are not "poor man's nuclear weapons". Rather, they are useful only against poorly prepared regional and sub-state actors and only nuclear weapons can deter advanced adversaries (Russell 2005). As K. Sundarji, former Indian Army Chief of Staff, is reputed to have said, the principal lesson of the Gulf War was that a state intending to fight the United States should avoid doing so until and unless it possesses nuclear weapons (McKenzie 2000). Still, Judith Miller, et al., demonstrate with the debates within the US government over how to cope with the possibility of Iraqi CBW use in the Gulf War that, despite the effectiveness in retrospect of the US threats in deterring their use, the US was largely unprepared to fight in a chemical or biological weapons environment (Miller, Engelberg, and Broad 2001). The US decision to renounce CWs in 1991 was the result not only of recognition of their potential for use by states like Iraq and in future asymmetric conflicts with other advanced militaries, but also because advanced weapons technologies had made CWs largely obsolete for the US military (Zanders 2000).

Minor powers altered their strategic thinking and developed what the US government came to describe as "4th generation" or "asymmetric" warfare, in which "adversaries are likely to attempt to circumvent or undermine U.S. strengths while exploiting its weaknesses, using methods that differ significantly from the usual mode of U.S. operations" (McKenzie 2000). These wars are "attempts to change states not by defeating the enemy's armed forces but by using fighting to send messages to the enemy, the enemy's supporters, and other constituencies in order to effect political changes" (Hammes 2005).

The possibility of NBCW use in asymmetric or fourth-generation warfare increased as analysts contemplated states such as Pakistan or North Korea providing NBCWs to others to use against their enemies. NWs have also regained some apparent utility for tactical situations, as evidenced by the US exploring of "advanced concepts" nuclear weapons: weapons with a "unique" contribution to a situation because of either their high energy (earth-penetrating weapons) or special effects (Brown 2005). It has also become increasingly apparent that major (Western) states had excluded many BW uses attractive to actors facing asymmetric conflicts (Robinson 1973:143). As asymmetric warfare is adopted by weaker states as a strategy it is possible that, as a US OTA report concludes,

> …[T]he drawbacks of biological agents for tactical military use (e.g., delayed action, the dependence on meteorological conditions for their effectiveness, and the difficulty of precise targeting)…might be attractive as a strategic weapon-particularly for small, nonnuclear nations embroiled in regional conflicts or threatened by a nuclear-weapon state (OTA 1993b).

It appears many states "increasingly are facing real or potential adversaries whose main goal is to cause…pain and suffering, rather than to achieve traditional military objectives" (Tenet 2002).

States were not the only actors to shift in pursuit of political goals from confronting enemies head on to exploiting weaknesses to impose costs. Terrorism also gained salience as a transnational issue as it became more about breaking the will of an enemy. The decline of pro-Communist terrorist organizations after the end of the Cold War contributed to a decrease in the overall number of terrorist attacks. However, attacks by newer terrorist groups exhibited increasing lethality, a greater tendency to be religiously based, and were more likely to attack the global system (as represented by the US) in pursuit of broader, albeit vaguer, policy goals (Cronin 2003). Extrapolating from increasing lethality, for many the threat of NBCW terrorism took center stage. The 9/11 terrorist attacks were significant on their own but also continued a trend of the previous ten years.

The higher premium placed on lethality by terrorist organizations reinforces the perception that these groups will seek weapons to facilitate mass casualty events: nuclear, biological, and chemical weapons (Cronin 2003; NDU 2002).[87] The attacks on the World Trade Center (1993 and 2001), Tokyo's subway system (1995), and Oklahoma's Murrah Federal Building (1995) have "clearly signaled" to many the interest of terrorists in mass casualty events (Intriligator and Toukan 2006). The fear of mass-casualty terrorism reflects the concern that state and NSAs are seeking these weapons as part of an asymmetric strategy against powerful states (Moodie 2003). The 2001 US experience with anthrax-laced letters attracted attention to the risk of terrorist BW attacks against transit locations, military rear support areas, and the food supply (Moodie 2003; US Senate 2002).

To summarize, traditional great powers sought to simultaneously deter and plan for major wars with other major powers, but with minor powers sought their decapitation

[87] This project recognizes that many include radiological dispersion devices as a similar category of weapon, however, these are not covered in this project.

or defeat to achieve amenable policy outcomes. NWs were important deterrents for these conflicts while the strategic incorporation of CWs did not appear possible until the 1980s and did not for BWs until reconceptualized in the asymmetric warfare context. Minor powers facing major powers were left with the choice of defeat or costly low-intensity conflicts. However, with other minor powers they simultaneously deterred and planned for major wars when possible by great power security guarantees and when not with deterrent forces, primarily CWs. At the end of the Cold War, the number of internal or civil conflicts also came to a peak just as many minor states pursued security using a new strategy of asymmetric warfare because of the apparent inadequacy of second- and third-generation warfare tactics (and CWs) in preventing great power intervention.

The cumulative effect of these trends in the security environment can be observed in the number of internationalized internal conflicts (which increase through to 1979 but are relatively numerous through the late 1980s) and the number of internal (civil) armed conflicts, which increase throughout the Cold War to peak in the early 1990s (PRIO-Uppsala armed conflict dataset, 1946-2002, see: Gleditsch et al. 2002).

Opportunity for Use

One proxy for the opportunity for NBCW use at the systemic level is the number of interstate rivalries. States will be strategic about planning to fight their rivals, incorporating long-term planning and the anticipated need for deterrent weapons (NBCWs) that states involved in small, one-off conflicts might not anticipate. Therefore, rivalry density may be a good proxy for interest because the majority of conflicts are not independent observations and a small number of feuding states are the states most likely to become involved in a violent conflict (Thompson 2001). However, rivalry data incorrectly constrains the opportunity for NBCW use. As one example, Thompson's data shows the US involved in three rivalries since 1945, though the US implied a threat to use nuclear weapons in a number of other events: MacArthur's request for use in the Korean War, the potential for escalation to nuclear war in the Cuban Missile Crisis, the French request for use in Vietnam, and the implied threat to retaliate in the 1991 Gulf War if Iraq used CBWs, to name just a few. The rivalry data also ignores the possibility of NBCW use by sub-state or NSAs.

A better proxy for NBCW use opportunity is therefore the universe of conflicts in which NBCW-capable actors are involved. I therefore use the annual count of the number of conflicts in which states are involved as reported in the PRIO-Uppsala Armed Conflict Dataset (Gleditsch et al. 2002). Actors possessing, or near possessing, NBCWs therefore threaten their use in every conflict in which are involved and for which their use could bring an advantage. Conflicts in which NBCW-capable states are involved are both opportunities for NBCW use and situations in which opponents fear their use. Figure 7 summarizes the total number of conflicts involving NBCW capable states (states are counted in multiple categories and for multiple conflicts when they are involved in multiple conflicts; the y-axis is placed at 1970 because of the previously discussed data break).

While asymmetric warfare is still largely theoretical between states, it is being realized in the evolution of terrorism. Since the Cold War, the number of terrorist attacks has decreased but their lethality has increased. To proxy for terrorist interest in using NBCWs as mass casualty weapons, I calculate a three-year moving average of the mean number of individuals killed in terrorist attacks as reported by ITERATE (Mickolus et al.

2003) and then log transform the mean.[88] The results are illustrated in Figure 3.4, where the threshold line at "1" shows where the log of individuals killed becomes positive. This suggests terrorism had little effect upon the NBCW threat perceptions of states except for a small blip in the mid-1980s and after the mid-1990s (and only in three years adds more than one to the total number of conflicts).

The existence of a dispute (whether rivalries or militarized disputes) may be endogenous to NBCW capabilities in that states which have acquired an NBCW capacity may do so because they perceived a positive utility for acquiring them to challenge others. This analysis avoids this endogeneity trap by design as well as by necessity. NBCW capabilities are proxied using an array of indicators of technological and economic development by design: while the pursuit of NBCWs may be endogenous to strategic concerns (or vice-versa), the raw capability to do so is assumed to be largely exogenous. In no known cases, for example, were states without latent capabilities able to develop NWs: Libya failed to get off the ground and North Korea's one test fizzled. These indicators are also used by necessity because data is extremely poor on actor CBW programs (NW programs exhibit, apparently, less uncertainty), much less their intentions.

Damage scaling

Once an actor has acquired the weapon and has a situation in which to use it, the threat from the weapon remains limited by the damage it can do, which is in turn also a function of the specific agent and quantity, the delivery system, and the environment in

[88] Most terrorism databases have problems of missing or biased data. ITERATE is biased towards international terrorism data. This doesn't create too big a problem for this project because the dependent variable is the use of international organizations to help reduce NBCW threats and domestic sources of NBCW threats from NSAs are better controlled unilaterally than other threat sources.

which the weapon will be used. The damage an NBCW can inflict, controlling for quantity, is partly a function of types. CWs and BWs vary greatly by specific type while for NWs damage largely scales to the quantity of material used, outside the fission/fusion distinction. The damage an NBCW can inflict is also a function of the delivery system and the environment in which the weapon will be used. To arrive at comparable damage scalars, the type of weapon is limited to one representative of those commonly developed in weapons programs. Furthermore, to control for quantity and efficiency of delivery, it is assumed the weapon is a missile-deliverable warhead detonated at an optimal height for damage. All three types would experience degraded performance from suboptimal detonation, but CBWs perhaps more than NWs because they are so reliance on the non-explosive distribution of their payloads.

Using common assumptions regarding environmental conditions (average sunlight with wind speeds of about 10 knots), a uniform population density of 3,000 persons per square kilometer,[89] and minimal effects protection provided by common shelter materials, it is possible to roughly scale the damage posed by nuclear weapons and the most common biological (anthrax) and chemical (sarin) weapons. [90] Based upon these assumptions, Figure 9 reports the death rates within the area of exposure (if injuries

---

[89] According to the US Census Bureau, 108 U.S. cities had population densities exceeding 3,000 persons per square mile in 1990; the greatest density in 2007 is New York city with 27,080 persons per square mile (RAND 2007).

[90] Lynn Eden argues that most analyses of the effects of a nuclear weapon tend to ignore the casualties caused by firestorms: the mass fires initiated in the periphery of the blast (Eden 2004). Using an alternative CW agent would mean adjusting the damage indicator by anywhere from 2x for VX nerve agent to 1/100 or worse; see Footnote #16.

are untreated) for a single NBCW weapon.[91] Under these assumptions, the approximate number of deaths from a single NW (100 kt) is 122,000 people, a CW is 4,700 people, and a BW is 205,000 people.[92]

NBCW Threat Assessment Results

The annual threat scores illustrated in Figure 7 are significantly transformed when weighted by the respective death rates. First, several contrasts are apparent. Despite the greater damage BWs could cause, NWs were clearly a greater threat throughout the period being studied. While there were often many more CW threat states, scaling for damage demonstrates the almost negligible threat CWs have posed. Second, Figure 7 also reflects the minimal difference a demonstrated terrorist interest in NBCWs has upon the threat calculations presented here, though this is a difference that has become more significant with the higher profile and more lethal attacks of the 1990s and since.

Importantly, the measured threat levels correspond to historical perceptions. The peaks in the late 1950s, late 1960s to early 1970s, mid-1980s and the early and late 1990s all correspond to periods of international tension in which the potential for NW attacks were believed to be high. Though the methodology behind it is opaque, plotting the "minutes to midnight" on the famous clock of the Bulletin of the Atomic Scientists

---

[91] This damage question focuses on the quantities necessary for a mass casualty attack and puts aside "mass disruption" attacks such as could easily result from a radiological device or a hoax using chemical or biological agent look-alikes.
[92] Calculations assume a total area of 144 km^2 and a population density of 3000 ppl/km^2, or 432,000 persons:
Nuclear deaths: $18.08km^2$@$3000ppl/km^2$ + $45.34km^2$@$1500ppl/km^2$ = 122,271.8 people killed (28.3%).
Chemical: $3.14km^2$@$1500ppl/km^2$ = 4710 people killed (1.08%).
Biological: $50.24km^2$@$2400ppl/km^2$ + $56.72km^2$@$1500ppl/km^2$ = 205,656 people killed (47.6%). The number of biological weapon deaths is over a 7-10 day period; assuming that under most conditions exposure could go undetected until symptoms begin to manifest at 4-7 days, this number is divided by 4 for the delayed strategic effect (11.9%).

reflects similar trends.[93] The founding of the IAEA, and the authorities delegated to it, were a direct response to the perception that by reducing the relative cost of nuclear energy, states could be convinced to achieve advanced status through peaceful energy rather than offensive weapons. Few realized the effects upon nuclear proliferation the Atoms-For-Peace program would have, and within a few years it became clear further steps were necessary to contain the threat of nuclear war. The NPT was designed to supplement the IAEA's market-based incentive program with a transparency and enforcement mechanism. The increase in the threat that occurs after the increase in delegation in 1970 with the NPT could have been anticipated by states because of the dramatic expansion of the nuclear industry and could have taken several years to have an effect. However, it also follows the escalation of the Vietnam War and the Soviet reassertion of authority over Eastern Europe.

That the threat declines not after the entry into force of the NPT but with the formation of the Nuclear Suppliers' Group suggests the NSG was more successful than the NPT at controlling nuclear proliferation. The NPT's success is not well reflected in the threat measures; the number of nuclear weapons states was far fewer than could have been if more of the latent nuclear states had chosen to pursue that route. The next peak in the threat measure occurs in the mid-1980s when US-Soviet hostility torpedoed many proposed bilateral and multilateral formal arms control measures that could have reduced the threat. The increased number of inter- and intra-state conflicts, the increasing lethality of terrorist attacks, and the ascendance of asymmetric warfare, all since the fall of the

[93] The two measures show similar peaks and valleys but are negatively correlated, perhaps because the clock lags behind reality in inconsistent ways and because there is less attention by the Bulletin to events outside the superpower confrontation during the Cold War.

Soviet Union in 1990, has increased the perceived threat of small-scale nuclear events. These threats appear causal for the expansion of delegation to IOs observed in the mid-1990s, though an incomplete expansion because the CTBT has yet to enter into force.

CW and BW threats were historically treated as conjoined through the 1970s, with the two being formally split only because of US unwillingness in the 1980s to move ahead on controls on CWs. Prior to the late 1960s, there had been few discussions of collective action on CBWs outside of platitudes calling for "complete and general disarmament". Outside of the US facing accusations of BW use in the Korean War, there was little pressure for CBW controls until the 1960s when the US was criticized for its use of non-lethal CWs in Vietnam. In the 1960s, conflicts involving CW– and BW–capable states increased, corresponding to the CW threat measure reaching a peak in the late 1960s and the BW threat measure peaking in 1973, one year after the BWC was concluded but two years before its entry into force.

While the BWC lacked the monitoring, verification or enforcement measures present in the NPT, many US policymakers stated that the US and others believed the BWC was sufficient to solve the BW threat given their lack of military utility (US Senate 1974). The BW threat measure reflects this: while conflicts involving BW threat states continued to increase 1969-1973 (and after a small dip reached a plateau in 1975-1990), conflicts involving BW latent states disappeared almost entirely for thirty years. By this measure, it is not surprising that serious negotiations to strengthen the BWC did not begin again until the late 1990s. While clearly following the Yellow Rain accusations against the Soviet Union in Afghanistan and against Vietnam, both in the early 1980s, and the revelations a few years later of large-scale CW use in the Iran-Iraq War, the only significant collective response, the formation of the Australia Group to control trade in CBW materials and technologies, is difficult to explain with the CW and BW threat measures. The Australia Group was a reaction to the ability of a single state – Iraq – to build and maintain its CW program with procurement from abroad. Difficult to explain, simply on the basis of the threat measures, is collective delegation under the CWC. The CW threat measure data predicts a retraction of delegation throughout most of the history, and this is somewhat a reflection of the real-life reliance on informal mechanisms (the aforementioned Australia Group and diplomatic pressure), ad hoc mechanisms (the UN General Assembly fact-finding mission to Iran and Iraq in the mid-1980s), and unilateral policies (SIPRI 1986; SIPRI 1989) to control CW threats.

Hypothesis Testing & Results

The outcome to be explained is delegation to international agents for NBCW issues. In this section, I test three hypotheses concerning the basic drivers of delegation to international organizations for NBCW issues. H1 argues greater NBCW threats causes states to delegate more authority to international organizations. H2 challenges the basic institutionalist hypothesis by arguing delegation occurs not because it is in the collective interests of the participants but because of the interests of the most powerful states. H3 tests the effect of the Cold War upon delegation. The causal power of nuclear threats in causing nuclear delegation, and chemical threats in causing chemical delegation, is tested using a OLS finite distributed lag model, as described in Chapter 1 (Introduction).

Threats Cause Delegation (H1)

Statistical tests of the power of nuclear threats to cause nuclear delegation (H1) were conducted using several different models and are reported in Tables 3.2-3.4 Models

1 and 2 in Table 3.2 show that using a finite distributed lag model results in coefficients that are in the right direction (increased threats cause increased delegation) and significant. Nuclear threats are a significant factor in nuclear delegation. The estimated effect of a one-unit increase in nuclear threats (including terrorism) is to increase delegation by approximately 11.3 points. Models 1 and 2 in Table 3.3 impose a higher threshold of nuclear capability (latent states rather than by skills or access) with results that are also in the hypothesized direction and significant, though the magnitude of the effect is diminished. This suggests the source of threats driving delegation are not the most advanced nuclear states (restricting the source of threats to more capable states reduces the effect on delegation), but are those conflict-prone states with developing nuclear capabilities. This could be interpreted as supporting Sagan's pessimism in the debate with Waltz over the risks of proliferation by new states (Sagan 2002).

The robustness of the threat variable is demonstrated in Table 3.4. Tests using lists of states known to be pursuing or to possess NWs (Jo and Gartzke 2007) yielded results of similar direction and magnitude, though with weaker significance. This shows the capability measure to be convergent with historical evidence about known nuclear states. This is important because convergent validity is implied for the CW threat variable, where there are no reliable data on CW programs and possession.

Inference of the results for a statistical test of H1 for CWs is made difficult by the nature of the dependent variable. As discussed above, chemical delegation is "zero" for four decades, makes a massive single-period jump, and then exhibits variation but for only a few subsequent data points for analysis. Statistical tests of the power of the CW threat to cause chemical delegation are reported in Models 1 and 2 of Table 3.5. The estimated effect of the threat is very large relative to nuclear delegation, but is insignificant and also negative. This suggests increases in the threat should cause decreases in delegation. The best interpretation of these results is that delegation to international organizations for CW issues does not occur because of changes in international CW threats but because of changes in so-far unobserved factors.

With the observed absence of any BW delegation variation from zero, there is no statistical relationship between biological threats and delegation to test. As the observed level of BW threats is greater than that measured for CWs, it may be that the the BWC is an effective solution to BW threats. However, this does not account for the non-response to increases in threats since the 1990s, especially given attempts in the 1990s to negotiate a verification protocol. If the BWC does not solve extant BW threats, then there must be other reasons for the absence of delegation for BW issues.

Delegation Is A Fig-Leaf for Superpower Power (H2)

The second hypothesis tests the argument that delegation to international organizations, like the creation of any international institution, occurs when the most powerful states want them. By extension, delegation should erode as the power of the states that demanded this relationship also erodes. The results, however, do not support this argument. Superpower power (US and US-USSR combined CINC scores, see:Singer 1987) are negatively correlated with the indexes of delegation: decreases in US and US-USSR shares of international power are correlated with increases in delegation for nuclear and chemical weapons issues (Tables 3.6 and 3.7). The magnitude of the effect of nuclear threats upon delegation is diminished but similar to that estimated without its inclusion (Table 3.2). Similar results were obtained for CW delegation and CW threats, with the notable difference that the coefficient was much higher for USSR/Russian power than for the US (Table 3.7). This is not entirely surprising given that the US had been pressing for a comprehensive CW disarmament treaty as early as the mid-1980s while the Soviets resisted such an agreement because of their heavier investment in CWs.

Delegation Is Enabled By the End of the Cold War (H3)

A dummy variable to control for the system effects of the Cold War (*ColdWar*) was included to test the relationship hypothesized in H3. The end of the Cold War has a strong and significant effect upon nuclear delegation in all models in Tables 3.2-3.4. *ColdWar* also has a positive, large and significant effect upon CW delegation. However, the inclusion had little effect upon the significance, direction, or magnitude of the other coefficients. Further, the effect of the Cold War upon delegation remains uncertain and undertheorized: the end of the Cold War could signify a change in threat perceptions, but could also proxy changes in nuclear preferences or in the cost of revealing private information to other actors necessary to effect a cartel.

Conclusions

This chapter began with the puzzle that international delegation for nuclear, biological and chemical weapons issues is uneven across time and across types. Delegation should enable states to reduce NBCW threats to levels they could not achieve on their own by producing relevant policy and private information and improving the credibility of commitments. The magnitude of the threat from NBCWs, by defining the potential benefits from cooperation, should be causal in the observed decisions to delegate.

I began by building a model for evaluating the threats, individually, from nuclear, biological and chemical weapons. This model argues that the threat of NBCW use is a function of the probability of use and the potential damage from its use; the probability of use is a function of an actor's capability to use NBCWs and the opportunities in which they can be used. After reviewing the historical evidence of these three variables (capabilities, opportunities, damage), I develop from cross-national time-series data a historically informed indicator of the threat posed at the systemic level from NBCWs. Comparing the results of this indicator for each nuclear, biological and chemical weapons to evidence of NBCW threats in the literature suggests this indicator has face validity.

The indicator is then employed to test three hypotheses. First, nuclear threats do have a strong causal role in collective nuclear delegation, though there is also significant variation left unexplained by the threat measure. Statistical tests of the effect of CW threats upon CW delegation, however, yield results that, when significant, are strong but negative: increases in the threat are negatively correlated with increases in delegation. This is also not entirely surprising as states have generally pursued unilateral or informal multilateral, but certainly non-delegating, strategies to cope with their CW threats. That is, until the collective delegation under the CWC, a major delegation of authority that does not follow from measures of the CW threats alone. Finally, BW threats were not tested because, irrespective of the variation in BW threats, there has been no BW delegation.

Second, I find US-USSR condominium and US hegemony are not causes of delegation to international organizations for NBCW issues. In fact, decreasing US and Soviet/Russian power are correlated with increasing delegation; these effects are large and significant. Third, I find the Cold War has a significant and usually positive effect upon the ability to delegate. However, the substantive interpretation of this result is far from clear.

This analysis demonstrates that the level of the NBCW threat is an important factor in explaining why delegation to IOs for NBCW issues occurs when it is observed. However, persistence of significant unexplained variation and the inclusion of a single control variable – a dummy variable for the end of the Cold War – demonstrate the incompleteness of an explanation that rests solely on threats. The Cold War may represent a significant change in how NBCW threats are perceived. However, the Cold War's end may also be endogenous to changes in the underlying preferences of states. The extent of preference heterogeneity in the system of states over strategies to cope with NBCWs must therefore be taken into account (Chapter 6). Second, even if these preferences are relatively homogeneous, the costs of implementing nonproliferation and counterproliferation strategies are not constant. States face costs to revealing private information about their NBCW-related behavior. States must also confront real-world trade-offs in determining whether to allocate scarce budget dollars to an international verification mechanism or so-called "national technical means" of monitoring other actors' behavior. The utility of using an international agent to produce information is therefore also an important consideration (Chapter 7). While it is expected that the extent of the threats creates the potential gains to be internalized through international delegation, these additional factors must be incorporated for a more complete understanding of the causal processes behind such acts of delegation for the nonproliferation of nuclear, biological and chemical weapons.

Figures and Tables

Table 3.1: States with nuclear, biological, or chemical weapons or weapons programs

Country	Nuclear[94]		Chemical		Biological	
	Program	Weapons	Program	Weapons	Program	Weapons
Afghanistan			1982-	1982-		
Argentina	1976-1990					
Brazil	1978-1990					
Bulgaria					1993-	
China	1956-	1964-	1973-	1982-	1982-	1993-
Cuba			1982-	1973-	1993-1998	
Egypt			1963-	1963-	1960-	1970-
Ethiopia			1981-	1983-		
France	1954-	1960-	1945-1988	1945-1988		
India	1964-1965; 1972-	1988-	1980-1995	1980-1995		
Iran	1974-1978; 1984-		1987-	1987-	1984-	
Iraq	1973-1991		1981-1991	1984-1993	1981-1991	1984-1996
Israel	1955-	1966-	1955-	1955-	1948-	1948-
Kazakhstan		1991-1995				
Korea, N. (DRPK)	1982-		1957-	1979-	1963-	1983-
Korea, S. (ROK)	1971-1975		1986-1997	1986-		
Libya			1983-2003	1983-2003	1991-	
Myanmar			1983-1992	1983-1992		
Pakistan	1972-	1987-				
Romania			1969-	1986-1997		
Russia (USSR)	1943-	1949-	1945-1995	1945-	1945-	1945-
South Africa	1971-1990	1979-1991	1981-1990	1982-1993	1981-1990	1982-1993
Sweden	1946-1969					
Syria			1980-	1973-	1993-	
Taiwan (ROC)	1967-1976		1983-	1989-	1983-	
Ukraine		1991-1996	1994	1994		
United Kingdom	1941-	1952-	1945-1957	1945-1957		
United States	1942-	1945-	1945-1987	1945-	1945-1969	1945-1969
Vietnam			1974-1995	1974-1995		
Serbia (Yugoslavia)			1958-2000	1959-2000		

[94] Nuclear program and nuclear weapons possession data from: Jo & Gartzke (2005).

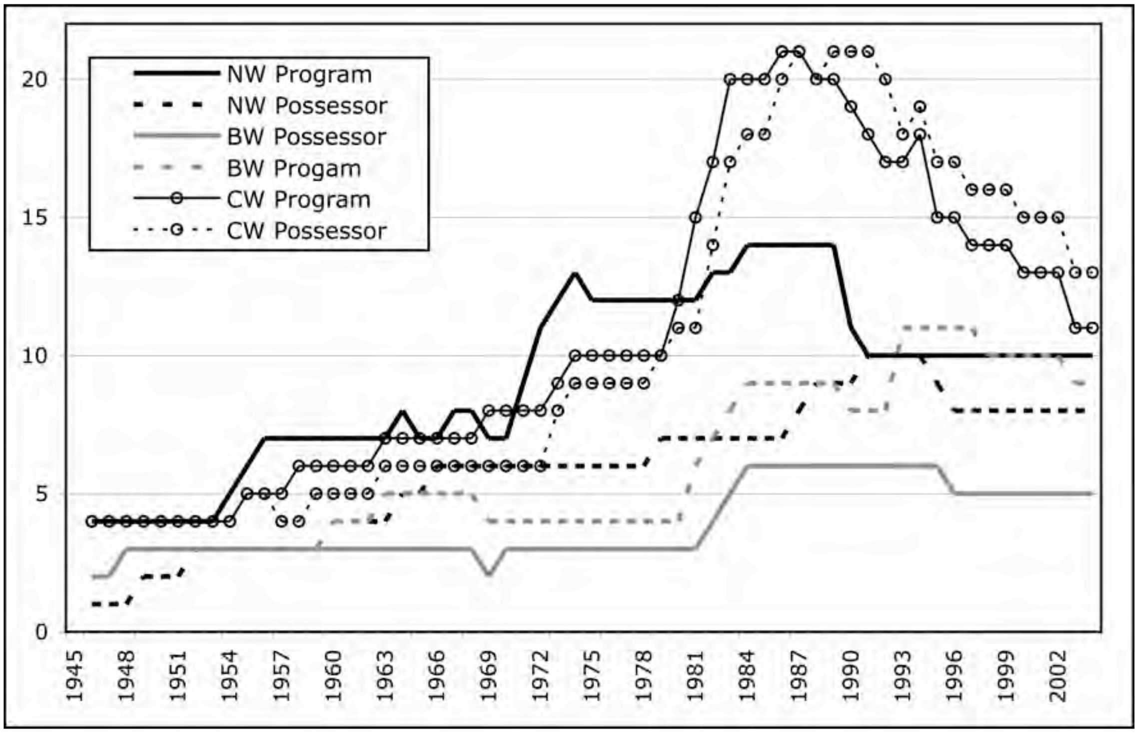


Figure 3.1: Number of NBCW Program and Suspected Possessor States

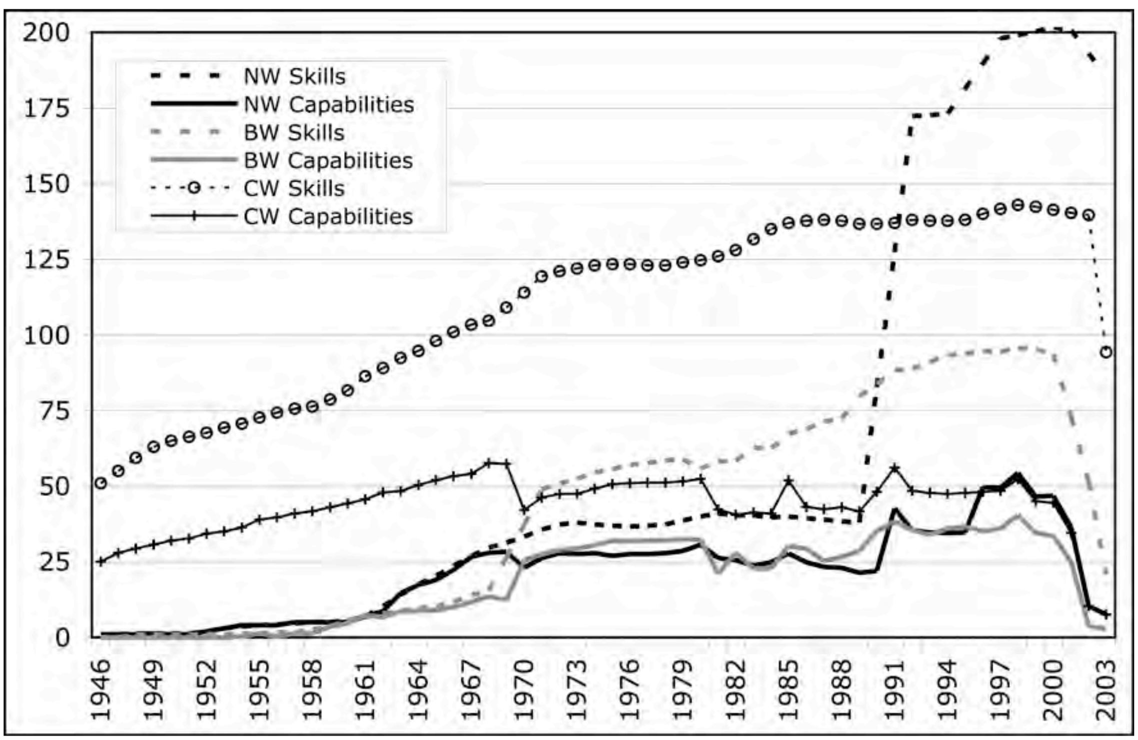


Figure 3.2: Sum of NBCW Skill & Capability Scores

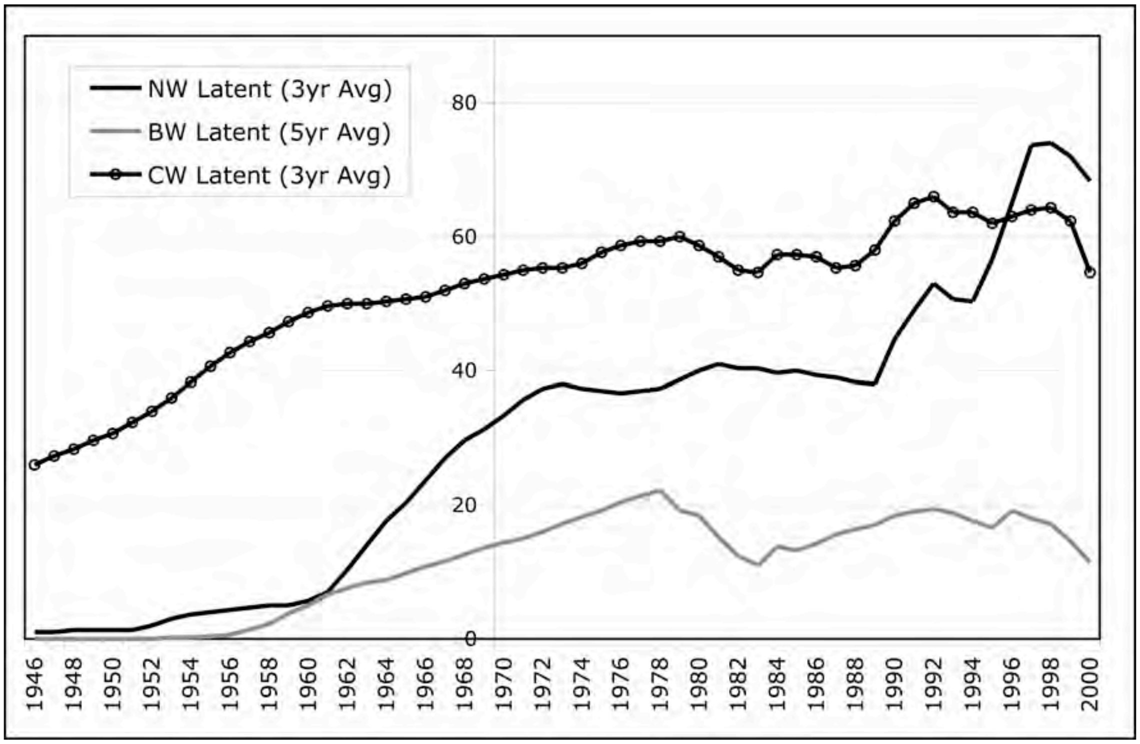


Figure 3.3: Number of NBCW Latent States

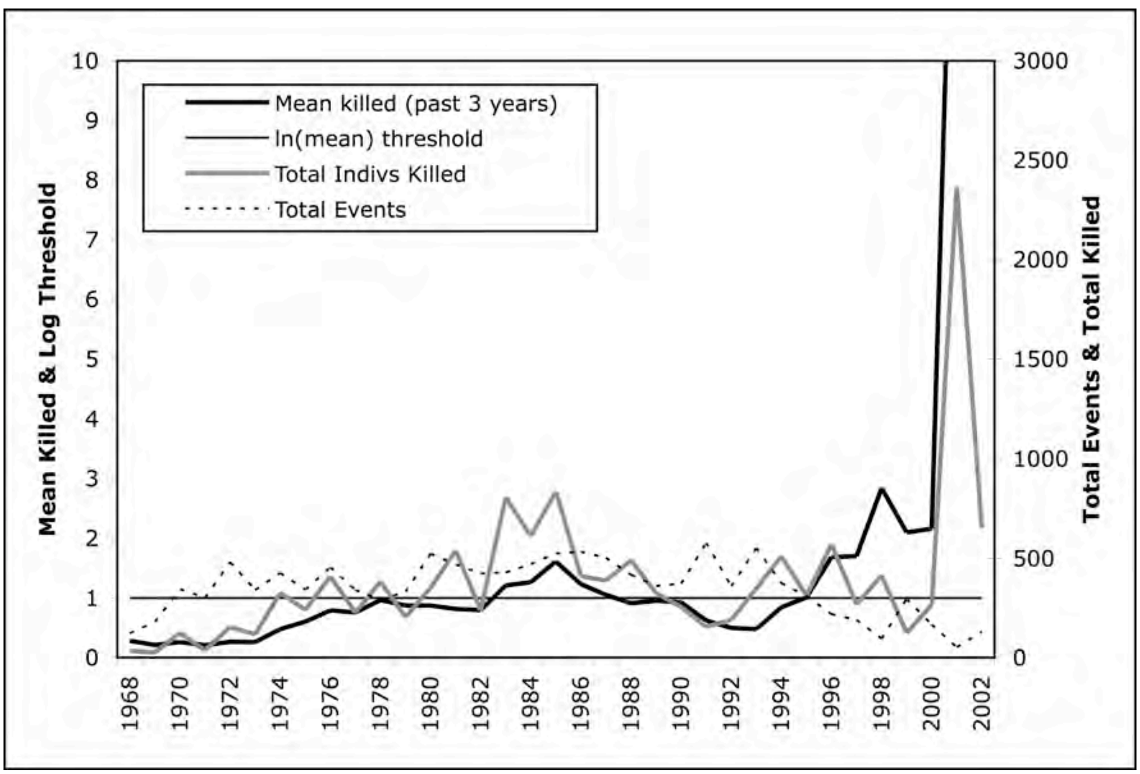
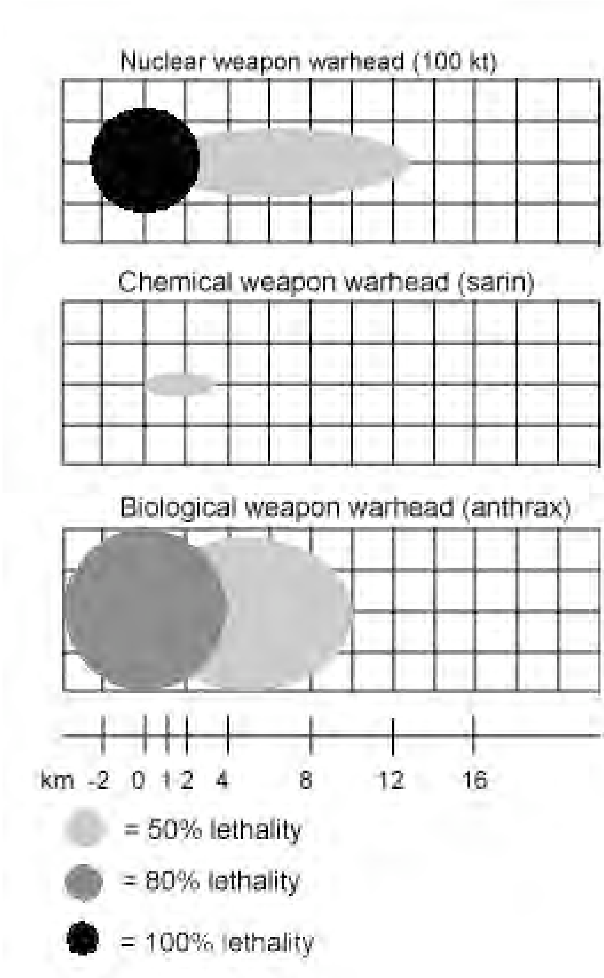


Figure 3.4: Terrorist incidents



Notes on table:

1. Adapted from: OSD. 1996. Proliferation: Threat and Response. Washington, D.C.: Office of the Secretary of Defense, U.S. Department of Defense. [95]
2. Nuclear weapon is assumed to be a 100kt nuclear warhead. In addition to deaths caused by the blast and immediate radiation release, residual radiation will be carried by prevailing winds and the grey oval describes the area that will receive in excess of 450 rems exposure (2000 rems with PF5 protection level), an exposure that is lethal for 50% of the population exposed.[96]
3. Chemical weapon is assumed to be a large missile with bomblets of sarin (GM) and exposure levels delivered to the area of between 0.1 mg-min/m^3 to 100 mg-min/m^3. An exposure of 100 mg/m^3 for one minute is lethal to 50% of the population, as is an exposure of 50 mg/m^3 for two minutes.
4. Biological weapon is assumed to be a large missile with bomblets containing anthrax, lethality declines with distance from detonation.

Figure 3.6: NBCW areas of exposure and death rates

---

[95] This figure is adapted from a similar figure published by the US Department of Defense Office of the Secretary of Defense (OSD 1996) using data provided by Scottish Campaign for Nuclear Disarmament (http://www.banthebomb.org/archives/wmd/ch4mosc.htm; accessed: 18 January 2006), Federation of American Scientists (http://www.fas.org/nuke/intro/cw/agent.htm; http://www.fas.org/nuke/intro/bw/agent.htm; http://www.fas.org/nuke/intro/nuke/effects.htm; accessed: 18 January 2006), US Department of the Army (Army 1993), Office of the Secretary of Defense (OSD 1997), atomicarchive.com (http://www.atomicarchive.com/Effects/effects15.shtml; accessed: 18 January 2006), and Intriligator & Toukan (Intriligator and Toukan 2006).

[96] Lynn Eden argues that most analyses of the effects of a nuclear weapon tend to ignore the casualties caused by firestorms: the mass fires initiated in the periphery of the blast. See: Eden, Lynn. 2004. Whole World on Fire: Organizations, Knowledge, and Nuclear Weapons Devastation. Ithaca, NY: Cornell University Press.

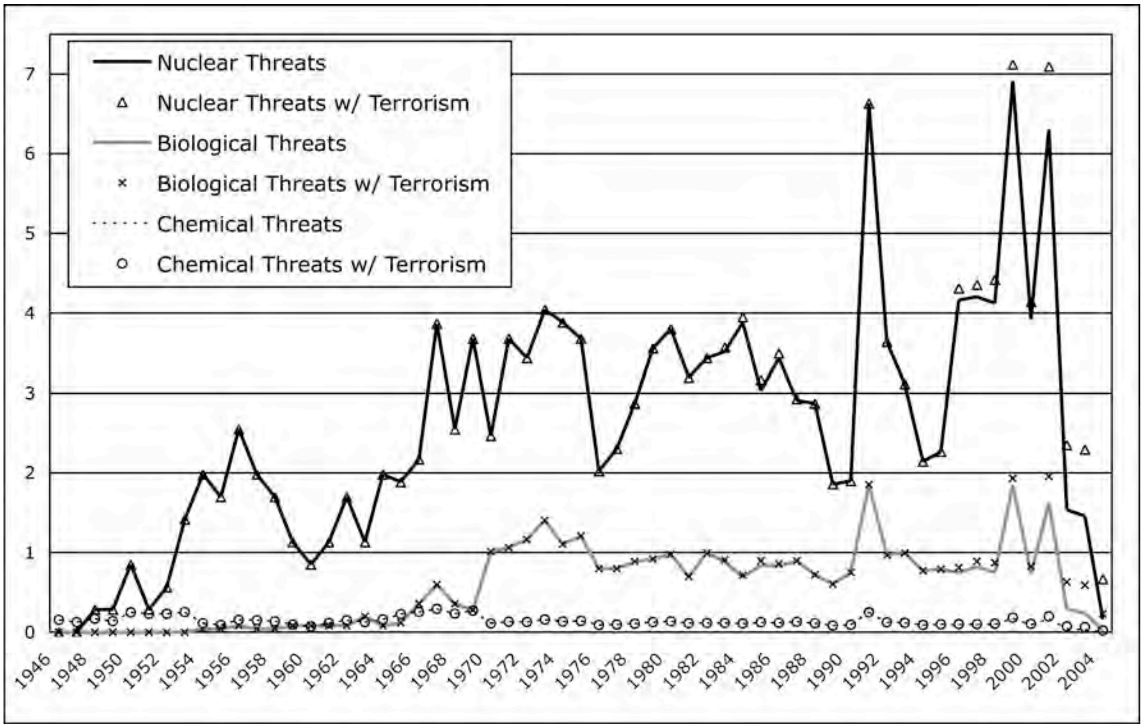


Figure 3.7: NBCW Threats: NBCW States' Conflicts, Scaled for Damage and Terrorism

Table 3.2: Nuclear delegation (nuclear threats)

Nuclear Threat	Model 1	Model 2
(Lag 1)	1.84	1.62
(Lag 2)	3.70***	3.05***
(Lag 3)	5.75***	4.74***
Distributed Effect	11.29	9.41
ColdWar		11.88***
_constant	2.10	3.89
N	57	57
R^2 (adj. R^2)	.70 (.68)	.76 (.75)

Note: ***p< 0.01; **p< 0.05; *p< 0.1.

Table 3.3: Nuclear delegation (latent state conflicts)

Latent State Conflicts	Model 1	Model 2
(Lag 1)	1.17**	.89
(Lag 2)	2.75***	2.49***
(Lag 3)	2.52***	2.32***
Distributed Effect	6.44	5.70
Cold War		7.49***
_constant	5.73***	6.74***
N	57	57
R^2 (adj. R^2)	.80 (.79)	.82 (.81)

Note: ***p< 0.01; **p< 0.05; *p< 0.1.

Table 3.4: Nuclear delegation (tests of alternative proxies for causal variables)

NW Program State Conflicts	Model 1	Model 2
(Lag 1)	4.69**	4.32**
(Lag 2)	4.18*	3.47
(Lag 3)	3.29	1.31
Distributed Effect	12.16	9.10
Cold War		12.19***
_constant	-.47	4.31
N	57	57
R^2 (adj. R^2)	.54 (.52)	.60 (.57)

NW Possessor Conflicts	Model 3	Model 4
(Lag 1)	3.46	4.09
(Lag 2)	4.26	5.17*
(Lag 3)	5.30*	6.10**
Distributed Effect	13.02	15.36
Cold War		-6.75
_constant	7.67**	5.05
N	57	57
R^2 (adj. R^2)	.62 (.60)	.63 (.60

Note: ***p< 0.01; **p< 0.05; *p< 0.1.

Table 3.5: CW Delegation (CW threats)

	Model 1	Model 2
Chemical Threat (Lag 1)	-34.43 (	-11.56
(Lag 2)	-11.88	-0.57
(Lag 3)	-16.34	-4.20
Distributed Effect	-62.65	-16.33
Cold War		13.87***
_constant	12.95***	2.48)
N	57	57
R^2 (adj. R^2)	.10 (.05)	.48 (.44)

Note: ***p< 0.01; **p< 0.05; *p< 0.1.

Table 3.6: Nuclear delegation (nuclear threats & US/US-USSR CINC Scores)

IVs	Model 1	Model 2	Model 3	Model 4
Nuclear Threat				
(Lag 1)	1.87**	1.24*	1.08	.479
(Lag 2)	1.51*	1.07	1.08	.66
(Lag 3)	1.06	.99	2.56***	1.19
Distributed Effect	4.44	3.33	4.72	2.33
US CINC	-218.6***	-215.3***		
US-USSR CINC			-141.3***	- 220.95***
ColdWar				-13.08**
_constant	59.3***	59.8***	65.37***	100.9***
N	53	53	53	54
R^2 (adj. R^2)	.90 (.899)	.94 (.93)	.91 (.90)	.94 (.937)

Note: ***p< 0.01; **p< 0.05; *p< 0.1.

Table 3.7: CW delegation (CW threats & US/US-USSR CINC Scores)

	Model 1		Model 2	
Chemical Threat (Lag 1)	-2.88	-0.58	10.62	3.79
(Lag 2)	4.99	5.77	9.61	7.33
(Lag 3)	-30.95	-20.24	-17.04	-17.96
Distributed Effect	-28.94	-15.05	3.19	-6.84
Cold War		10.42***		9.06***
US CINC	-18.30	6.06		
US-USSR CINC			-46.85***	-8.81
_constant	9.96**	1.11	17.48***	4.27
N	53	53	53	53
R^2 (adj. R^2)	.08 (.01)	.37 (.30)	.27 (.21)	.37 (.30)

Note: ***p< 0.01; **p< 0.05; *p< 0.1.

Appendix: NBCW Program and Possessor Codebook

Nuclear Weapon Programs and Possessors (Jo and Gartzke ND)

Chemical and Biological Weapons Programs

- AFGHANISTAN: SIPRI reported that allegations have been made (in 1983, 1987, 1988 and 1995), primarily by the US, that Afghanistan is a CW possessor state (SIPRI 1969-2004). SIPRI in 1995 cites a CRS report as naming Afghanistan as "probably" a CBW state (SIPRI 1995).
- BULGARIA: US Congressional Office of Technology Assessment listed as suspected of having undeclared offensive BW program (CSIS 2000).
- CHINA: Allegations that China has an active CW program emerge as early as 1973 (Robinson 1973) and has subsequently been named repeatedly as a CW state in US reports beginning in 1982 (SIPRI 1969-2004). China is similarly implicated in having an offensive BW research program as early as 1982. The reports are conflicting, with China implicated in 1981 (SIPRI 1982), possibly possessing BWs or having a BW program in 1994 and 1995 (SIPRI 1994; SIPRI 1995), and listed as having an undeclared offensive program in 1993, 1998 and 2000 (CSIS 2000; SIPRI 1996; SIPRI 1998).
- CUBA: In 1973 it was reported that Cuba may have received a large stock from USSR (Robinson 1973) and since there have been additional reports in the mid-1980s that Cuba is a CW possessor (SIPRI 1983; SIPRI 1987) and that Cuba used CWs in Angola (SIPRI 1989), though the US may have retracted this allegation. SIPRI in 1995 cites a CRS report as naming it as being “suspected” of having a CBW program (SIPRI 1995:340). The US Congressional Office of Technology Assessment in 1993 listed as having undeclared offensive BW program (CSIS 2000). SIPRI in 1995 cites a CRS report as naming it as being "suspected" of having a CBW program (SIPRI 1995:340).
- EGYPT: Egypt has been alleged to have chemical weapons since the 1950s (Robinson 1973; US Senate 2002), and especially after allegations that it used chemical weapons in Ethiopia in 1963-1967; however, these allegations conflict with the fact that Israeli forces did not encounter chemical weapons in the 1967 or 1973 wars with Egypt (SIPRI 1982). That said, SIPRI reported in 1985, 1987, 1989, 19993 and 1995 that US reports or intelligence leaks had named Egypt as possessing militarily significant quantities of chemical weapons (SIPRI 1969-2004). With respect to biological weapons, Egypt announced early in 1972, before signing the BTWC, that it possessed biological weapons (CSIS 2000). The US Arms Control and Disarmament Agency (ACDA) Director identified it in 1996 as a state believed to have “an active biological weapons program”, and ACDA stated in July 1998 that, “There is no evidence to indicate that Egypt had eliminated this capability and it remains likely that the Egyptian capability to conduct BW continues to exist” (CSIS 2000). SIPRI from 1995-1997 reported Egypt was “probably” a CBW state (SIPRI

1969-2004). Shoham details the Egyptian CW and BW programs in the 1960s-1970s (Shoham 1998).

- ETHIOPIA: Based on US statements, SIPRI reported in the 1980s (1982-1987) and in 1995 that Ethiopia was a CW possessor state - including allegations of use against Eritrea in 1988 (SIPRI 1989) - and left open the possibility that it may have engaged in some BW-related activities (SIPRI 1969-2004).
- FRANCE: France was among the few states to publicly acknowledge (prior to the CWC entering into force) that post-WWII it had a modern CW program (Robinson 1973; SIPRI 1982), and announced in 1987 that it was to begin chemical weapon rearmament (SIPRI 1989). Reports also appear to indicate some BW-related research (Robinson 1973; SIPRI 1995).
- INDIA: In its declaration on chemical weapons capabilities submitted to the OPCW upon the entry into force of the CWC, India admitted that it had a small-scale chemical weapons manufacturing facility and possessed chemical weapons, though it asserted these were for defensive purposes only (Hogendoorn 1997). SIPRI reported that Russia (SIPRI 1994) and the US (SIPRI 1998) both alleged India to have a CW program. Some sources list India's CW stockpile as consisting of mustard gas abandoned by the UK at the end of WWII, so it is difficult to ascertain when if ever India produced CWs. SIPRI reported in 1994 that Jane's Consultancy Services alleges India "possibly" possesses BWs (SIPRI 1994), an allegation that is supported by US reports (SIPRI 1995; SIPRI 1998), though India asserts all BW-related research is defensive only.
- IRAN: SIPRI reported in 1986 that the US stated Iran was seeking CWs (SIPRI 1987); in 1997 Iran reported it began CW production in 1987 (SIPRI 1988) and subsequent US and Russian reports (as reported by SIPRI in 1989-1998) named Iran as a CW possessor (SIPRI 1969-2004). Allegations that Iran possessed BWs preceded allegations concerning CWs, with SIPRI reporting in 1985 on allegations that Iran had violated the BWC with the use of cholera (SIPRI 1985). SIPRI has since reported on US reports that named Iran s a BW possessor (SIPRI 1992; SIPRI 1995; SIPRI 1996; SIPRI 1998), reports that are corroborated by Jane's Consultancy Services (SIPRI 1994) and repeated by the Canadian Security Intelligence Services (CSIS 2000). Finally, the US DOS identified it in 1998 as a “state sponsor of terrorism” with a BW program (US Senate 1998). The CIA was publicly reported in August 1996 to have credited Iran with a BW program, “largely in the research and development stage,” although Iran could possess weaponized biological agents that could be dispersed by artillery and aerial bombs, and be pursuing the development of biological warheads for ballistic missiles; Russia's Foreign Intelligence Service (SVR), in its 1993 report, acknowledged, that “It cannot be ruled out that small stocks of biological agents have already been created,” noting that Iran had reportedly been seeking to purchase “unofficially” equipment and material suitable for the production of mycotoxins in particular (CSIS 2000).
- IRAQ: SIPRI reported in 1982 that Iraq was implicated in CBW activity (SIPRI 1982) and the UN in 1984 confirmed its use of chemical weapons in the Iran-Iraq

War (SIPRI 1985). SIPRI reported in 1985 that there had been alleged BWC violations by Iraq (SIPRI 1985). SIPRI reported that Iraq continued to use CWs in the Iran-Iraq War in 1985 (SIPRI 1986) and in 1986 (SIPRI 1987), and in 1988 used CWs against civilians (SIPRI 1989). Iraq's CW and BW programs continued after the end of the Iran-Iraq War until Iraq was disarmed by UNSCOM after the First Gulf War during 1992-1996. US sources continued to assert Iraq had an ongoing BW and CW program until the US-led coalition overthrew and replaced the government in 2003 (the US Iraqi Survey Group in 2005 reported that it could not find any WMDs or extant programs to produce them, but that Iraq maintained "an intention" to resume offensive BW research).

- ISRAEL: Israel has been alleged to have had a CW program since at least the 1970s; Robinson stated in 1973 states there were allegations that it has CWs (Robinson 1973) and US Lt. Gen. Almquist testified to the US Senate that it possessed an operational CW program. SIPRI reported on US reports that Israel possessed CWs numerous times 1985-1995 as well as a 1993 Russian report to the same effect (SIPRI 1969-2004). Reports regarding an Israeli BW program are conflicting, with US (SIPRI 1995) and French reports (CSIS 2000; SIPRI 1994) alleging Israel's offensive BW program was quite advanced but the SVR (Foreign Intelligence Service, Russia) stating in 1993 that while it pursued biological research "in which elements of a military-applied purpose are present" and "Israel possesses a strong civilian biotechnology base, which, if necessary, could be reoriented sufficiently rapidly to the production of biological weapons," there was "no direct evidence of the presence in Israel of biological weapons" (CSIS 2000). However, others have testified to the US Senate that Israel has had a CW program since the 1950s and a BW program since 1948 (Cohen 2001; Cohen and Graham Jr. 2004; US Senate 2002).
- KAZAKHSTAN: SIPRI in 1995 cites a CRS report as naming it as "probably" a CBW state (SIPRI 1995:340).
- KOREA, DEMOCRATIC PEOPLE'S REPUBLIC OF (North Korea): SIPRI reported on US, but also USSR/Russian and South Korean, allegations that North Korea possessed chemical weapons beginning in 1985 and continuing through to the present; North Korea is widely believed to have a large number of chemical weapons among the missiles and other weapons deployed along the DMZ separating it from South Korea (SIPRI 1969-2004). The Nuclear Threat Initiative (NTI) reports that the DPRK began research into offensive CWs about 1957 after the acquisition of some agents from USSR[97]; despite ongoing attempts, North Korea appears to have been unsuccessful at advancing its program without further assistance and doesn't begin full-scale production of CW agents until around 1979 (NTI 2004b).[98] North Korea

[97] See: Joseph S. Bermudez Jr., "CW: North Korea's growing capabilities." Jane's Defence Weekly, Vol. 11, No. 2, 14 January 1989, p. 54.
[98] See: (1) Testimony, Hearing of the International Security Proliferation and Federal Services Subcommittee of the Senate Governmental Affairs Committee, Weapons Proliferation in North Korea, 21 October 1997. (2) South Korea Says North Has Biological, Chemical Weapons,"

had "begun to emphasize" an offensive BW program during the early 1960s (CSIS 2000; US Senate 2002); SIPRI further reported allegations as early as 1986 (and repeated 1994-1998) that North Korea was implicated violations of the BWC (SIPRI 1986) and had a BW program (SIPRI 1969-2004; US Senate 1998). NTI suggests that the BW program began in the 1960s and began producing BW agents in the 1980s (NTI 2004a).[99]

- KOREA, REPUBLIC OF (South Korea): South Korea has been alleged by North Korea to have a chemical weapons program (SIPRI 1986; SIPRI 1989), allegations that have seen some support by US reports (SIPRI 1987; SIPRI 1995). These allegations have apparently been confirmed by South Korea's declarations to the OPCW as required under the CWC, as South Korea is the unnamed "State Party" described in OPCW documents as being a CW possessor state (Moodie 1999) and is making positive progress under the CWC in destroying any stockpiles it has.[100] South Korea has also been alleged to have some BW capabilities (SIPRI 1994; SIPRI 1995).
- LIBYA: SIPRI reported US allegations from 1984-1997 that Libya possessed chemical weapons (SIPRI 1969-2004), reports which were supported by similar Russian reports but which Israel in 1986 stated could not be confirmed (SIPRI 1987). Reports that Libya was pursuing BWs emerged first in 1991 (SIPRI 1992) and these allegations were repeated throughout the 1990s (SIPRI 1969-2004). However, SIPRI reported in 1998 that the 1997 US Proliferation Threat and Response listed it as having an inadequate infrastructure to support a BW program; it said Libya "may be able to produce laboratory quantities of agent," but: "Given the overall limitations of the program, it is unlikely that Libya will be able to transition from laboratory work to production of militarily useful quantities of biological warfare agent until well after the turn of the century" (SIPRI 1998). The US Arms Control and Disarmament Agency reported in July 1998, "Evidence indicates that Libya has the expertise to produce small quantities of biological equipment for its BW program and that the Libyan Government is seeking to move its research program into a program of weaponized BW agents" (CSIS 2000). Libya announced in December 2003 that it would abandon its nuclear, biological and chemical weapons programs; disarmament of CWs was completed in 2004 under supervision of the OPCW.
- Myanmar: SIPRI reported on US allegations from 1984 to 1995 that Myanmar possessed chemical weapons (SIPRI 1969-2004). A 1994 US Congressional Research Service report broadened the allegation by identifying it as "probably" a CBW state (SIPRI 1995) but a 1993 Defense Intelligence Agency report stated that Myanmar is no longer developing CWs.

Kyodo News Service, 23 October 2 1992; Joseph S Bermudez Jr., "CW: North Korea's growing capabilities...," Jane's Defence Weekly, Vol. 11, No. 2, 14 January 1989, p. 54.

[99] See: Pak Tong-sam, "How Far Has the DPRK's Development of Strategic Weapons Come?," Pukhan, January 1999, pp. 62-71, translated in FBIS Document ID: FTS19990121001655.

[100] It should be noted that, during interviews conducted for this project, no government or OPCW officials appeared willing to discuss or reveal the identity of the "State Party".

- PAKISTAN: SIPRI reported first in 1982 that Pakistan has been involved in the proliferation of chemical weapons (SIPRI 1982), and subsequently reported on US and other allegations from 1987 to 1997 (SIPRI 1969-2004). However, these allegations have not been supported and some (such as allegations by USSR that Pakistan provided CWs to the Taliban in Afghanistan) were disconfirmed. Pakistan was first alleged to have a BW capability in 1993 (SIPRI 1994), an allegation that was repeated by US sources in 1994 and 1997, though US sources appear to indicate that while Pakistan has a BW research capability, there is no evidence of the production of BW agents.
- RoMANIA: SIPRI reported in 1987 that the US reports Romania is a CW possessor (SIPRI 1987). Other sources cite a 1982 US intelligence report as indicating it had CW production facilities.
- RUSSIA (SOVIET UNION): Robinson stated that USSR was believed to have extensive CW programs (Robinson 1973). The USSR was alleged to have used CWs in Afghanistan in the 1980s and to make widespread CW use a component of its European strategy to compensate for Western nuclear supremacy. In 1990, SIPRI reported that the USSR stated that it does not manufacture CWs, does not have CWs outside its borders, and has never transferred to CWs to another state (SIPRI 1990). Russian research into CWs allegedly continued into the 1990s according to reports that it had developed potent new nerve agents. Russia has reported that it is endeavoring to fulfill its obligations under the CWC to destroy its CW stockpiles but has been encountering financial and technical hurdles. With respect to BWs, there were first reports of a Soviet BW program beginning in 1960 (Miller, Engelberg, and Broad 2001) but about 1968 the US began to reject these reports because it couldn't locate supposed facilities (Robinson 1973). Miller, et al, state that the Soviet BW program began pre-WWII and resumed in 1946 with major advances by 1956 (Miller, Engelberg, and Broad 2001). The USSR is reported to have begun a major BW effort in 1975 that was revealed by the 1979 anthrax release; this program was finally terminated in 1991 after the fall of the Soviet Union, though reports emerged in 1992 that offensive BW research activity had continued and Russia has been quite resistant to permitting access to BW research-related facilities, such as that sought under the Cooperative Threat Reduction program.
- SOUTH AFRICA: Robinson in 1973 stated South Africa possessed CWs (Robinson 1973). SIPRI reported in 1982-1995 that South Africa was a chemical weapons possessor, including allegations of CW use in Angola in 1988 (SIPRI 1969-2004). SIPRI reported in 1996 that it had a program in the mid-1980s and terminated the program in 1993 (SIPRI 1996), whereas other sources put the program as initiating in 1980 and being dismantled in 1990 alongside its nuclear disarmament. There were also reports in the mid-1990s that South Africa possibly had a BW program (SIPRI 1994; SIPRI 1995). Gould & Folb (2000) state that a combined CBW program was initiated in 1981, with production facilities completed in 1982, and "Project Coast" being terminated in 1990 and most agents (except non-lethal incapacitating CWs) being ordered destroyed in January 1993 (Gould and Folb 2000).

- SYRIA: SIPRI reporting on US allegations that Syria was a CW possessor state began in 1985 and continued through to the present (SIPRI 1969-2004), though some sources allege Syria's CW program began in the 1970s. It appears Syria received significant stockpiles of CWs from Egypt in 1973 but did not begin its CW program until the late 1970s or early 1980s (Diab 1997). SIPRI likewise reported on US allegations that began in 1994 that Syria had an offensive BW program. In 1993, Russia's Foreign Intelligence Service (SVR) maintained that "there is no reliable information about the existence of biological weapons in Syria or a target program for the creation of an offensive potential in the biological sphere" while in 1997 the US Defense Department stated outright that "Syria probably has an adequate biotechnical infrastructure to support a small biological warfare program, although the Syrians are not believed to have begun any major weaponization or testing related to biological warfare" ((Canada) 2000).
- TAIWAN: SIPRI reported in 1985 that a US July 1984 Special National Intelligence Estimate had named Taiwan as a chemical weapons possessor state, allegations which have been repeated through at least 1995 (SIPRI 1969-2004). The US Director of Naval Intelligence is reported to have testified to Congress that the CW program was operational in 1989. The 1984 NIE also named Taiwan as "possibly developing" BWs (SIPRI 1994) and these allegations were repeated in 1995-1996 but in 1998 US Arms Control and Disarmament Agency concluded "The evidence indicating a BW program is not sufficient to determine if Taiwan is engaged in activities prohibited by the B[T]WC" (CSIS 2000).
- UKRAINE: SIPRI in 1995 cites a CRS report as naming it as "probably" a CBW state (SIPRI 1995:340).
- UNITED KINGDOM: The UK had a chemical weapons program during WWII but reported that it destroyed its CWs stockpiles in 1957 (Robinson 1973). In the mid-1980s the government contemplated rebuilding a CW program under pressure from the US but determined it could rely upon its nuclear deterrent.
- UNITED STATES OF AMERICA: The US had a chemical weapons program at the close of WWII and maintained an active program and stockpiles through 1969 but had not added to them since 1969 (Meselson and Robinson 1980). The US began exploring the production of chemical weapons again in 1986, focusing on so-called binary chemical weapons, because it judged its current stockpiles to be obsolete and nondeployable, but terminated the program before full-scale production began. The US began destroying its chemical weapons in the 1990s to bring the US into compliance with the CWC, but has yet to complete the process. SIPRI reported that US officials in 1987 named US as a known CW possessor (SIPRI 1988:102). SIPRI reports in 1988 that US CW destruction continues and new CW production was stopped by Congress (SIPRI 1989:104). In 1969, the US was the only state acknowledging an offensive BW program, a program that was terminated by US President Nixon in 1969 (though there were allegations that the CIA continued some offensive BW activities into the mid-1970s). The US does maintain a large and active

BW defensive research program. The US has been accused of using CW and BW in a number of military actions.

- VIETNAM, DEMOCRATIC REPUBLIC OF: SIPRI reports in 1982 that Vietnam has been involved in the proliferation of chemical weapons, including the alleged use of chemical weapons against Laos 1974-1981 (SIPRI 1982). SIPRI reported allegations 1983-1995 that Vietnam possessed chemical weapons though some sources doubt there is a indigenous production capacity and others argue Vietnam may have captured significant stocks of tear and CS gas from the US after the US withdrew from Vietnam (SIPRI 1969-2004).
- YUGOSLAVIA (SERBIA): Sources indicate that Yugoslavia may have had an active CW program, which was inherited predominantly by Serbia when the state dissolved. The CW program began small-scale production of CWs in 1958[101] and moved to larger-scale agent production in 1959. CW use was incorporated into military doctrine in 1981. Since, allegations emerged in 1994 that Croatia used tear gas and chlorine gas against Serbia (SIPRI 1994). Yugoslavia acceded to the CWC in 2000 and OPCW inspectors supervised the destruction of remaining CW-related equipment and materials.

Other states sometimes alleged to have chemical or biological weapons programs:

- ALBANIA: Albania reported to the OPCW in 2002 that it discovered a small stockpile of CWs on its territory. Stockpile destruction is underway through funding from the US under the Cooperative Threat Reduction program and is being supervised by the OPCW.
- ANGOLA: SIPRI reported in 1986 that Angola was implicated in the use of chemical weapons in 1985 against UNITA and again in 1988 and 1994 (SIPRI 1986; SIPRI 1989; SIPRI 1994). Some sources suggest that these chemical weapons came from Cuba, USSR, and/or South Africa.
- CHILE: SIPRI reports on a 1993 Russian report that alleges Chile has CWs or a CW capability (SIPRI 1994); SIPRI in 1995 cite a 1994 US report by the Congressional Research that names Chile as being "suspected" of having a CBW program (SIPRI 1995).
- CZECHOSLOVAKI: Named by SIPRI in 1987 as being a "past possessor" of CWs (SIPRI 1987), after SIPRI reported in 1986 that US officials had named Czechoslovakia "sometimes" as a chemical weapons possessor state (SIPRI 1986:173).
- GERMAN DEMOCRATIC REPUBLIC: SIPRI reported in 1986 that US officials had named GDR "sometimes" as a chemical weapons possessor state (SIPRI 1986).

---

[101] "Yugoslav Chemical Warfare Capability. Mostar's History of Chemical Weapon Research, Development, Production: What, When, Where, How Much?" The ASA Newsletter, <http://www.asanltr.com/ASANews-99/992a.htm>

- INDONESIA: SIPRI reported in 1986 that Indonesia was implicated in the use of chemical weapons in 1985 (SIPRI 1986) while SIPRI in 1987 named Indonesia as having inherited its CWs from the Dutch and having since destroyed them (SIPRI 1987).
- NICARAGUA: SIPRI reported in 1986 that Nicaragua was implicated in the use of chemical weapons in 1985 (SIPRI 1986) and in 1987 that the US reports Nicaragua is a CW possessor (SIPRI 1987), though the US retracted this allegation.
- POLAND: SIPRI reported in 1986 that US officials had named Poland "sometimes" as a CW possessor state (SIPRI 1986).
- PORTUGAL (CW 1973-): Robinson in 1973 states there were allegations that it has CWs (Robinson 1973).
- SUDAN: Sudan has had a CW program since the 1980s (US Senate 2002).
- THAILAND: After reporting in 1985-1986 that Thailand was suspected of having a chemical weapons (SIPRI 1986), SIPRI reported in 1986-1988 that Thailand was "apparently not" a CW possessor (SIPRI 1986) and that some US officials also doubted Thailand possessed chemical weapons (SIPRI 1989). In 1995, SIPRI cited a CRS report as naming it as being "suspected" of having a CBW program (SIPRI 1995).

Chapter 4: Preferences and Delegation

Neoliberal institutionalists have long argued that cooperation with others through institutions can solve some of the problems of opportunism, uncertainty, asymmetric information, and contract enforcement that can arise in arms-length market transactions between states (Haggard and Simmons 1987). Delegation by states represents an even deeper level of institutionalized cooperation with potentially even greater gains. A major precondition for cooperation is sufficiently shared preferences over outcomes. While a growing number of analysts are attempting to identify state preferences and incorporate indicators of such "revealed" preferences in their analyses, most infer the convergence of preferences from the decision to create and strengthen international institutions (Keohane and Martin 1999).

This chapter tests the hypothesis that preferences must converge among the prospective collaborators prior to their collective delegation of authority. Convergence is defined here in spatial terms as a decrease in the linear distance between states' preferred policy outcomes. If the hypothesis is correct, a major precondition for whether states will agree to delegate to solve their joint concerns over NBCW proliferation is the extent to which they actually share that concern. All states at all times do not necessarily believe proliferation worsens the security threats they face. However, cooperation becomes possible when they share this perception, and share the belief that by working cooperatively they can collude to raise to states to acquiring NBCWs.

I begin by examining the literature on preferences and developing a theory that describes the relationship between the distribution of state preferences over outcomes in an issue area, and the decision to delegate authorities to an international actor to produce collectively sought outcomes. I then examine the role of preferences by examining the history of two negotiations to select, and then begin to monitor and enforce, a bargain for controlling the threats posed by nuclear and chemical weapons. These negotiations result in the Statute of the IAEA and the Chemical Weapons Convention and reflect the collective selection of an equilibrium strategy, including its monitoring and enforcement, that occurred when the interests of a diverse body of important states coalesced. This history provides confirming evidence for the preference convergence hypotheses.

To test the hypotheses statistically, I develop an indicator of revealed preferences for NBCW issues using the "S" statistic proposed by Signorino & Ritter and data on NBCW-relevant votes in the United Nations General Assembly and ratification of formal NBCW treaties (Gartzke 1998; Gartzke 2000; Signorino and Ritter 1999). This indicator does not tell us what particular strategies states prefer, but it does indicate the extent to which states preferences are similar or different on NBCW issues. The year-to-year trends in these statistics appear to match expectations about the importance of preferences created by historical analysis. Finally, I statistically test the relationship between the distribution of NBCW preferences and measures of delegation. This quantitative analysis provides additional evidence that the distribution of NBCW preferences are causally related to collective decisions to delegate for NBCW issues.

Delegation and Preferences

While most IR scholars acknowledge the importance of state preferences for explaining or predicting behavior, we are unable to directly observe preferences. This presents problems for how we infer actors' preferences and how these interests interact to produce outcomes. Realists have focused on the most powerful states, as indicated by their military capabilities, and ignore the role of the less major and the minor states in explaining systemic-level outcomes (Mearsheimer 2001; Waltz 1979). Of course, these analyses also usually ignore differences in the interests of states, assuming interests to be identically ordered and inherently conflicted in their search for power.

Others acknowledge the causal power of differences in interests among actors and their ability to cooperate to achieve conjoined interests, but are often unable to agree *ex ante* which actors' preferences matter most. Lyne, Nielson and Tierney show that, especially in highly institutionalized international interactions, as is present in most IOs, it can be misleading and lead to falsely negative results to focus only on the great powers and to exclude small states that participate in the voting coalitions that form in IO governing bodies to change the status quo policies (Lyne, Nielson, and Tierney 2006a). The specification of the relevant actors has a large effect upon hypothesis testing (Lyne, Nielson, and Tierney 2006a; Lyne, Nielson, and Tierney 2006b).

Analysts of international trade policy have used a variety of means to determine individual preferences, such as Scheve and Slaughter's use of data on employment income (factor income) and asset ownership to explain trade policy preferences (Scheve and Slaughter 2001) and Beaulieu and Magee explain the policy preferences of US political action committees using the import-export orientation of their contributors (Beaulieu and Magee 2004). In the specific context of international delegation, there is growing application of revealed preferences to explain behavior by both principals and agents. For example, Lyne, Nielson and Tierney in a number of articles impute foreign policy preferences over lending by international banks using indicators of national social and environmental policy (Lyne, Nielson, and Tierney 2006a; Lyne, Nielson, and Tierney 2006b; Nielson and Tierney 2003).

In the area of security preferences, it is far more common to assume the preferences of states. Most Realist-inspired work assumes state's security policies are driven by concerns for relative power (Morgenthau 1985; Waltz 1979), though more refined efforts have security policies responding to threats that are largely a function of power (Walt 1985). Other efforts have focused on other factors that affect the security preferences of states, such as distance, the domestic instability of neighbors, and regime type (Gleditsch 2002). However, while these analyses certainly help to explain and predict international conflict, they only assume preferences based on unit characteristics and do not actually identify the actor's preferences.

One reason is that identifying preferences, as discussed above, is theoretically problematic. Preferences can be arrived at by assumption, deduced from other theories, or inductively through observation (Frieden 1999). Imputing actor preferences based on observations of their past behavior is referred to as using "revealed preferences." When determining preferences inductively, however, we know states behave strategically and therefore a states full ranking of preferences cannot be inferred from their behavior (Frieden 1999). For example, just because a state chooses to join a particular international organization with a particular goal doesn't mean it prefers that strategy to an alternative organization or goal. In this case, joining implies only that the state prefers joining to not joining. A sufficient number of such decisions, however, may provide a basis for inferring something about a state's preferences. Arriving at preferences of individual actors is a problem, but we must also determine how these interests interact. We must be able to compare state's decisions to each other state on the same questions to infer something about the relationship created by the differences in their preferences.

Cooperation in cartels can be hard to effect when actors have different preferences over outcomes or they share general preferences over outcomes, but disagree over the distribution of the gains from cooperation (Downs 2000; Martin 1992b). To illustrate, an individual state in the international system can be said to have an ideal point within a given policy space that describes a policy in which its preferences are perfectly satisfied. Moving out from this point are other outcomes that the actor prefers less than his ideal point, represented by indifference curves (assumed concave), but which provide that actor with a positive utility that decreases as the indifference curves move farther from the ideal point. While it is an oversimplification, this actors' preferences can be represented graphically, as in Figure 4.1, where actor "A" has a single ideal point at "A_1" and a single indifference curve displayed (arc "A_1") for a policy space with two dimensions, x and y. Added to Figure 1 are two additional actors ("B", and "C") who have different ideal points (represented by "B_1" and "C_1", respectively) and who face the status quo outcome at "SQ_1".

The area in which the three indifference curves overlap is referred to as the "winset" for those states: a set of policy outcomes they would all accept as an outcome. The figure also demonstrates the effect of a change in B's preferences such that they converge with, or become spatially closer to, those of A and C: the size of the winset increases and more policy outcomes become feasible.[102] Even when preferences are clear and nearly aligned, small differences in preferences and beliefs about the causal structure require bargaining to distribute gains and select strategies.

The nature of the good to be produced, however, determines which actors' cooperation or positive contribution is necessary for production to occur.[103] However, while the positive contribution of more actors to cooperation on NBCW issues can be made necessary by the nature of the good to be produced – nonproliferation is a public good with a "weak link" production function (Chapter 1) – in most cases the inclusion of additional actors in the interaction can only decrease the size of the winset and reduce the potential for cooperation (Tsebelis 2002). Further, uncertainty over preferences can make it harder to identify bargains which are likely to be stable – equilibrium outcomes – because they are incentive compatible.

Cooperation is the mutual adjustment of actors' strategies to produce outcomes better than could otherwise be achieved (Keohane 1984). The benefits to an individual actor are maximized as policy outcomes converge with that actor's ideal point; as multiple actors' ideal points converge, cooperation presents less compromise and becomes more likely. As delegation is one form of cooperation, delegation should become more likely as preferences converge.

Delegation to an IO can be a solution to cooperation problems to the extent that the act of delegation and then the ongoing principal-agent relationship produce additional

---

[102] A larger bargaining space does not necessarily mean a cooperative policy outcome will occur; the actors must still bargain over the policy outcome and may take advantage of whatever leverage they bring to the table (Powell 1999).
[103] There is an extensive literature on collective action (Aggarwal and Dupont 2003; Aoki 2001; Axelrod and Keohane 1986; Cooter 2000; Esteban and Ray 2001; Hirschleifer 1987; Holzinger 2003; Olson and Zeckhauser 1966; Ostrom 1990).

information and improve the credibility of commitments. The general hypothesis, therefore, is that delegation of authorities by state principals to international agents is more likely to occur when the preferences of the state principals are closer rather than when they are farther apart:

> *H1: The more convergent the distribution of actors' preferences over NBCW issues, the greater will be delegation to NBCW international organizations.*

A second, more specific hypothesis (H2), endogenizes institutional change over time. After the initial contract has been negotiated, change in the preferences of actors comprising the collective principal should cause revision of the delegation contract. If a shift results in preference convergence among the principals, they should increase their delegation to the agent. If their preferences diverge, the inverse should then be true and delegation should decrease.

> *H2: The more convergent the distribution of actors' preferences post-delegation, the greater will be delegation to investigate and propose changes to the delegation contract.*

A recurring theme in the literature on cartels is the power to affect prices of the actors who are colluding. While NBCWs are clearly a "weakest link" issue, states with more NBCW "market power" are more important to successfully mitigating NBCW threats than those without such influence. In both hypotheses, therefore, the preferences of states with NBCW market power should have a stronger causal effect than those without NBCW capabilities.

Preferences and NBCW Cooperation

International cooperation on NBCW issues has exhibited three consistent divisions in state preferences. Two of these divisions are obvious to observers of international relations. The first division is the Cold War gap between the United States and the Soviet Union. This division was generally reflected in which side was more disadvantaged by a given individual arms control agreement and by the provisions required to make the agreement credible. Usually, the USSR rejected intrusive inspection regimes because it feared compromising military secrets (and its closed society). It was not opposed to trampling the sovereignty of others and opening them to inspections, only to opening itself. The USSR also actively strengthened the role of the UN Security Council in oversight of international peace and security issues, though again for the self-serving reason that it could maintain greater control over multilateral processes.

Second, there is a perennial gap between the developed and developing world. "Nonproliferation", which seeks to constrain access to materials and technologies by prospective producers, by definition discriminates against existing non-producers. Nuclear nonproliferation has been one factor in cutting off developing states from exploiting cutting-edge energy and medical technologies. CW and BW nonproliferation policies similarly have blocked access to some non-military economic activities (and blocked access to "poor man's" substitutes for nuclear weapons). The development gap was became a factor as Non-Aligned Movement (NAM) states regularly sought to use any bargaining power they had to reduce the inequity or discrimination endemic in nonproliferation agreements and to extract economic benefits for their sacrifices. For states being asked to sacrifice economic advantages and juridical sovereignty, they wanted compensation in the form of guaranteed technical assistance.

Third, and less obvious, is a gap between those states required to open to intrusive verification procedures and those that are not. For example, the voluntary nature of IAEA safeguards (pre-NPT) meant safeguards were only required for states seeking nuclear assistance from the IAEA or a state that required them as a condition of sale. The nuclear suppliers themselves would not have to accept the indignity or commercial sacrifice of inspections.[104] Under the NPT, discrimination became more significant as the treaty-identified Nuclear Weapon States (NWS) were exempt from the requirement to accept IAEA safeguards.[105] The burden of inspection safeguards therefore, as structured currently, is borne mostly by non-weapon states (NNWS) with the most advanced nuclear energy programs: Germany and Japan (who also happen to be among the greatest contributors of resources to the IAEA). The remaining nonproliferation institutions are less discriminatory with respect to the need to accept inspections, but differential industrial structures do threaten to impose different levels of costs upon states for complying with any given agreement. States rationally anticipate and negotiate over these costs.

These three divisions – East-West, developing-developed, and intra-developed – form the starting point for the importance of preferences convergence in explaining delegation on NBCW issues. This section examines the IAEA and the CWC as two cases of delegation to show the significance of preferences. These two cases are chosen because they book-end the period of analysis: the IAEA is formed among states on both ideological sides of a simmering Cold War while the CWC is concluded by a similarly diverse group of states after the Cold War has come to an end. While the CWC has been

---

[104] There were few states that were only exporters and not importers of nuclear technology. Prior to the NPT, however, the less nuclear assistance received from abroad, the lower the proportion of a nuclear program that others could demand be safeguarded.

[105] The US offered early to open some facilities to safeguards inspections as part of a "voluntary offer agreement" that went a significant distance towards equalizing the risk of compromising commercially valuable technologies.

in force for only a few years, the debates that led to it and the creation of the Organization for the Prohibition of Chemical Weapons (OPCW) were long, circuitous, and intimately related to the 1972 Biological Weapons Convention and the Australia Group export control organization. The IAEA, on the other hand, was intended to succeed in controlling nuclear proliferation by operating almost entirely different than the role it plays in nonproliferation today; its negotiation and then evolution in its early years serve as an ideal case for demonstrating the role of state preferences. In each case, the credible identification of preferences was important to identifying possible bargains and to negotiating and implementing provisions to monitor and enforce a bargain.

The IAEA

In 1945, the US held a monopoly on nuclear weapons and there was as of yet no known prospects for nuclear energy. Most US nuclear scientists joined advocates of complete and general disarmament, world peace, and a world government in calling for nuclear technologies to be put under international controls. Their goal was to make credible the self-denial by states whose self-serving pursuit of power had caused the two World Wars. This idea became the core belief of nonproliferation movements: by some states credibly denying themselves a class of weapons, others would no longer find their pursuit of these weapons to be necessary.

When the US presented the Baruch Plan to the world in 1946, calling for internationalization of all things nuclear, it was endorsed by the UN General Assembly. US allies like France, the UK, and West Germany were all publicly supportive of the Baruch Plan but were quietly skeptical. The UK wasn't sure of the plan's practicality and wanted to keep the nuclear option open for itself.[106] France was suspicious of US motives and was somewhat resentful of the US monopoly, having been excluded from participating in the wartime efforts. Europeans in general were suspicious the US would sacrifice their interests to advance its own, and nuclear issues were no exception.

Preference gaps among the superpowers were more of a stumbling block: The USSR outright rejected internationalization if it required abandoning its own nuclear program before the US disarmed. Meanwhile, US fears of the Soviet conventional advantage in Europe obviated its nuclear disarmament until an international process could guarantee the USSR couldn’t also gain a nuclear advantage. Wittner argues the USSR may have also feared a precedent of sacrificing its UN Security Council veto or that a stronger UN could be a front for Western imperialism (Wittner 1993).

Despite an apparently heartfelt desire for nuclear disarmament by the US, prospects for global nuclear disarmament quickly faded with the heating up of the Cold War. After the start of the Korean War in 1950, the US deployed nuclear weapons to Europe under NATO command to reassure its allies (Trachtenberg 1999) and the Soviets provided nuclear assistance to the PRC to support their relationship (Bunn 1992). The widening chasm between the USSR and the West was replicated on nuclear disarmament negotiations: the UN body established to negotiate nuclear issues ceased to even meet after the USSR’s first nuclear test in 1949 and, after three years of inactivity, was finally dissolved in 1952 (IAEA 1997).

---

[106] After having been cut out of a US-led effort in 1945, the UK decided to pursue an independent nuclear weapons capability (a decision kept secret even from some members of the Cabinet and the broader Parliament until 1952, see: Wittner 1993).

With President Dwight D. Eisenhower's 1953 "Atoms for Peace" speech before the United Nations, the US again attempted to contain the threat of nuclear weapons. However, bilateral talks with the Soviets floundered, and the US shifted in 1954 to negotiations with technologically advanced or nuclear supplier states (Bechhoefler 1973; IAEA 1997; McKnight 1971). Australia, Belgium, Canada, France, Portugal, South Africa, the UK, and the US together endorsed a draft text on 4 December 1954, bringing together the major Western nuclear technology and uranium supplier states – some also among the most likely to seek nuclear weapons – behind a nonproliferation proposal based on "Atoms for Peace".[107] The draft also anticipated Soviet apprehensions with its formula for representation and with safeguards only being required when states request assistance and not as a condition of membership (Bechhoefler 1973).

The negotiations were then expanded in February 1956 to include Eastern Bloc representation, with the USSR and Czechoslovakia, and by NAM states India and Brazil. This brought into the bargaining process the developing nuclear powers that could otherwise prevent it from being effective. The negotiating states agreed sanctions would be possible for non-compliance, primarily being the curtailment of assistance or repossession of IAEA materials, though the IAEA Board could also report violations to the UN Security Council and General Assembly (McKnight 1971).

Disagreement over two issues, however, shows that the interest gap was not only between East and West, but between developing and developed states and among developing states. First, developing states feared their diminished representation on the

---

[107] West Germany did not formally regain its sovereignty until May 1955 (Haftendorn 2005). US government documents indicate that the "fourth country problem" (after the UK, US and USSR) focused on Canada, China, France, Israel, Japan, and Sweden (Burr 2005).

Board of Governors would allow the most powerful states to dictate the direction of the future organization and undercut technical assistance, single out states for unrelated political reasons, or use safeguards to block economic development.[108] Second, the great powers feared the expense of the organization. While they would pay the direct and indirect high costs of inspecting nuclear states, they would also have to fund a large technical assistance budget to buy-off developing states.[109]

When a compromise document was presented to 81 countries at the Conference on the Statute of the International Atomic Energy Agency in September 1956 (US Senate 1957:20), it was accepted with little amendment, and the Statute entered into force as an international treaty on 29 July 1957, creating the IAEA. The main goal of the IAEA was to direct any "surplus" fissile material towards peaceful nuclear energy programs and away from weapons programs while also attempting to prevent lowest-common-denominator controls on nuclear trade (IAEA 1998). The USSR had argued a no-use treaty was more important, but it was content to accept a plan that imposed constraints on Western governments' nuclear programs while reinforcing a strong UN Security Council role and the Soviet veto (Timerbaev and Welsh 1994). At its creation, then, the IAEA Statute successfully brought together the key interest groups: East, developing NAM states, developed Western states, and the pro-safeguards US.

[108] The division of powers between Board and General Conference left the Board dominant. The Board of Governors uses a complex formula to represent the interests of the most advanced nuclear states by geographic region, almost guaranteeing seats to some states (the US) and blocking out others.

[109] Technical assistance has come to include a variety of nuclear-technology related services the IAEA offers, from consulting on converting nuclear power plants to fighting malaria with radiation-sterilized mosquitoes.

Since the creation of the IAEA these basic interest factions have continued to function, though with some modification. First, battles over the budget have been part and parcel of the IAEA since its inception. The IAEA's responsibilities increased in the 1960s with the transfer of bilateral safeguards from the US and Soviet's support for safeguards that emerged after the Cuban Missile Crisis. The 1970s expansion of the nuclear industry and the addition of the NPT's safeguards requirements further increased the demands upon the IAEA (Goldschmidt 1977). Safeguards spending increased at twice the rate of the technical assistance budget 1973-1982 (Scheinman 1985) until developing states began to block increased spending on safeguards unless they received equitable spending on technical assistance. The result, beginning 1982-1983, was a "zero-growth" policy for budget that slowly eroded its safeguards efforts (Scheinman 2005).[110] The US recently negotiated an end to the zero-growth policy in order to expand the safeguards effort, but still had to agree to increase its voluntary contributions for technical assistance (Senate 2004). Preventing the slow starvation of the IAEA has required continuous proof of the stability of the original bargain, proof generated by annual affirmation of developing and developed states that the IAEA still served their interests.

Second, there has been continuous debate over how intrusive safeguards must be to verify the non-diversion of nuclear materials. The safeguards process was not defined in the IAEA Statute (or later in the NPT), but was relegated to the IAEA itself to determine after entry into force. The recent push for states to accede to the Additional Protocol has generated a new fracture line over the safeguards process with some states,

[110] "Zero-growth" is not strictly no growth in the budget but to limit growth to the level of inflation.

such as Brazil, arguing that INFCIRC/153 is by itself sufficient to determine compliance with the NPT (Official 2005b).

While the necessary level of intrusiveness may appear to be a purely technical question, policy-makers demand a balance with the costs of implementing safeguards. Many developed states recognize the advantages of more intrusive safeguards but are also "cost conscious" when they pay the cost of their application (Official 2005b).[111] The safeguards-assistance budget battles have meant economizing in safeguards through increasing use of remote monitoring technologies (seals on access points and storage facilities, cameras and other recording devices, etc.) and spreading thin the inspections themselves. Therefore, putting aside temporarily the developing states' desire to spend more on technical assistance, the battles over safeguards have pitted US and Soviet/Russian desires to spend more against the desire of non-NWS with civilian programs for energy to spend less. The compromise safeguards process preserves the autonomy of the Secretariat to select targets for inspections that permits an informal imbalance in the resources devoted to some large but apparently "safe" nuclear programs. The recent changes in the structure and budget for safeguards has reignited an old debate over a more "integrated" approach that would allow the IAEA to formally shift inspection resources to more problematic states. As with the budget battles, regular confirmation has been necessary that safeguards outcomes are not too divergent from those sought by developed states on different sides of the safeguards debates.

---

[111] At the IAEA, this is referred to as the WEOG or "Western European and Others Group", an informal grouping that includes Western European states, the US, Canada, Australia and Japan (Official 2005b). The USSR was far more restrained in allowing its allies access to nuclear technologies and in controlling their nuclear energy programs in order to constrain their ability to act independently.

Third, and finally, there are disagreements over nuclear trade. When the IAEA was negotiated in 1956, commercial nuclear power (energy) was a futuristic dream (IAEA 1997). The nuclear industry expanded greatly after the oil shocks in the early 1970s, and nuclear power plant construction drove a huge increase in nuclear supply until exogenous shocks to the relative price of nuclear energy (including the 1979 Three-Mile Island and 1986 Chernobyl accidents) led to the cancellation of many construction plans. The resulting overcapacity caused competition amongst the existing suppliers that extended beyond price to technology transfers of sensitive fuel cycle technologies with fewer strings attached.

When this threatened to help developing states acquire nuclear weapons, as it had helped India prepare for its 1974 nuclear test, the US and UK led the formation of the Nuclear Suppliers Group in 1975. Both Western and East Bloc states participated in the NSG, but it was also the first collaborative nonproliferation institution to include France. Their agreement to monitor nuclear supply, and sometimes block supply to key states, and to require levels of safeguards as a condition of supply that exceeded the NPT's apparent requirements have contributed significantly to nuclear nonproliferation.[112] However, many NPT states view export controls as violation of the NPT's Article IV commitment to aiding states with their peaceful nuclear energy program if they have not shown to be violating their safeguards agreements. The commercial differences among nuclear supplier states, and between them and developing recipient states, prevented

[112] Coordination through the NSG led in the 1990s to Germany notifying the UK that Libya was seeking centrifuge calibration devices. The devices were provided but were first altered so that they wouldn't work properly, preventing Libya from progress on uranium centrifuge enrichment (Official 2006).

revising the status quo institutionalized within the IAEA. Converging preferences among the supplier states in the 1870s, though, permitted an extra-IAEA solution.

In short, the belief in the 1950s was that there would not be a natural market for nuclear materials and technologies and that nuclear technologies were too expensive to be anything other than the purview of states seeking nuclear weapons and futuristic nuclear technologies. The authority delegated to the IAEA to fulfill its primary mission – implementing safeguards when providing assistance and withholding assistance from noncompliant states – became its weakness. The divisions continued after creation of the IAEA in debate over the IAEA's budget, the reform and strengthening of safeguards, and extending nonproliferation controls to nuclear trade policies.

The IAEA's escape from institutional infancy required developing expertise but also implementing bargains across the divides created by the Cold War, by differentials in economic development, and among developed Western states. Over time these bargains shifted the approach of the IAEA, expanding its monitoring authority, to be more in tune with controlling than promoting proliferation. H1 and H2 both appear supported in the formation and maintenance of the IAEA. The IAEA's creation required convergence on a bargain among nuclear suppliers that was also acceptable to developing state interests, but which would also not tip the balance in the US-Soviet Cold War. Furthermore, after the IAEA's creation, delegation to the IAEA in terms of authorities and resources both rose and fell with the strength of the consensus among its members.

The CWC

While proposals in the 1940s and 1950s referred to "complete and general disarmament", the international focus was primarily on nuclear weapons into the 1960s.

The international pressure that culminated in the 1972 *Biological* Weapons Convention began with criticism of the US use of chemicals – herbicides and riot-control agents – in the Vietnam War, and the apparent inadequacy of the 1925 Geneva Protocol's ban on the use in war of poisonous gasses. Substantive proposals emerged from both the West and East to update the Geneva Protocol: The UK proposed in 1969 a comprehensive BW-only package that provided for an investigatory mechanism, assistance to states threatened by BWs, and the right to develop defenses (ter Haar 1991). The USSR countered with a proposal that was broader in that it banned the development, production or stockpiling of BWs *and* CWs but it provided only for "consultation and cooperation" on compliance problems (Goldblat 1971). The USSR eventually conceded to the US demand to negotiate only over BWs, and not CWs, at this time. When the BWC was concluded in 1972, CWs were left out of the treaty, but the parties committed themselves under Article IX "to continue negotiations in good faith… on effective measures" to cope with CWs.

Unlike BWs, CWs appeared to retain at least some military relevance (Spiers 1986; US House of Representatives 1980). The hurdle to concluding an agreement were primarily at the major power level as it was believed no other states had the capacity to produce enough weapons to be militarily useful and had the CW protective equipment and training to be able to use them. The United States only slowly conceded the need for any treaty at all, but significant international differences of opinion persisted over how to define "CWs". The United States argued then, and continues to argue today, that herbicides and incapacitants (riot control agents such as tear gas) should be excluded from consideration. The USSR, as in the nuclear arena, resisted any agreements that included intrusive verification.

When the US and USSR had completed twelve rounds of talks on a CW treaty by 1980, they did agree on a comprehensive CW ban, including CW destruction under a general timetable, declarations of stockpiles after entry into force, and on using a toxicity criterion to delimit CWs (US House of Representatives 1980). However, they continued to disagree whether riot control agents and herbicides were covered, how to control or monitor dual-use chemicals, or how to verify the treaty (Bernauer 1990). The US-Soviet differences therefore reinforced their joint differences from almost all other states seeking a CW treaty.

Then, increased US-Soviet tensions in the early 1980s made a CW treaty less likely. This even as a jump in CW threats from the third-world made it more necessary. The US accused the USSR of using CWs in Afghanistan, which were quickly followed by reports out of Southeast Asia of "yellow rain" that killed people and crops, and out of the Middle East of CW use in the Iran-Iraq War. The US and Soviet connections to these events made many states hesitant to get involved at first (US Senate 1983).[113] Further, when the UN system was applied to the CW problem, the targets delayed or blocked the investigations. This convinced many that resolution of any individual case through ad hoc

[113] The USSR was accused of supplying CWs to Vietnam and Laos because these states were otherwise incapable of producing these weapons. Investigations seem to have confirmed that CWs were used in Southeast Asia, but most investigations were so delayed that conclusive evidence was not identified (Sims 1987; US Senate 1984; US Senate 1983; US Senate 1989b). The US was connected to CW use in the Iran-Iraq War as it shielded Iraq from pressure to help Iraq's war against Iran (Findlay 1991; Hogendoorn 1997; Russell 2005; US Senate 1989a).

measures would be biased by Cold War politics and superpower interests (Bernauer 1990; Pearson 2004).

The inability of the existing international system to cope with these events was clear: the BWC and Geneva Protocol treaties were long on obligations but short on verification and enforcement without a supportive UN Security Council, which was blocked by US and Soviet vetoes. However, as Deputy Director of ACDA David F. Emery noted, the perception in the third world that they were the most likely targets of CWs created surprising interest from developing states in the US CWC proposal despite the fact that they were not traditional allies of the US (US House of Representatives 1984).

Though negotiations on a Chemical Weapons Convention (CWC) were on track at the UN Committee on Disarmament, proliferation proceeded faster than the negotiations. More states were concerned that CWs were becoming a poor man's nuclear weapon (ibid.), and the number of states suspected of possessing CWs increased from fewer than 10 in 1978 to 21 by 1987 (Chapter 3). This was not only a problem among developing states: in the 1980s the US initiated a new CW program (Bernauer 1990; SIPRI 1986; Spiers 1986; US Senate 1982) and France considered a return to CWs (Bernauer 1990).

The 1983 and 1984 Western proposals demonstrated a continuing focus on three divisive issues: the structure and powers of an international secretariat, if one were to be created; the scope of the CWC; and, measures for ensuring compliance with the CWC (Sims 1987). Recognizing the failure of the NPT to deal with states known to possess nuclear weapons, there was agreement that a CWC would have to include universal destruction in addition to any ban on development, production, stockpiling, and use. The debate focused instead, like the debate in the 1960s and 1970s, over whether chemical agents that either do not affect people or are without permanent effects – herbicides and riot control agents – were covered. The US continued to defend and negotiate a place for the use of these chemical agents.

With the US and USSR both preference outliers, major Western states began cooperating at least on export controls on CW chemicals and dual-use technologies to stem the tide of proliferation by developing states. The "Australia Group", modeled after the Nuclear Suppliers Group, was an informal grouping of major Western chemical supplier states who agreed on increase controls over the chemical trade (SIPRI 1992). All recognized that this was a stop-gap measure and weakened by the same lowest-common-denominator problems as the NSG when a verifiable ban appeared within reach.

The US and USSR positions narrowed as their broader relations thawed. Not only did the US Congress ultimately reject the CW rearmament plan pursued by the Reagan administration but the USSR had finally come around to accepting the necessity of intrusive verification (Bernauer 1990).[114] They agreed the prospective CWC would create an IO with an inspectorate to conduct routine and non-routine (challenge) inspections. It was still undecided what specific procedures would govern the inspectorate's activities, how to define "chemical weapons", the time-line and process of CW destruction, how to control CW-related trade, and what process to create for on-site inspections and

[114] The Soviet position on verifying destruction was, in part, informed by the US invitation to a number of countries to view a destruction trial, which demonstrated that CW destruction could be verified without revealing military secrets.

investigations of alleged CW use (Bernauer 1990; Crone 1992). Almost to the end of the negotiations, bargaining was facilitated by the focus on institutionalizing US-Soviet *bilateral* verification with only a small *international* monitoring role for OPCW. When the USSR collapsed, a larger scope for the OPCW was created than originally expected (Mundell 2005).

By the time the CWC negotiations concluded and the treaty was opened for signature in January 1993, many of these issues had either been resolved or delegated to the future OPCW to negotiate. As with the IAEA, negotiations over the control of CWs required not only bridging the differences between the US and USSR, but also meeting the needs of developed and developing states with respect to their economic and security interests. These negotiations ultimately culminated in the CWC but only after decades of work and significant evolution in the interests of the participating states. Of course, differences in preferences of these states remain and continue to complicate efforts to eliminate the threat of chemical weapons.

Since the CWC's entry into force, two issues have persisted because of the different preferences of the States Parties. First, while the CWC does limit trade on CW-precursor chemicals, export controls on additional chemicals and dual-use items continue to be coordinated by the Australia Group. The Australia Group continues to be viewed as discriminatory by less-developed states that are compliant with the CWC (Bernauer 1990). This very much parallels arguments regarding nuclear trade among IAEA-safeguarded states. Second, while the CWC has been a useful confidence building measure (Trapp 2005), South Asian and Middle Eastern states have been slower to join. Many

Arab states refuse to ratify the CWC not because they are outliers on CW issues. Instead, they seek to link CW and nuclear weapons disarmament because of Israel's NBCW programs (Ramzy 2005; Trapp 2005).

CWC Summary

Differences in preferences have played an important role in international efforts to deal with the threat of nuclear weapons, as exemplified by the IAEA, and the threat of chemical weapons, as exemplified by negotiations over a CWC. While in both cases cooperation was successfully concluded as preferences converged on their respective issues, the negotiation process demonstrates that this was not a forgone conclusion. This evidence of the importance of preference convergence, while strong, is subject to the usual critiques that the evidence has been hand-picked and disconfirming evidence ignored. Further, while the preferences of individual states are important to understanding their individual policy choices, the distribution of their preferences over NBCW-related issues is an important causal factor in explaining delegation. The remainder of this chapter therefore develops a theory of preferences and proposes one possible indicator of state preferences on NBCWs as "revealed" by their behavior. This operationalization is then analyzed for its power to cause delegation to an international agent as measured in Chapter 2.

Measuring Preferences

Bruce Bueno de Mesquita (BdM) analyzes foreign policy preferences using Kendall's tau-b (τ_β) method of comparing the rank ordered lists of two actors' alliance portfolios (Bueno de Mesquita 1975). Essentially, BdM arrays a set of states along a continuum of [-1, 1] relative to one state in the system such that states with scores closer to “1” shared completely similar security preferences and those approaching “-1” have completely dissimilar preferences. BdM chose alliances as his indicator of security preferences specifically because he was interested in an indicator of security preferences that was broadly distinct from trade or other preferences. However, to arrive at NBCW preferences, general indicators such as alliances capture too many dimensions of the security problem and are too constant over time. Also, because it exploits only alliance data, tau-b is unable to distinguish states that lack formal alliances because they are hostile from those states that have implicit alignments or are simply strategically irrelevant (Signorino and Ritter 1999).

While tau-b provides a simple and tractable indicator of state preferences, Signorino and Ritter argue it is essentially a test of association between two ordered lists and can therefore report their portfolios to be completely dissimilar when the lists differ only slightly in their orderings or rankings (Signorino and Ritter 1999). Signorino and Ritter have developed an alternative measure, *S*, that they argue measures more truly the similarity of foreign policy preferences using a spatial measure of the distance between two state portfolios relative to the overall possible distance. *S* can also include multiple types of relationships in the analysis, allows weighting of individual observations by their relevance, and performs better in predicting wars and the use of force when used in an expected utility theory of war (Bennett and Rupert 2003). However, *S* does bias towards scores of 1 (similarity) while tau-b skews to –1.

In analyzing delegation to international organizations in the area of weapons of mass destruction, it would be useful if states revealed their preferences on NBCW issues in a manner that is sensitive to change over time, revealed often in a somewhat costly manner, comparable across time, and available for all the states of interest (Sweeney and Keshk 2005). Gartzke has presented a case for using UN General Assembly roll call votes as a reasonable proxy for state preferences that satisfies these criteria (Gartzke 1998) and he develops a method to apply *S* as formulated by Signorino and Ritter (Gartzke 2000). Data is available on UN General Assembly roll-call votes for all votes on resolutions from 1946-2002 (excluding 1964) as compiled by Erik Gartzke and Dong-Joon Jo for 1946-1996 (Gartzke 1998; Gartzke 2000; Jo and Gartzke 2007) and extended by Erik Voeten to 2002 (Voeten 2004).

S has since been applied in testing a number of hypotheses in international relations theory. For example, Gartzke has used UNGA voting to test elements of the democratic peace theorem (Gartzke 1998; Gartzke 2000) and Haftel and Thompson use *S* based on both alliance data and UNGA voting in their analysis of what causes the independence of regional institutions (the distribution of preferences is used as a control variable, but they find no effect (Haftel and Thompson 2006).

However, *S* as used by Gatzke and others incorporates UNGA voting on issues ranging from the environment to security to human rights, and therefore reports a distribution of preferences without first differentiating among issues. Like BdM's reliance on alliance data, using all UNGA votes captures preferences that may be too broad for any specific issue, such as preferences over NBCW issues, and there have been a large number of UNGA roll-call votes on resolutions pertaining to weapons of mass destruction (Voeten 2004). While a few of these resolutions commend the member states to ratify a specific treaty, most resolutions do not relate specifically to institutionalization. Rather, they criticize the actions of specific states (such as Israel's attack against the

Osiraq reactor or India's and Pakistan's nuclear tests) or commend general behaviors (superpower nuclear disarmament, negotiation of a CW treaty, etc.).

To construct an *S* for preferences over only NBCW issues, all resolutions voted upon in the UN General Assembly were coded for their relevance to NBCW issues. The frequency of NBCW-related votes is 19.6% of all UN votes 1946-2002. The actual annual frequencies range from zero to 31.97% of the total resolutions per year; the portion of NBCW-related resolutions ranges between 0%-17% from 1946-1970 (there are none 1953-1957), 10%-20% from 1971-1979, and 22%-32% from 1980-2002. Resolutions were coded "0" if they were completely unrelated to any WMD issues, "1" for general and complete disarmament, "2" for nuclear weapons and technology issues, "3" for chemical and biological weapons, "4" for chemical weapons issues only, and "5" for biological weapons issues only.

Regarding the coding, votes on chemical and biological weapons issues were easily distinguished from votes on other WMD issues, especially nuclear weapons. Category "1" resolutions often mention nuclear weapons in their scope but also include those pertaining to "complete and general disarmament", "new types" or "new systems" of "weapons of mass destruction", great power disarmament, referrals of disarmament issues to the Committee on Disarmament (or its successors), conventional disarmament, regional disarmament, and "zones of peace." "Complete and general disarmament" predominantly meant nuclear weapons but not exclusively so. This category therefore overlaps too much with Category 2 to reject but too analytically vague to analyze separately. Further, the frequency of CBW-related votes is never more than 5, which makes drawing any conclusions suspect. Due to these constraints, more refined analysis – such as measuring CBW preferences – was not conducted.

In addition to UN General Assembly votes, the timing of states' ratification of key nonproliferation treaties (Geneva Protocol, IAEA Statute, NPT, BWC, and CWC) were also included to indicate when that states' preferences were sufficiently in line with the intent of the treaty that it was ratified. For each treaty, states were coded as "1" when they signed the treaty, "2" when they ratified, and "0" otherwise (the exception being the Geneva Protocol, for which states were coded as "1" if they ratified with substantive reservations[115]; the other treaties do not explicitly permit reservations). This approach avoids the methodological tautology of using a behavior to predict its own occurrence: preferences must converge upon the treaty prior to it entering into force or else an insufficient number of the required states will choose to not ratify. Further, the treaties were negotiated outside the UNGA; UN votes might commend a treaty but do not convey a legal obligation.

The resulting variable, *iwmdS*, therefore incorporates in each annual dyadic observation votes in the UNGA and NBCW treaty memberships. While treaties may vary in the cost they impose upon states when they sign or ratify the treaty and while a treaty ratification is probably more costly than a vote on a single UNGA resolution, this analysis weights a treaty ratification equal to a single UNGA vote.[116] Further, while

---

[115] Reservations relating to the recognition or non-recognition of another state were not counted.
[116] The formula used to compute the similarity of states' institutional memberships and states' UNGA NBCW-relevant votes, called *iwmdS*, is:

$$S(Pi,Pj,W,L) = 1-2\left[\frac{\sum_{k=1}^{N}[(w_k/\Delta_k^{max})(P^i_k-P^j_k)] + \sum_{m=1}^{N}[(w_m/\Delta_m^{max})(P^i_m-P^j_m)]}{\sum_{k=1}^{N}[(w_k/\Delta_k^{max})(P_k^{max})] + \sum_{m=1}^{N}[(w_m/\Delta_m^{max})(P_m^{max})]} \right]$$

Where P^i_k is state i's vote on each UNGA resolution for that year from P^i_1 up to P^i_N, P^i_m is state i's position on each treaty during that year from up P^i_1 to P^i_N, P_k^{max} is the maximum possible

Signorino & Ritter's equation is designed to incorporate different weighting of the input data (certain IO memberships or UN votes matter more than others), this feature does not weight importance of actors' preferences against each other. To return to the cartel analogy, state relevance to NBCW issues is a function of their NBCW market power. The *iwmdS* scores are weighted post-estimation with capability scores. The NBCW capability scores were generated by interacting indicators of economic development with indicators of weapon-specific capabilities developed in Chapter 3.

Analysts employing *S* based on alliances or all UNGA votes have defended its validity as an indicator of broad-based state preferences over international outcomes. However, it is important to establish that using a subset of the UNGA voting data produces an indicator of preferences over NBCW issues distinct from the distribution of preferences more broadly. That is, it is important to demonstrate the measure has discriminant validity. The distinctness of the measure is indicated by comparing NBCW preferences, which is composed of NBCW-related resolutions and IO memberships, to non-NBCW preferences, which is composed of all UNGA resolutions that are not related to NBCW issues. [117]

The three mean preference scores (all UNGA votes, non-NBCW votes, and the iwmdS variable constructed from NBCW votes and treaty ratifications) are represented graphically in Figure 4.2. The non-NBCW preference measure does not differ

---

difference between states i and j given the resolutions for which they both have data during that year, and P_m^{max} is the maximum possible difference between their institutional memberships for that year, and w_k/Δ_k^{max} is the normalized weighting scheme.

[117] A replication of Gartzke's work correlated to .9708 with his reported *S* scores (specifically the "sun3cat" variable), which is strong confirmation that the *S* scores are constructed similarly enough for comparable analysis.

substantially from all votes (they correlate to 0.987), while the NBCW preference score correlates only to 0.095 with non-NBCW preferences. This figure shows the three preference scores are fairly similar during the 1960s (the absolute differences are small), during the rest of the sample period (the late 1950s and 1970-2002) the distribution of NBCW preferences is distinct from the distribution of non-NBCW preferences.[118] While all three show a general tendency to converge through to the late 1980s, the absolute differences are often quite large and changes in one score do not track well with changes another. Beginning in the early 1970s, UN states shared preferences on non-NBCW issues much more so than they did on NBCW issues.

The differences are made all the more apparent when NBCW preference scores are weighted by their NBCW market power, as shown also in Figure 4.2. The weighted scores are close to the unweighted NBCW and non-NBCW preferences only in a few isolated years (again during the 1960s), but are otherwise distinct from non-NBCW preferences. The two weightings converge as the number of nuclear capable states increases and become effectively identical after about 1987.[119] The weighted and unweighted NBCW preference scores also converge in the 1990s, again as NBCW capabilities proliferate to greater and greater numbers of states. This supports the argument that state preferences over outcomes of NBCW issues are being measured in a manner that is distinct from broader preferences.

---

[118] Treaty accession is included for every year the state remains a Party; one reason *iwmdS* stabilizes is the additive effect created by the conclusion and accession to additional NBCW-related treaties.

[119] A CBW-specific weighting was also tested but the results were identical to those from the NBCW weighting until 1989 and then diverged only slightly.

The Face Validity of the NBCW Preferences Score

The translation, or face, validity of the NBCW preference scores is best indicated by how well the direction of change and the (relative) absolute levels correspond to historical evidence regarding the preferences of these states. In this section, pattern matching is used to determine the correspondence between NBCW preferences and historical evidence regarding the preferences of states. The strong translation validity of the measure indicates it is valid for statistical inference of its predictive validity for causing international delegation.

There are effectively three different historical periods within the longer period of analysis. The first spans from the 1950s through to the mid-1970s and is marked by the successful conclusion of the IAEA Statute, the NPT, and the BWC. The negotiations behind the IAEA Statute indicate preferences were converging behind the need for international controls on nuclear power, if not behind disarmament or outright nonproliferation of nuclear weapons (Bechhoefler 1973; IAEA 1997; McKnight 1971). These same states then achieved sufficient consensus on the safeguards necessary to implement the IAEA's mission that they enacted the first "model" safeguards agreement, INFCIRC/26, in 1961. The three indicators reported in Figure 4.2 are at a relatively low level after the entry into force of the IAEA statute but converge sharply through the IAEA Board's decision. The 1962 Cuban Missile Crisis was for the world a portent of horrible things to come if nuclear weapons proliferated further throughout the world. However, the first solution – a test ban – failed to be realized because the preferences of the nuclear powers were too far apart over how such a ban could be implemented

(McBride 1967). The result, as diverging preferences among the nuclear capable states indicates, was a less-than-comprehensive Limited Test Ban Treaty in 1964.

Meanwhile, the preferences of the broader population of states (NBCW capable or not) coalesced behind the idea that the IAEA was by itself insufficient and had to be reinforced by an explicit agreement to not proliferate nuclear weapons (finished weapons or the materials and technologies necessary to develop them indigenously). In many ways, this perception was driven by the PRC's nuclear weapons program and then its successful test in 1964 (Selvage 2001). The NPT was nearly in its final form in 1966, and the preference scores do converge to this point, though it took a couple of more years for the US to abandon its plan for a European multilateral nuclear force (MLF) and for international consensus on the IAEA as an implementing agent for the treaty (Quester 1970). Even before the ink was dry on the NPT, the US was under fire for the war in Vietnam, including its use there of CWs (Goldblat 1971; Wright 2002). These two tensions – progress on nuclear issues but tension on the Vietnam War – explain the conflicting movement of the *imwdS* weighted by nuclear capabilities on the one hand and the unweighted and NBCW weighted scores on the other. That the preferences of all states are diverging after the agreement on the NPT is no surprise given the inability of states negotiating a CBW parallel to the NPT to agree on anything other than the shallow and limited scope BWC.

The period closes in 1975 with the entry into force of the BWC and the creation of the Nuclear Suppliers Group. Both events were cooperative but represent only limited progress forward and certainly falls short of the deep cooperation represented by delegation to an international actor. In the case of the BWC, as discussed above, states somewhat shared the opinion that CBWs were a threat to be controlled but they disagreed over what to include in controls and how those controls should be implemented and made credible enough to depend upon for states concerned with their security and survival (ter Haar 1991). The NBCW-weighted and unweighted *iwmdS* scores reflect this: preferences begin to diverge and when they again converge it is nowhere near at the same rate as in the preceding decade. That is, the rate of convergence slows: a total net change of 0.3 during 1957-1965 as compared to 0.05-0.1 during 1968-1978. Also, nuclear capable states finally converge to the previous maximum level of 1961 in 1977 while a broader index of NBCW capable states reflects less of a decline that returns to the 1965 maximum around 1973 and continues to converge slowly until 1977.

The NSG forms as it becomes clear crucial states will remain outside the NPT/IAEA cartel and could continue to receive nuclear materials and technologies helpful to constructing nuclear weapons (Le Guelte 1999; US Senate 1977a). Most significantly, India's 1974 nuclear test highlighted the need to extend collusion to account for states that exploit gaps in the NPT by not joining or in the IAEA system by maintaining un-safeguarded facilities or diverting to unintended "peaceful" uses such as PNEs.[120] The NSG at its formation was most significant for its ability to bring France into cooperation on export controls, a state which was among the significant hold-outs from the NPT but also one of the largest exporters of nuclear materials and technologies (Thorne 1997; US Senate 1977a). The moderate convergence of preferences

[120] India asserted that this was a test not of a nuclear weapon but of a PNE or peaceful nuclear explosive. PNEs presented a loophole for states for many years because of the theoretical application of nuclear explosion devices for peaceful uses such as for large-scale excavation of canals, recovery of oil and gas deposits, mining, etc. (Brennan 1976; Firmage 1969; US Senate 1987; US Senate 1977b).

demonstrated by the nuclear capability-weighted *iwmdS* reflects the observed convergence of opinion on nuclear controls by the cartel members and the perception that the threat of proliferation was shifting to developing states that currently lacked appreciable nuclear capabilities. While the NPT reflects deep cooperation through legally binding constraints enforced through IAEA monitoring and UN Security Council action, it is important to remember that the NPT was a bargain that brought states without nuclear weapons capabilities into a nuclear control cartel.

The second period spans from the mid-1970s through to the mid-1980s and is marked by the absence of significant multilateral or bilateral approaches to NBCW threats and the prevalence of unilateral strategies. The poor international cooperation on nuclear controls in this period causes the United States to begin during the Ford administration to try to prevent the export by the US or its allies of enrichment and reprocessing capabilities to any additional states. This proved insufficient, because US allies such as France and Germany continued to pursue exports of these technologies to states such as Brazil. The US increased pressure on its allies to limit nuclear cooperation with others and the Carter administration terminated contributions to research on plutonium-based breeder reactors and proposed a Nuclear Non-Proliferation Act, passed by Congress in 1978 (Brown 1982; Goldschmidt 1977; Gummett 1981; Lowrance 1976; US Senate 1977a).[121]

---

[121] The breeder reactors are fueled by plutonium but plutonium is also produced as a by-product of the nuclear reaction. Breeder reactors were therefore important to many US allies to reduce their dependency upon foreign nuclear fuel supplies. The 1978 NNPA added insult to injury by unilaterally threatening to cut off from US supply any state which did not insist upon Full-Scope Safeguards (Barnaby 1993; Brown 1982; Greenwood and Haffa 1981; Hildenbrand 1978; Jones et al. 1985; Pilat, Pendley, and Ebinger 1985; Tate 1990).

As discussed above, the Carter administration had made a strategic choice to seek arms control progress from bilateral US-Soviet negotiations. When Ronald Reagan took office and US-Soviet relations chilled, there was little room for progress. US allies had become distanced from the US by its unilateral strategies on nuclear controls and then feared US security policies would leave them exposed to Soviet aggrandizement.[122] The US first defended Israel's strike against Iraq's Osiraq reactor complex, which led to the temporary US withdrawal from the IAEA (Barnaby 1993; IAEA 1982; IAEA 1984; Power 1986; Scheinman 1985), and then blocked stronger action against Iraq for its use of CWs in the Iran-Iraq War (Bernauer 1990; Findlay 1991; SIPRI 1985; SIPRI 1988; SIPRI 1989; US Senate 1989a; US Senate 1989b). Therefore, while multilateral negotiations proceeded on a CWC and there was growing consensus behind a comprehensive nuclear test ban, the major powers were less interested at this stage than the population of states as a whole. The US and Soviet Union continued to disagree over what could be credibly negotiated given the level of verification available, and the US and its allies continued to disagree about what could safely be exported. The *iwmdS* measures reflect not only the disagreements among NBCW-capable states over the appropriate strategies – dissonance within the cartel – but also the difference between the NBCW states and those in the general population. As indicated by US unilateral actions, the divergence begins in 1978 and reaches its nadir in 1980 – a precipitous drop to levels not seen since 1964 for NW- or NBCW-weighted scores. While the scores do not reach "historic" lows, they do reach levels similar to previous peaks in Cold War tensions and

---

[122] For example, US allies feared the Reagan administration's pursuit of missile defense would be a step in decoupling their fates in the event of a Soviet attack, reducing the credibility of US commitments to come to Europe's aid.

reflect the inability of states to advance collective solutions to NBCW threats during the early 1980s.

The third period spans from the latter half of the 1980s to the close of the period of analysis in 2002. US-Soviet relations began to warm in the mid-1980s and resulted in the successful negotiation of a series of bilateral arms control treaties, including the Intermediate Nuclear Forces or INF Treaty (SAROV 2004) and the Threshold Test Ban and Peaceful Nuclear Explosive Treaties (DOS 1986; Medalia 1998; US Senate 1987; York 1987), and saw progress on a CWC (Forsberg et al. 1995; Hart et al. 2002; Pearson 2004; Smithson 1993; US House of Representatives 1994). These improvements in relations are well reflected in the magnitude and direction of change in *iwmdS* scores from 1984-88. Moving beyond the bilateral context, the international community more broadly approved the delegation of the responsibility for disarming Iraq of NBCWs and missiles to UNSCOM and the IAEA, referred North Korea's safeguards violations from the IAEA Board of Governors to the UN Security Council, strengthened IAEA safeguards, opened for signature and brought into force the CWC, and opened for signature the Comprehensive Test Ban Treaty. These developments are reflected in the all-time highs in *iwmdS* scores reached in 1993 that are basically maintained through 2002.

Some of these steps may have put the cart before the horse, however, in that euphoria from the end of the ideological Cold War conflict led states to believe they were closer in interests than they were actually. Three examples suffice to demonstrate this: the disintegration of consensus on the UN Security Council behind disarming Iraq that leads to UNSCOM's withdrawal in 1998 (Findlay 2003; Oudraat 2002; Thompson 2006b), weakened resolve on North Korea by the late 1990s and into the present (Wit, Wolfsthal, and Oh 2005), the non-entry into force of the CTBT (Asada 2002), and the non-use of the CWC's challenge inspection powers despite apparent evidence of violations (Wolf 2004). The post-Cold War euphoria among the major cartel members is well represented by the convergence of *iwmdS* scores among both NBCW- and nuclear-capable states from 1983-1984 to 1993 (a net change of 0.2 for nuclear-capable states and 0.15 for NBCW- and CBW-capable states). Meanwhile the preferences of the broader population of states first converged and then diverged for almost no net change (0.54 in 1983 to 0.65 in 1988 to 0.54 in 1993). The convergence of preferences among the various populations of states is emblematic of the rising proportion of NBCW-capable states, but it is still a useful exercise given the large difference between the extent to which they hold similar views on NBCW-related and non-NBCW-related issues.

Hypothesis Testing

The preceding section developed a quantitative measure of NBCW preferences and demonstrated the strong correspondence between the historical record of the distribution of state preferences and this operationalization of the phenomenon. This section, finally, turns to statistical tests of the temporal relationship between the distribution of preferences among prospective (or extant) cartel members and their decisions to delegate to an international agent. In short, H1 argues delegation by states with NBCW market power is more likely when their preferences converge or are highly convergent. Convergence of preferences among states with market power in NBCWs should be more causally related than the preferences of all states to delegation events. H2 argues that once a cartel has been formed, the convergence or divergence of the preferences of states with NBCW market power should be causally related to changes in delegation to the agent. In addition to observing the NBCW preferences of the population of states as a whole, also analyzed are those preferences weighted by a state's market power (the preferences of more capable states count more), the preferences of those states already having chosen to join the relevant cartels (international institutions), and the preferences of cartel members weighted by their market power.

Beginning first with nuclear issues, H1 is supported by a strong, positive, and significant relationship between nuclear delegation and most variations of nuclear preferences (Table 4.1). This effect persists when including the variable for nuclear threats developed in Chapter 3. There is also a strong and positive effect from the convergence of preferences among IAEA member states (and similarly among Nuclear Suppliers Group participant states), whether weighting for nuclear capabilities or not and including the nuclear threat variable or not (Table 4.2 and 4.3). Interestingly, the preference distribution of NPT member states, when significant, is strongly negative (Table 4.4). The relationship is also illustrated graphically in Figure 4.3.

Given the apparent strength of the relationship between nuclear delegation and the preferences of states with nuclear market power as measured by widely available capability indicators, it is useful to exploit the high quality data on nuclear program and nuclear possessor states in a similar fashion as a robustness check on the latency indicator. Table 4.5 provides the results of limiting the sample to nuclear program or weapon possessing states: the relationship is again strong, significant and positive. Figure 4.4 represents this graphically.

In support of H2, the preferences of IAEA member states, weighted or unweighted by their market power, were strongly and significantly related to an increase in delegation to that organization (Table 4.6). The effect upon delegation to the IAEA of changes in preferences of the larger population of NPT states, when significant, is negative. The convergence of preferences among NPT member states has a strong and significant positive effect upon delegation to the NPT (Table 4.7), but not if the preferences of NPT states are weighted by their market power. Together, these results indicate that as NPT states' preferences diverged, a subset of those states resolved themselves to increasing their delegation to the IAEA.

Further, only when the preferences of all states – nuclear capable or not – converged did delegation under the NPT increase through its indefinite extension. One possible explanation is that NNWS were doubtful the NWS would ever follow through on their commitment to disarm themselves of nuclear weapons. While nuclear-capable states did not agree on the future of the treaty, the broader population of states was more fearful of the reversion point without NPT extension: a world without the NPT. Therefore, the lowest common denominator preference, given the perceived disaster of opening any aspect of the treaty to renegotiation, was indefinite extension.

Even though the CTBT has not yet entered into force, the "temporary" organization created by the CTBT while it awaits entry into force – the Preparatory Committee to the CTBTO – does have authorities and the resources to execute those authorities. The results imply that NBCW preference convergence does not have a significant effect upon delegation to the CTBT (Table 4.7), that something other than a convergence of preferences caused states to proceed upon its negotiation and opening for signature, and that preference divergence has impeded its entry into force. However, as discussed previously, there are significant hurdles to the CTBT entering into force: the ratification by all 44 Annex 2 countries. Therefore, as long as the preferences of any one of the nine remaining states is too distant from the others, the treaty is unlikely to enter into force and there is little risk to ratification by others.

Turning to CBW issue delegation, it is important to view the following results with two caveats in mind. First, delegation occurs only late in the period with the formation of the OPCW under the CWC in 1997 and continues with slight variation for five years, for a total of six non-zero observations in the data-set. Inference is therefore likely biased. Second, the small number of CBW-related votes means CBW preferences are primarily extrapolated from state positions on nuclear issues and general disarmament.

With these caveats in mind, Figure 4.5 shows the NBCW preferences of states relative to the entry into force of the CWC in 1997 as well as the BWC's entry into force in 1975 and the formation of the Australia Group in 1984. Though the results are generally insignificant, unweighted preferences among Geneva Protocol states, BWC states, and all states generally have a negative effect of preferences upon delegation among the population as a whole (divergences in their preferences "cause" delegation) and the CBW-weighted preferences scores of GP states, BWC states, and all states were associated with a positive effect upon delegation (Table 4.8 and 4.9). The results had highly significant effects for CW delegation in only four cases: a negative effect of the unweighted preferences of GP states, and a positive effect of preference convergence among Australia Group states (weighted and unweighted by CBW capabilities) and among the CBW-weighted preferences of all states.

Conclusions

I argue that the distribution of preferences among states in the international system is a necessary, but not sufficient, condition for collective decisions by states to delegate to achieve shared goals. I expect to observe preference convergence preceding delegation to IO and preference convergence among members or participants in an extant international institution preceding further increases in delegation to that institution. This chapter analyzes the distribution of NBCW preferences among states and their delegation to international institutions for nuclear, biological, and chemical weapons.

I develop a quantitative indicator of the similarity of states' preferences over NBCW-related issues using their votes in the UN on NBCW-related resolutions and their accession to important international NBCW treaties. The resulting *iwmdS* statistic was generated using Signorino and Ritter's method of computing the dyadic spatial distribution of states' behavior-revealed preferences ("S") and was shown to provide a measure of preferences distinct from that constructed by Gartzke using all UNGA votes. Selected relevant populations of states and capability weightings were then introduced in the post-estimation of dyadic *iwmdS* statistic to measure the distribution of preferences among prospective and extant NBCW cartel members.

This chapter provides evidence that the distribution of preferences is important to predicting or explaining international delegation as a solution to the problems faced by those states. Changes in the *iwmdS* measure over time correspond to expected changes in state preferences discussed in qualitative histories, lending the indicators translation or face validity. Using the measure as a proxy for state preferences on NBCW issues, I find that the distribution of NBCW preferences are strongly and significantly correlated to delegation for nuclear issues. The relationship between the distribution of NBCW preferences and CBW delegation is weaker, though limited delegation events makes any assertions problematic. The results support both the method of analyzing preferences (*S*) and for the hypothesis that preference convergence is causally related to delegation by states over NBCW issues. The results also provide evidence that cooperative nonproliferation efforts among states are analogous to cooperation in cartels.

Figures and Tables

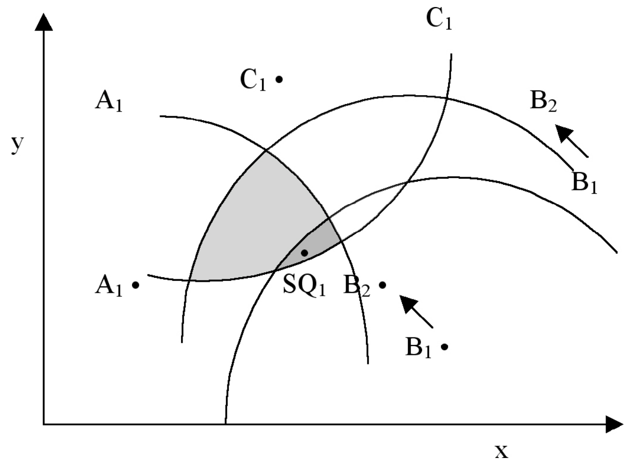


Figure 4.1: Preference Convergence

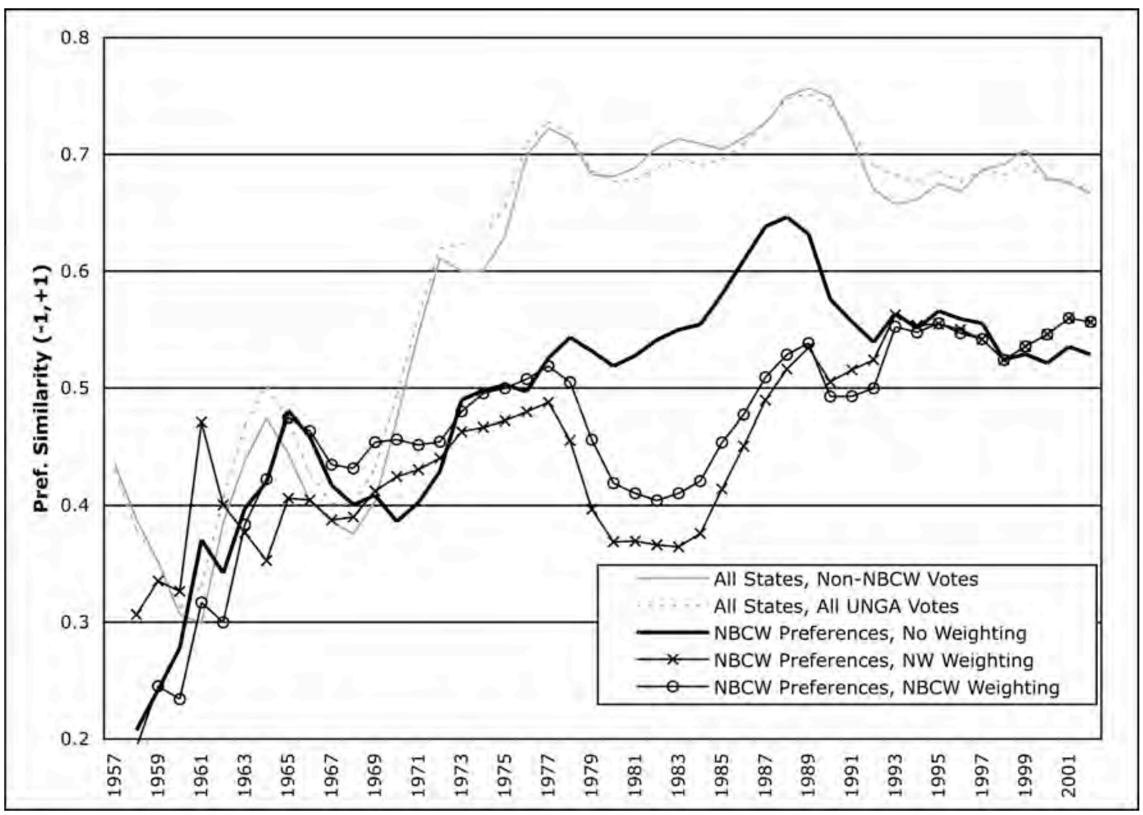


Figure 4.2: Comparison of Preference Score Means

Table 4.1: Nuclear delegation and NBCW Preferences of States

	All States (Unweighted)			All States (NW Weighting)		
NBCW Prefs						
Lag 1	84.54***	8.29	10.54	40.19***	34.10*	29.63*
	(13.37)	(22.87)	(21.32)	(7.67)	(14.94)	(13.34)
Lag 2		13.09	10.81		26.66	22.38
		(19.33)	(18.03)		(15.72)	(14.02)
Lag 3		49.17*	37.62†		39.17*	29.67†
		(22.10)	(21.13)		(16.84)	(15.26)
Distributed Effect of Preferences	85.54	70.55	58.97	40.19	99.93	81.68
Nuclear Threats			2.09*			2.55**
			(0.86)			(0.82)
Constant	-4.43	5.89	4.88	20.54***	-4.96	-4.79
	(6.61)	(6.82)	(6.36)	(3.64)	(8.12)	(7.21)
Adj. R2	0.46	0.52	0.58	0.38	0.47	0.58
N	46	36	36	44	36	36

Note: † p<0.1, * p<0.05, ** p<0.01, *** p<0.001, Standard Errors in parentheses

Table 4.2: Nuclear Delegation (IAEA States)

	No Weighting			NW Weighting		
NBCW Prefs						
Lag 1	64.61**	-2.63	3.35	41.34*	14.24	10.56
	(18.84)	(22.68)	(21.17)	(15.71)	(17.64)	(15.75)
Lag 2		34.70†	28.77†		18.30	15.28
		(17.30)	(16.21)		(17.48)	(15.59)
Lag 3		72.13**	56.69*		38.30*	29.99†
		(21.38)	(20.77)		(17.40)	(15.73)
Prefs: Distributed Effect	64.61	104.2	88.81	41.34	70.84	55.83
Nuclear Threats			2.02*			2.73**
			(0.81)			(0.89)
Constant	0.99	-19.0	-16.7	17.3*	5.3	4.1
	(11.09)	(9.91)	(9.23)	(8.26)	(7.58)	(6.76)
Adj. R^2	0.20	0.57	0.63	0.12	0.38	0.51
N	43	36	36	43	36	36

Note: † p<0.1, * p<0.05, ** p<0.01, *** p<0.001, Standard Errors in parentheses

Table 4.3: Nuclear Delegation (NSG States)

	No Weighting			NW Weighting		
NBCW Prefs						
Lag 1	26.65***	19.22	10.72	18.71**	5.72	-3.50
	(6.73)	(16.77)	(18.88)	(6.27)	(14.94)	(16.32)
Lag 2		-24.63	-11.08		-8.06	6.90
		(26.09)	(29.52)		(23.22)	(25.57)
Lag 3		39.11*	32.10†		27.26†	19.18
		(16.62)	(18.10)		(15.41)	(16.38)
Prefs: Distributed Effect	26.65	33.70	31.84	18.71	24.92	22.58
Nuclear Threats			0.72			1.05
			(0.74)			(0.80)
Constant	28.98***	25.38***	23.94***	34.28***	31.24***	28.80***
	(4.23)	(4.05)	(4.31)	(3.84)	(3.72)	(4.12)
Adj. R^2	0.35	0.49	0.49	0.22	0.37	0.39
N	28	26	26	28	26	26

Note: † p<0.1, * p<0.05, ** p<0.01, *** p<0.001, Standard Errors in parentheses

Table 4.4: Nuclear Delegation (NPT States)

	No Weighting			NW Weighting		
NBCW Prefs						
Lag 1	-90.0***	-55.62*	-52.87*	9.04	7.63	3.68
	(21.77)	(24.48)	(24.63)	(15.55)	(24.98)	(24.16)
Lag 2		-23.28	-17.58		-4.00	3.54
		(27.56)	(28.13)		(31.59)	(30.72)
Lag 3		-24.74	-27.60		11.00	7.40
		(24.71)	(24.87)		(24.33)	(23.51)
Prefs: Distributed Effect	-90.0	-103.64	-98.05	9.04	14.63	14.62
Nuclear Threats			0.68			1.51†
			(0.68)			(0.85)
Constant	99.3***	108.7***	102.9***	39.24***	36.47**	31.14**
	(13.49)	(13.16)	(14.39)	(8.84)	(10.54)	(10.58)
Adj. R^2	0.33	0.42	0.42	-0.02	-0.08	-0.01
N	34	31	31	33	31	31

Note: † p<0.1, * p<0.05, ** p<0.01, *** p<0.001, Standard Errors in parentheses

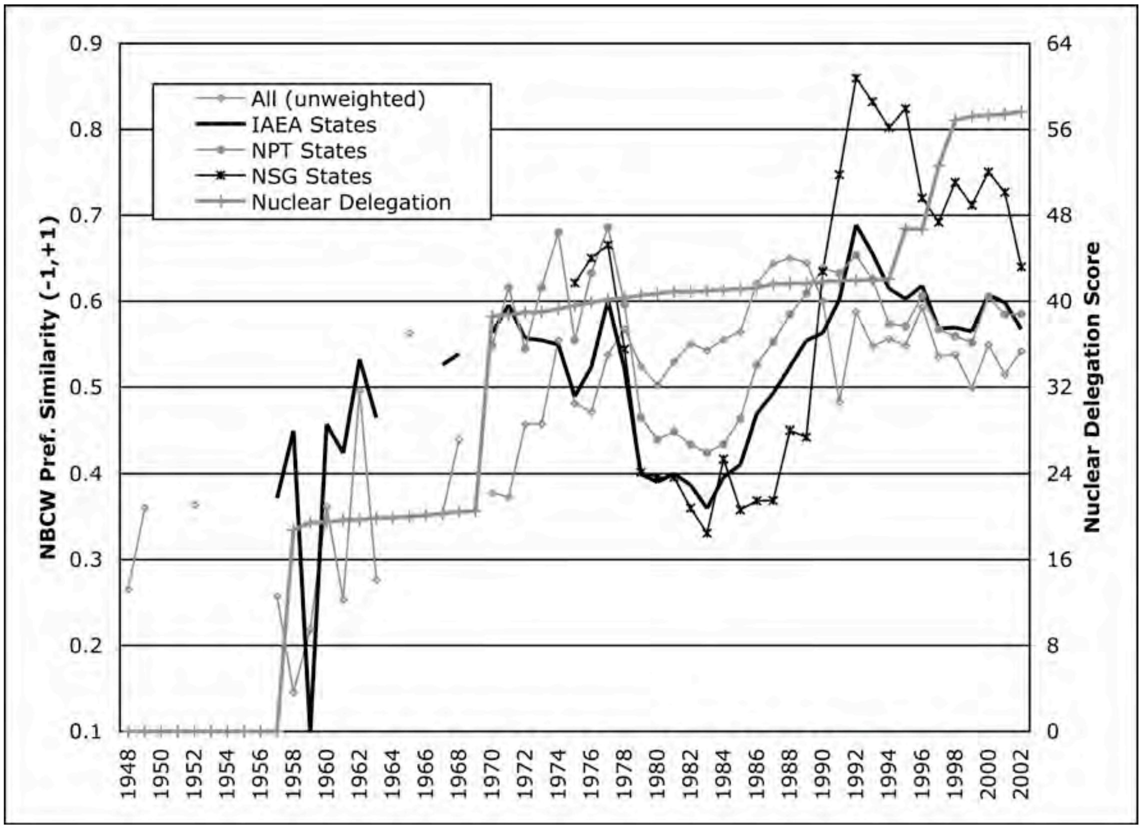


Figure 4.3: Nuclear Delegation and Nuclear Preferences of States by IO Membership

Table 4.5: Nuclear Preferences and Nuclear Delegation: nuclear weapon program and possessor states

	NW Program States			Nuclear Weapons States		
NBCW Preferences						
Lag 1	96.24***	10.91	17.70	48.48***	-23.82	-16.26
	(16.51)	(22.95)	(20.99)	(9.19)	(21.77)	(19.77)
Lag 2		22.83	6.95		23.59	13.55
		(24.65)	(23.11)		(20.46)	(18.74)
Lag 3		51.06*	40.19†		58.19**	44.84**
		(22.29)	(20.62)		(16.92)	(15.90)
Distributed Effect of Preferences	96.24	84.80	64.84	48.48	57.89	42.13
Nuclear threats			2.69**			2.83**
			(0.97)			(0.97)
Constant	7.49	14.18*	11.84*	22.47***	22.25*	18.33*
	(5.19)	(6.11)	(5.62)	(3.20)	(8.40)	(7.68)
Adj. R^2	0.42	0.36	0.47	0.38	0.31	0.44
N	46	36	36	4 5	36	36

Note: † p<0.1, * p<0.05, ** p<0.01, *** p<0.001, Standard Errors in parentheses

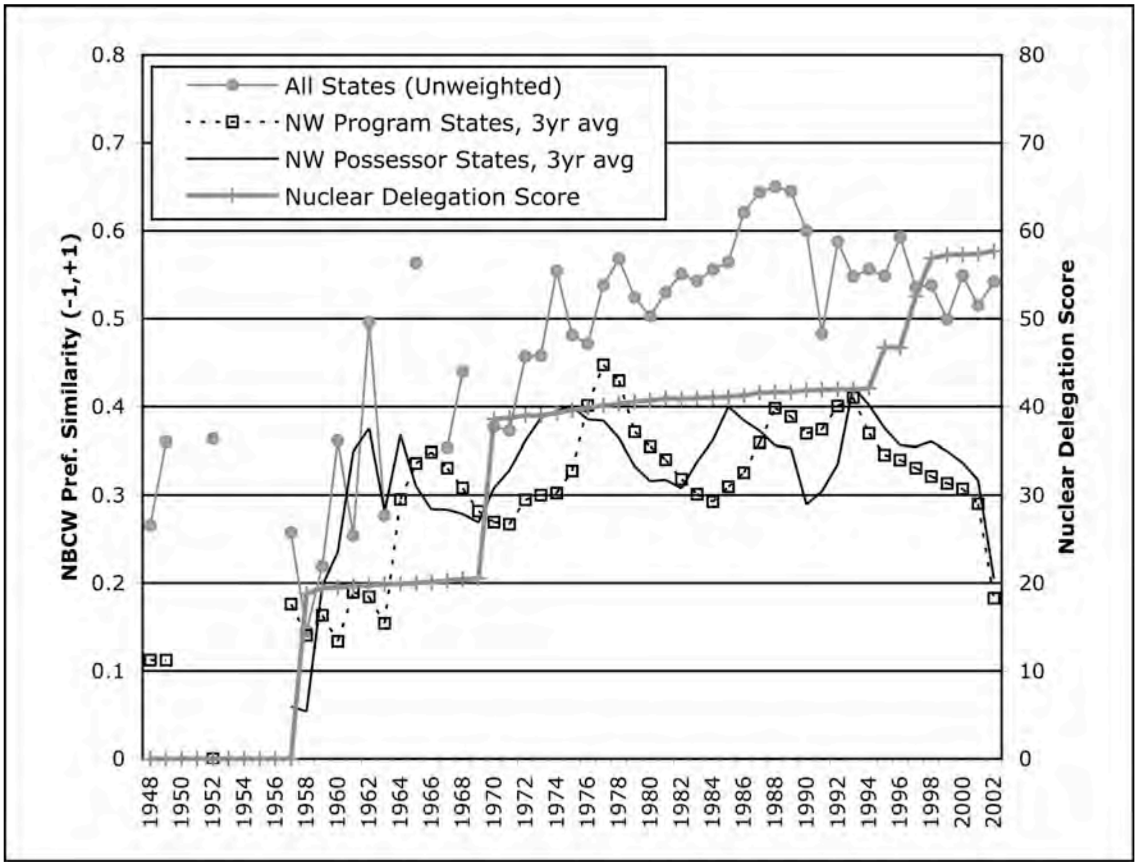


Figure 4.4: Nuclear Preferences of Nuclear States and Nuclear Delegation

Table 4.6: Delegation to the IAEA

	IAEA States			IAEA States (NW Weighted)			NPT States		
NBCW Prefs.									
Lag 1	22.75**	-1.49	0.47	15.56**	6.09	4.90	-36.9***	-29.17*	-28.21*
	(6.64)	(8.86)	(8.51)	(5.47)	(6.44)	(5.94)	(9.33)	(11.64)	(11.82)
Lag 2		12.69†	10.75		6.91	5.94		-8.07	-6.07
		(6.75)	(6.52)		(6.38)	(5.87)		(13.11)	(13.50)
Lag 3		25.32**	20.27*		13.37*	10.69†		-5.97	-6.98
		(8.35)	(8.35)		(6.35)	(5.93)		(11.76)	(11.94)
Distributed Effect of Preferences	22.75	36.52	31.49	15.56	26.37	21.53	-36.91	-43.21	-41.26
Nuclear threats			0.66†			0.88*			0.24
			(0.32)			(0.33)			(0.32)
Constant	12.41**	5.45	6.20	17.65***	13.17***	12.78***	50.04***	54.38***	52.32***
	(3.91)	(3.87)	(3.71)	(2.88)	(2.77)	(2.55)	(5.78)	(6.26)	(6.91)
Adj. R^2	0.20	0.51	0.56	0.14	0.39	0.48	0.31	0.37	0.36
N	43	36	36	43	36	36	34	31	31

Note: † p<0.1, * p<0.05, ** p<0.01, *** p<0.001, Standard Errors in parentheses

Table 4.7: Dependent variable is delegation to the CTBT PTS (left) and NPT (right)

	CTBT Delegation (No Weighting)			CTBT Delegation (NW Weighted)				NPT Delegation (No Weighting)		
NBCW Prefs										
Lag 1	4.92	-6.56	-5.67	3.78	6.07	5.21		14.39**	15.97†	13.64
	(3.7)	(10.77)	(10.32)	(2.27)	(5.80)	(5.75)		(4.52)	(9.03)	(8.38)
Lag 2		-1.04	-1.95		8.39	7.56			7.76	5.53
		(9.10)	(8.72)		(6.10)	(6.04)			(9.50)	(8.80)
Lag 3		10.71	6.11		9.59	7.76			15.06	10.10
		(10.41)	(10.22)		(6.54)	(6.58)			(10.18)	(9.58)
Distributed Effect of Prefs	4.92	3.11	-1.51	3.78	24.68	20.53		14.39	38.79	29.27
Nuclear Threats			0.83			0.49				1.33*
			(0.42)			(0.35)				(0.52)
Constant	-1.09	0.22	-0.08	-0.29	-9.50**	-9.46**		5.289*	-4.759	-4.668
	(1.830)	(3.213)	(3.080)	(1.078)	(3.155)	(3.110)		(2.145)	(4.912)	(4.530)
Adj. R^2	0.017	-0.038	0.050	0.039	0.219	0.241		0.175	0.250	0.362
N	46	36	36	44	36	36		44	36	36

Note: † p<0.1, * p<0.05, ** p<0.01, *** p<0.001, Standard Errors in parentheses

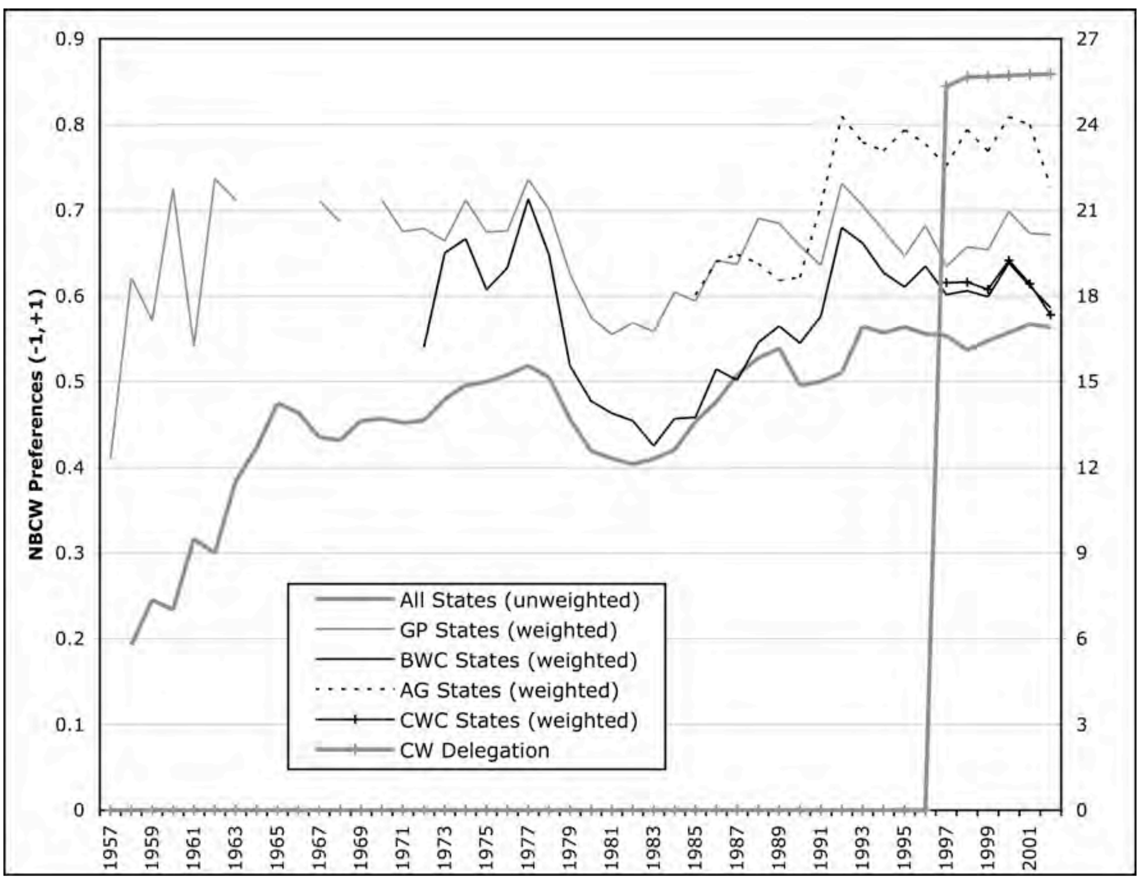


Figure 4.5: NBCW Preferences of CBW Institution Members and CW Delegation

Table 4.8: NBCW Preferences and CW Delegation

	All States (No Weighting)			All States (CBW Weighting)			GP States (No Weighting)		
NBCW Prefs									
Lag 1	9.35	-20.38	-21.73	23.08*	9.81	3.39	-18.28	-53.13	-62.20†
	(9.83)	(28.63)	(28.73)	(9.95)	(25.82)	(26.62)	(16.60)	(34.93)	(35.38)
Lag 2		-9.99	-3.35		10.07	15.49		-35.07	-28.92
		(24.20)	(25.29)		(21.84)	(22.51)		(26.89)	(27.11)
Lag 3		32.85	27.64		13.03	12.54		22.90	26.31
		(27.67)	(28.30)		(24.98)	(24.99)		(30.27)	(30.14)
Prefs: Distributed Effect	9.35	2.48	2.56	23.08	32.91	31.42	-18.28	-65.30	-64.81
CW Threats			44.74			46.04			56.57
			(48.26)			(46.29)			(45.29)
Constant	-1.70	2.81	-2.77	-7.51	-11.72	-16.65	15.19	48.16*	40.93
	(4.86)	(8.54)	(10.46)	(4.58)	(7.40)	(8.91)	(11.33)	(22.98)	(23.51)
Adj. R^2	-0.0	-0.04	-0.05	0.09	0.05	0.05	0.01	0.04	0.06
N	46	36	36	46	36	36	46	36	36

Note: † p<0.1, * p<0.05, ** p<0.01, *** p<0.001, Standard Errors in parentheses

Table 4.9: NBCW Preferences and CW Delegation

	AG States (No Weighting)			AG States (CBW Weighting)		
NBCW Prefs						
Lag 1	76.60*	36.14	12.35	71.33†	20.73	3.82
	(32.92)	(80.87)	(87.58)	(34.54)	(73.66)	(77.81)
Lag 2		-20.39	-21.56		2.00	-3.14
		(113.63)	(115.49)		(104.59)	(106.45)
Lag 3		80.85	98.04		69.59	85.29
		(77.33)	(81.57)		(76.25)	(79.95)
Prefs: Distributed Effect	76.60	96.6	88.83	71.33	92.32	85.97
CW Threats			58.02			57.87
			(73.77)			(73.02)
Constant	-50.02	-63.91	-64.99	-44.61	-58.9	-61.25
	(24.68)	(32.29)	(32.85)	(25.18)	(33.03)	(33.69)
Adj. R^2	0.21	0.16	0.13	0.16	0.11	0.08
N	18	16	16	18	16	16

Note: † p<0.1, * p<0.05, ** p<0.01, *** p<0.001, Standard Errors in parentheses

Chapter 5: The Technical Incentives to Delegate for Information

Before even the first atomic bomb was dropped on Hiroshima on August 6, 1945, the US had secured the agreement of the other Manhattan Project partners that they would not share nuclear materials or technologies with any other states (Goldschmidt 1985). By consciously monopolizing known sources of uranium ore and by refusing to share the knowledge necessary for others to enter the nuclear market, Canada, the UK and the US formed a nuclear cartel. Their intimate knowledge of each other's atomic capabilities but also of their national interests made this cartel credible.

As the number of nuclear producers increased, and threatened to continue to increase, this cartel was insufficient to prevent proliferation. Growth in the number of states with nuclear programs, and the distance from the original cartel members of their proliferation and geo-strategic interests, threatened any nonproliferation strategy without better information about who sought to proliferate and what policies would be useful to prevent it. The same issue had long plagued cooperation on biological and chemical weapons: the 1925 Geneva Protocol had limited its scope to use, and not production, because of monitoring and verification concerns.[123]

Long-term cooperation in a NBCW cartel generally requires that states, in addition to identifying policies that *could* raise the market price for others, must have some common information about each other's interests and the actions to implement such policies (Kandori 2002). Information about a state's NBCW capabilities and interests that

[123] Many US Senators, at least, rejected a verifiable Geneva Protocol because they rejected "supervision of any outside body...nor be subject to inspection or supervision by foreign agencies or individuals" (see cables by US Secretary of State Kellog to US mission for 1928 Kellog-Briand Pact in February-April 1926, cited in: McElroy 1991:138).

are not publicly known can yield gains to the actor if misrepresented to others (Fearon 1995). States seeking information about the proliferation activities of actors both inside and outside their borders face dilemmas in how to get that information: should they look where they can, improve their ability to look in new places, or seek the help of others? Some information may be easily applied to designing and implementing nonproliferation policies but is extremely expensive to acquire, while other information is less costly to acquire but harder to use. Information may be more difficult to use because each piece is more or less incomplete, inaccurate, irrelevant, or produced by biased agents.

The literature on international institutions has long argued institutions somehow improve the informational environment (Keohane 1984). However, there has been little done to explore "information" and show the conditions under which this role for international institutions will be particularly valuable. States pay search costs to produce information and can contract with various informational agents for doing so. Most such agents are domestic (national) but a few are not ("foreign" or "international"). I argue one reason states in a cartel would choose to delegate to an external agent for nonproliferation issues is that the agent (properly designed and motivated) is valuable for producing, collecting, and disseminating information relevant to designing and implementing a nonproliferation bargain.

I argue states hire agents to produce information about NBCW activities that are relevant to a nonproliferation bargain when doing so reduces the cost of searching for this information. First, search costs increase when expertise on nonproliferation increases or assets specific to producing such information becomes more expensive to acquire. This is true by definition, but will also be shown to be empirically true. Second, search costs increase when the information is held in small pieces by a large number of actors such that few individuals encounter, can draw conclusions about, and have an incentive to communicate that information with others (Raustiala 2004; Dai 2007). Finally, search costs decrease when an agent can exploit economies of scale in information production. In short, search costs increase with data diffusion and rapid change in the policy or issue area, creating benefits when data production tasks are centralized and redundancies eliminated. Investment in information is necessary to reduce uncertainty about the scope of the problem, its causes, and the potential solutions. And, through delegation to an informational agent, states pay lower search costs to acquire this information.

The Literature on Information, Search Costs and Informational Agents

One criticism of the traditional IR literature is its unstated assumption that states operate in an environment of poor-quality information. Waltz, for example, recognizes that beyond the basic goal of national survival, states will have an endless variety of strategies to produce survival (Waltz 1979). However, Waltz argues that because these strategies and interests change over time, it is really only important to understand the distribution of capabilities among states. Others place greater importance on the problems of incomplete or uncertain information. Schelling, for example, argues the outcomes of international bargaining situations are strongly influenced by the ability of the actors to communicate their commitments in a credible manner (Schelling 1960). More recently, Fearon and Powell have each linked private information – information about actors' interests and/or capabilities that is held asymmetrically for strategic advantages – to the causes of inter-state war (Fearon 1995; Powell 1999; Powell 2002). The ability to observe such private information is theorized to be an important factor in how international institutions may be structure to reduce or otherwise cope with uncertainty over actor behavior or the state of the world (Koremenos, Lipson, and Snidal 2001).[124]

However, while information is described as a key variable, it is rarely treated as something that varies. Most recent formal answers to the "why war?" question focus on the positive probability of war that is created when moving from a complete information environment to one of incomplete information (as reviewed by Powell 2006). The world exists as a binary informational state in most of these works. Similarly, Raustiala argues that citizen "fire alarms" are efficient sources information on compliance with environmental regulations relative to government "police patrols" because "the structure of information about environmental enforcement is one in which information *is* relatively dispersed" (Raustiala 2004:405, emphasis added). The issue is not whether information about environmental compliance is or is not dispersed, it rather that information costs vary with the type and detectibility of violations. Snidal, for example, argues that the informational requirements for international cooperation should vary with the issue area in which state seek to cooperate (Snidal 1985).

Most analyses of cartels focus on public or private communication between the producers about prices as noisy signal of cheating (Aoyagi 2002; Aoyagi and Frechette 2005; Baliga 1999; Kandori 2002).[125] Some cartels find it unnecessary to identify the

[124] Uncertainty about "the state of the world" exists when actors either lack necessary scientific or technical knowledge about the world or are uncertain about the consequences of policy choices (Koremenos, Lipson, and Snidal 2001:778).
[125] In the seminal model of Green and Porter, collusion requires an industry that is temporally stable in its population and in which the only variable is firm output; firms are unable to differentiate their product or divide the market regionally (Green and Porter 1984). This excludes almost any other factors that could inhibit successful cartel operation. If some firms are vertically integrated, it can complicate determining where in the supply chain, and therefore by whom,

cheater because effective punishment is possible through a reciprocal defection that erases the initial cheater's gains from cheating.[126] OPEC, for example, is well known for its reliance upon monitoring the market price of crude oil as a noisy signal of its member's compliance with the agreed level of production at that point in time. When there are no public signals of the level of compliance, such as price, or the source of the defection is also important to know, cooperation requires producers to be able to rely upon some mutual monitoring system to produce information about compliance (Aoyagi 2002; Carpenter, Bowles, and Gintis 2006; Compte 2002b). For states concerned about NBCW proliferation, monitoring must be able to reduce information asymmetries by revealing private information about the NBCW activities of others.

As Raustiala notes, there are situations when information is available at a low-cost to decision makers because they, or others with whom they are in communication, encounter the information due to their proximity or existing expertise (Raustiala 2004:405). However, when information is scarce and expertise limited, actors must pay search costs to acquire the information needed for decision making. States seeking information face search costs that include not only the cost of the search itself (sending inspection teams, reviewing satellite imagery, etc.), which increases with the number and diversity of search targets, but also the cost to design, implement, and on occasion redesign the search process.

---

cheating is occurring (Carlton and Perloff 1994). Collusion can also be impeded when consumers have access to attractive substitutes.

[126] Supply and demand set the market price but in monopoly or oligopoly conditions, the producers can raise rents by reducing supply or coordinating prices. When one actor cheats by increasing supply or lowering their prices, reciprocal defection by others also increasing supply or lowering their prices can leave the first actor – as well as all others in the cartel – worse off than under cartel conditions, thus punishing defectors with reciprocal defection.

Empirically, the more expensive it is to produce information, the sooner it becomes efficient for some individuals – "informational intermediaries" – to specialize in the production of information about that market, and then spread the cost of production over many buyers (Hanchen and von Ungern-Sternberg 1985).[127] Specialization by an informational intermediary is distinct from centralization of informational activities (Koremenos, Lipson, and Snidal 2001:789), though under some circumstances it may be sufficient to enable cooperation (Ostrom 1990).

Search Costs and Delegation Theory

The strategic advantages of secrecy and the ease of hiding NBCW activities make external monitoring necessary. A key distinguishing feature of some NBCW IOs is the centrality to cooperation of their compliance-monitoring role. Delegation to these IOs for monitoring far surpasses the centralized information sharing in intergovernmental organizations, such as occurs within the NSG, or even the delegation to a director or small staff to serve as a clearinghouse for decentralized national information gathering and reporting activities (as envisioned by Koremenos, Lipson, and Snidal 2001:789).

The primary function today of the IAEA is to monitor and report on state's compliance with various nonproliferation agreements.[128] The IAEA implements safeguards, but safeguards are a monitoring and reporting function in which the IAEA inspectors must verify that state declarations about their nuclear activities are both accurate and complete such that there are adequate guarantees ("safeguards") that fissile

[127] An intermediary will also produce more detailed information than any individual consumer wants to buy.
[128] The other major role of the IAEA, though some will argue whether co-equal or secondary to safeguards, is the promotion of peaceful uses of nuclear technology.

materials have not been diverted to use in nuclear weapons. Similarly, the OPCW was created to identify, monitor and report on the destruction of declared possessors' CW stockpiles and on production and trade by facilities capable of producing CW-precursor chemicals. And, as discussed below, the CTBTO consists primarily of the International Monitoring System, to monitor the environment for evidence of nuclear testing, and upon entry into force of the underlying treaty also an On-Site Inspection agency, to investigate and report on events that parties identify as characteristic of a nuclear test.

In this chapter, I attempt to establish the technical incentives for states to delegate part or all of the search for NBCW information to an external agent. Delegation to a centralizing informational agent for producing and communicating information on nonproliferation-related activities is more likely when search costs are high, but not so high as to produce an insurmountable barrier to entry. First, each state searching for evidence of NBCW production by others pays an additional cost to investigate each additional state and each additional location within each state.[129] Dai and Raustiala each point to the ability to rely upon "fire alarms" rather than centralized "police patrols" to produce information when there are low-cost monitoring "agents" available (Dai 2007; Raustiala 2004).[130]

Dai, for example, argues that the expense of centralized monitoring isn't worthwhile for monitoring human rights regimes because individual victims and non-governmental organizations are aware of human rights violations and can assume the role

---

[129] Often referred to as "border effects", international borders mean not only another language but different national legal and bureaucratic systems, different industrial organizational structures, and potentially unique indigenous production technologies.
[130] These authors build upon the distinction in arrangements used by the US Congress to monitor the actions of the Executive (see: McCubbins and Schwartz 1984).

of “agent” and bring violations to the attention of the responsible authorities. However, such low-cost monitors may not be available when activities are dispersed widely. The A.Q. Khan black-market nuclear network, for example, made reliance on a fire alarm mechanism more complicated by spreading procurement of dual-use items over a number of producers in multiple countries. Even if proliferation activities were occurring within the same country, individuals working on separate components can be sufficiently isolated from each other that they are unable to connect the activities together: only those individuals assembling centrifuges for uranium enrichment may be aware of the specific purpose of the acquired aluminum tubes, rotors, corrosion-resistant pipes and other equipment, but may still be unaware that the end goal is a weapons program. The alternative military and civilian uses of most proliferation-related activities makes the closest parallel to a clear violation of human rights treaties the final assembly or testing of a weapon. For most states, this would be too late to act.

Second, low-cost monitors are also not available when monitoring requires costly investments in assets, such as expertise or equipment. The investments required in assets specific to an issue area increases as the number of relevant issue areas or functional fields increases. The necessary investments to maintain expertise also increase as the technology advances. The ongoing biotechnology revolution, for example, has potentially created new sources of BW agents (e.g., genetically engineered organisms or bio-regulators) without obviating older approaches (e.g., diseased fleas, rotting carcasses, etc.). That is, as aspects of the behavior being monitored become more specialized and change more quickly, the cost of expertise increases.

In short, the more geographically diffuse and functionally differentiated the information, the greater the efficiency gains from delegating to an informational agent. This expectation parallels the expectations of most of the Rational Design literature: centralization should increase with greater uncertainty over behavior or the state of the world (Koremenos, Lipson, and Snidal 2001). Two hypotheses, therefore, follow:

H1: The more diffuse the information, the more likely states delegate to an information intermediary to monitor compliance with the delegation contract.

H2: The more expensive the specific assets for information production, the more likely states delegate to design and implement monitoring of compliance with the delegation contract.

The first hypothesis suggests that the greater the number of potential targets of monitoring, the more valuable it will be to individual states to economize (eliminate their redundant activities) and delegate information acquisition. The second hypothesis presents the necessary investment in specific assets also as being causal: investment should increase when technological advancement of the industry makes expertise more expensive to acquire. Data may be diffused over industries that are distinctly different but linked by their common relationship to NBCW technologies. The effect of these variables can be expected to be curvilinear. The basic concept of increasing economies from scale implies returns are not monotonic throughout production levels (here information is being produced) and will be less efficient at lower levels. Therefore, under conditions of uncertainty, no information production may be observed if the scale believed necessary for efficient production is very high.

I first offer a case study of nuclear test ban negotiations as a concrete empirical example of these arguments, to demonstrate that the cost of information is variable over time. This case study offers a qualitative analysis of the cost of acquiring information on nuclear weapons programs and verifying proposed test bans using a treaty-based system. I then provide quantitative tests of the causal power for delegation of the technical cost of information using cross-case data on the nuclear power, chemical, and biological and biotechnology industries.

Data Diffusion and Asset Specificity: Test Ban Treaties

The earliest test-ban negotiations occurred for clear strategic reasons. First, the fear that without international controls of some kind, US-Soviet arms racing and competitive posturing could cause another world war. Second, a test ban was useful to prevent the spread of nuclear weapons to new states because nuclear technology, and the underlying physics, was still sufficiently undeveloped that testing was the only way to ensure a weapon design worked. If states were prevented by a test ban from verifying their bomb designs and demonstrating the credibility of their nuclear forces, US-Soviet nuclear arms racing could be slowed and the emergence of "Nth country", new nuclear powers prevented (Brennan and Halperin 1961).[131] However, the consistent impediment to test ban negotiations over the course of the post-WWII period has been the information necessary for negotiating and implementing a nuclear nonproliferation bargain: how could such a ban be verified and what verification measures would the parties accept?

This study examines the cost of information for implementing a nuclear test ban, important for analyzing how one strategy (an international equilibrium strategy) becomes more or less useful because of changes not only in number of monitoring targets but also

---

[131] It cannot be ignored that there also was growing public clamor for a test ban because of a popular fear of the environmental repercussions of fallout that begins as early as the 1954 Castle Bravo test but continued with later atmospheric tests that spread radiation in populated areas.

in the monitoring technologies themselves. I divide the post-1945 time frame into four periods, which correspond to points at which collective international decisions were reached or rejected, reflecting the technological and political limits facing negotiators. I highlight changes over time in the informational variables identified above: diffuseness of relevant data across states and across industries, and the cost of investing in information on specialized techniques, technologies and actors.

Period 1: 1954-1963

US President Dwight Eisenhower became convinced by 1957 that a test ban could be verifiable. When the Soviet's tested their first nuclear weapon in 1953, the US had multiple techniques for not only verifying a test had occurred but also gathering information about the nature of the test. Seismic stations first detected the test itself and shortly later radiological monitoring stations (24+ fixed-location air- and rainwater-filtration stations) began to confirm that the unusual seismic activity had been an airburst (above-ground) test (Richelson 2006b). These capabilities were not accurate enough to measure the yield, the 400 kiloton (kt) test was estimated to be 500kt to 2 megatons (Mt) and likely 700 kt, but did determine it was not a true fusion bomb (Richelson 2006b). Within two years of Eisenhower taking office, the US also had six seismic stations on US territory and five abroad, supplemented by access to a UK seismic station in Pakistan and multiple Canadian stations (Richelson 2006b).

Eisenhower therefore proposed convening an international technical conference on monitoring a test ban (Brown 2007). With Western participation by the US, UK, and France and Eastern Bloc participation by the USSR, Poland, Czechoslovakia, and Romania, the 1958 conference recommended by consensus a "Geneva system" of seismographs, atmospheric monitoring of acoustic and radio signals, radioactive debris collection and – supported also by the Soviets – on-site inspections (Goodby 2005). Viewed as successful, Eisenhower agreed to discuss negotiating a comprehensive test ban treaty (CTBT) and followed with a test moratorium that the Soviets also joined.

Though more than the USSR, the US had little experience with underground nuclear tests. Just as Eisenhower's popularity began to slide, new data indicated that the number of unidentified continental earthquakes was an order of magnitude greater than previously believed and that methods of conducting underground nuclear tests could complicate seismic monitoring (Goodby 2005). The US therefore argued any test ban must be "limited" because the absence of underground nuclear tests was technologically impossible to verify without on-site inspections. Even the ability to detect airburst tests was limited: US intelligence estimated that its existing national system had 90%-100% chance of detecting an airburst of 10kt or larger, a 60%-90% chance with 3-5kt airburst; and a less than 30% chance of detecting an airburst test smaller than 3kt (Richelson 2006b). The US therefore offered in April 1959 a ban that only covered atmospheric and underwater testing, and followed in February 1960 with a proposal for a ban on all but the smallest (and unverifiable) nuclear tests (McBride 1967). The US goal was to phase in a nuclear test ban with improvements in detection (Goodby 2005).

The USSR rejected both the "Limited" and "Threshold" test bans because the US was ahead in underground testing.[132] The two were close to a CTBT that would be verified, along the "Geneva system" recommendations, by 180 land-based control posts and an inspection system (Bonham, Sergeev, and Parshin 1997), though they didn't agree

[132] The US began exploring underground testing in the late-1950s (Carothers 1995:21,91).

on the annual maximum number of permitted on-site inspections: the US and UK called for a limit of twenty in each party whereas the Soviets wanted only three (Goodby 2005). The Soviets were, of course, concerned that a greater number of on-site inspections would mean greater access to their closed society and reveal more about Soviet military operations. Talks ended after the May 1960 downing of a US U-2 spy plane over the Soviet Union and tensions escalated further with the failed Bay of Pigs operation and the Soviet construction of the Berlin Wall (Loeb 1991; Wittner 1997). Tensions continued to worsen until the 1962 Cuban Missile Crisis brought the US and USSR to a shared view of the effects of proliferation upon international strategic stability (Wittner 1997).

Despite their disagreements, both US President Kennedy and Soviet Premier Khrushchev saw blocking a Chinese nuclear bomb as the primary purpose for test ban negotiations (Burr and Richelson 2000).[133] The Eighteen-Nation Disarmament Conference successfully concluded the Limited Test Ban Treaty (LTBT) in 1963, banning all nuclear tests except those carried out underground. The LTBT was considered a step back from talks on a comprehensive test ban because the US and UK believed it would be unverifiable as long as the USSR refused to allow at least ten seismic stations (York 1987). The LTBT did not provide any mechanisms for verification or determining compliance and none appeared likely to be negotiated after Premier Khrushchev was removed from power in 1964 (Bonham, Sergeev, and Parshin 1997). Sixty-two states had ratified the LTBT by the time of its entry into force in October 1963, increasing to ninety-four states by 2006 (and twenty-three otherwise acceding).

[133] Fred Iklé (1960) argued that potential proliferator states like France and China were unlikely to sign onto such a treaty and might be able to develop nuclear weapons without testing or with small tests that would be undetectable (Brennan and Halperin 1961).

Eleven states are now known to have begun nuclear weapons programs by 1963 (though not all were necessarily known at the time) and fifteen had achieved a level of latency that put a nuclear weapons program realistically within reach (Jo and Gartzke 2007). While this number appears small relative to the total number of states, existing monitoring capabilities were limited in number and by the extant technologies and the absence of geological data needed to employ them. In particular, there remained a very large gap between the limited number of extant seismic stations (eleven and a handful in friendly hands focusing on the USSR) and the 180 recommended for the global "Geneva system". That said, it is even uncertain with this limited number if any were redundant or if there was any effort at centralization of the labor-intensive analysis process to reduce other redundancies. Also, some of the targets (i.e., China) were quite large and/or inaccessible to monitoring strategies.

Period 2: 1964-1979

By the early 1960s the US had developed new monitoring technologies that reduced the need to rely upon others for information. The US launched its U-2 program in 1956 with planes capable of high-resolution aerial photography. Over-flights of the USSR were limited after the Soviets detected and protested the over-flights and then saved for rare instances after Soviet anti-aircraft weapons became dangerous, as the US learned in May 1960 (above). As a result, as of early 1960 "more than 85% of suitable area, 95% of priority areas, and 85% of rail route mileage in priority areas had not been observed or covered by useable TALENT [U-2s] during the period" (Lindgren 2000).

More significant was the US deployment of the first CORONA satellites in 1960. While their resolution at 40 feet was much poorer than the U-2's "six inches or a few feet" (Richelson 2006a), the first successful CORONA mission on 18 August 1960 produced more USSR images in one day than all U-2 overflights to date (Richelson 1999).[134] The resolution of satellite imagery improved quickly, achieving resolution levels of 4 feet by 1963 and 6 inches by 1966 (Richelson 2006a). To put these numbers in context, a resolution of about 15 feet is needed to detect a plane on the ground, but a resolution of about 5 feet is required to recognize the class of plane (e.g. cargo/bomber or fighter), 3 feet to identify the plane model (type of fighter), and 6 inches to make specific descriptions about its capabilities (Ondrejka 1986).

Therefore, while satellites were useful for identifying nuclear reactors under construction and missiles being transported or staged horizontally, most of what was learned about states' nuclear weapons programs was based on inference from shapes and the relative relationship of these shapes. During the Cuban Missile Crisis, for example, the US identified elements of the Soviet presence in Cuba from the familiar patterns of silos, air defenses, and roads used in missile fields constructed in the USSR and from "cratology": inferring deliveries to Cuba from the size and shape of shipping crates on Soviet cargo ships.[135] Despite Cuba's small relative size and its being an existing intelligence target, the US was late to detect the buildup.

The US picture of China's nuclear program prior to its 1964 test was similarly based on inference but was searching for an incomplete program in a much larger

[134] Lindgren reports the first CORONA satellite as having resolution of 25-30 feet (Lindgren 2000:102).

[135] The National Security Archive at George Washington University has posted a number of exemplifying aerial photographs from the period. Salient examples of the use of inferences include extrapolating the placement in Cuba of SA-2 surface-to-air missile batteries from the Star of David pattern first observed in images of the USSR and extrapolating the shipment of Komar guided-missile boats and IL-28 bombers from the size and shapes of crates on Soviet ships in route to Cuba (Chang and Kornbluh 1999).

"haystack". From 1960-62, the US was able to identify the major – and physically large – components of the PRC nuclear program using a combination of CORONA and U-2 imagery (the latter from U-2s flown by ROC pilots): its plutonium production reactor, uranium enrichment plant (gaseous diffusion), and nuclear weapon test site. However, illustrating the inference problem, US intelligence assumed the PRC would pursue a plutonium-based bomb, partly because of mirror imaging from the US and Soviet bomb building experiences but also because analysts believed the PRC gaseous diffusion uranium enrichment plant was still inactive and also too small (Burr and Richelson 2000). Even as the US satellites and other intelligence sources detected test preparations and unusual weather sampling and air traffic near the site, CIA analysts insisted a test was likely not for 6-8 months (Burr and Richelson 2000). The US did detect the test itself on 16 October: 7 acoustic and 11 electromagnetic pulse detection stations provided data on yield estimates and time, and then a fleet of US aircraft dedicated to air filtration missions gathered nuclear debris for 21 days to try to determine from the fission products the type of weapon and how efficient it was (Richelson 2006b).

Too late to block a Chinese bomb, the USSR became less enthusiastic about negotiating a treaty against nuclear states proliferating or aiding proliferation by others (York 1987). Still, the NPT negotiations concluded in 1968 with a grand bargain: non-nuclear weapons states (NNWS) renounced nuclear weapons and accepted safeguards administered by the IAEA on all their nuclear materials in exchange for international assistance in exploiting peaceful nuclear energy *and* the commitment by the nuclear weapons states (NWS) to nuclear disarmament (Reicke 1999). The entry into force of the NPT in 1970 is significant to test ban negotiations because many states made it clear in their decision to join the NPT that NWS disarmament, especially by the US and USSR, was key to the bargain. Pressure for positive progress on disarmament became the impetus in the test ban negotiations that were to follow.

However, as the US Senate hearings in 1973 show, there were also technical incentives: while the US now had 16 seismographic stations worldwide for detecting nuclear tests, these were insufficient for separating low-yield tests from natural seismic events (US Senate 1973). This was especially true in the USSR and PRC where these states were most likely to test where the US was uncertain of the location and/or geologic conditions. The low-yield detection problem became worse because, by the 1970s, half of all US nuclear weapon tests were less than 20kt and it was anticipated future testing would be largely for non-yield issues (US Senate 1973).[136] Everden estimated it would be necessary to place as many as 15-20 seismic stations within the USSR to seismically verify compliance with a test ban because of the number of possible test sites within a country as large as the USSR (US Senate 1973:74). The US did not have even this number around the USSR and a large number of additional stations would presumably be necessary to monitor the testing activities of China and other states.

NPT-related pressures did lead to US and Soviet progress on supplementing the LTBT with a ban on all nuclear tests in excess of 150 Kt under the Threshold Test Ban Treaty (TTBT). Concluded in 1974, the TTBT was deemed by the US and USSR to be a verifiable alternative to a comprehensive test ban treaty. The 150 Kt threshold, however,

[136] Early tests were at full yield to verify the basic physics and effects of increasing the scale of explosions (Carothers 1995:4). Later tests were designed to test refinements of nuclear warhead designs from changes in production processes, ensure stockpile reliability despite aging, and advance delivery systems, the latter of which did not even require *nuclear* tests (US Senate 1973).

was somewhat arbitrary and reportedly driven by a single person's testimony to the US Congress that the science of seismic monitoring was still so uncertain that it had a "factor-of-two uncertainty": a test established at 150kt with 95% probability could have an actual yield of 75kt (0.5x) to 300kt (2x) (US Senate 1987; US Senate 1977b).[137] This decision was political because, as Panofsky testified, there is a difference between test identification and yield measurement, implying the minimum required for yield measurement exceeds the threshold necessary to establish noncompliance (a central piece of evidence is not only proof a test occurred but also scientifically accurate data regarding the yield). The TTBT, however, left a major loophole for peaceful nuclear explosives (PNEs) and as soon as the TTBT was signed the US delayed Senate ratification until a Peaceful Nuclear Explosives Treaty (PNET) could be negotiated (US Senate 1977b).

The US did not ratify the PNET or TTBT at this time. Officially, the reason was verification concerns: while satellite imagery improved, the US still had too few seismic stations to monitor foreign testing activities. Therefore, without significant access to test locations and high quality data about the test and the surrounding geological conditions, there could be little confidence in the determinations about yield and, therefore, about compliance. And, compared to the state of the world in 1963, there were three more states that had tested nuclear weapons, 5 more with programs, and as many as 15 additional states with the capacity to pursue a nuclear weapons program (Chapter 3).

The TTBT was clearly the technical and political limit of test-ban verification at this time. This period is most remarkable, in the context of test-ban negotiations, for a transition from test-bans being seen as useful in their own right to their being pursued as

---

[137] Paul G. Richards testified that the margin for error was closer to 1.5x (US Senate 1987).

a substitute for "real" progress on disarmament under NPT obligations. It was clear that many in the US government supported continued US testing and used concerns about verification as a pretext (Thee 1988).[138]

Period 3: 1979-1990

Again under pressure for progress on disarmament for the 1980 NPT Review Conference, trilateral discussions between the US, USSR and UK restarted in 1979 on a CTBT verification agreement satisfactory to each state's concerns. Early in the resumed talks there was general agreement on the need for seismic stations in each country, on-site inspection of suspicious events, a finite but extendable treaty duration, and a need to ban PNEs (the PNET having not entered into force). Ever protective of its sovereignty, though, the Soviet Union wanted delayed transmission of seismic data (to provide time to screen for and remove "illegal" data because seismographs could reveal information about other military secrets). It also wanted inspections to be "voluntary" and implemented similarly to SALT-I's Standing Consultative Commission. The USSR, furthermore, wanted to exclude as evidence for challenges any non-seismic data such as overhead imagery, air or soil samples, or intercepted communications or telemetry, all of which had been used previously to detect testing activity.

While the US and UK were somewhat flexible on these issues, negotiations again deadlocked later that same year over the number of seismic stations. The USSR wanted an equal number in each country, which the US and UK refused because of their drastically smaller sizes (York 1987). The US and UK believed ten seismic stations were

[138] The reasons then are similar to those used today: a robust US nuclear arsenal is necessary for nonproliferation because it discourages US opponents from acting against US interests and it reassures allies such that they do not see a need for nuclear weapons.

the minimum necessary to verify USSR compliance but believed only one station was sufficient to verify UK compliance. The USSR, however, wanted UK to locate seismic stations also on its various territories around the world to verify the absence of tests in the South Pacific and to monitor countries unlikely to accede to the CTBT, such as the PRC and France. The talks became tense when the US negotiating team was instructed to press the USSR on a suspected violation of the TTBT (though the US hadn't ratified it), and then were completely derailed by the Iran hostage crisis, the Soviet invasion of Afghanistan, and the election of President Reagan (York 1987).

When relations improved in the mid-1980s, the international nuclear nonproliferation regime was reinforced by the accession of key states to existing treaties and the negotiation of new treaties, such as the Intermediate Nuclear Forces (INF) Treaty and the Convention on the Physical Protection of Nuclear Materials (CPPNM) in 1987 (CNS 2004). In between, however, one possible test off the southern coast of South Africa highlighted an uncertainty in the back of many minds. Known as the Vela Event, on 22 September 1979 the US VELA satellites equipped with multiple systems to detect atmospheric nuclear tests indicated that a nuclear test had occurred, which many attributed to the efforts of either South Africa, Israel, or the two working together (Richelson 2006c).

US President Ronald Reagan finally began in 1987 to push for ratification of the TTBT and PNET. These two treaties entered into force in 1990 when the Soviets accepted US demands for a change in the monitoring technologies for verification (Callen 1990; State 1986; Thee 1988; US Senate 1987). The US demanded the Soviets accept the CORRTEX method, a very specific monitoring technique that requires placement of equipment in the same or nearby tunnel to that used to emplace the warhead to be tested (Callen 1990). The US may have renewed ratification of the TTBT and PNET in order to avoid pressure for a CTBT (US Senate 1987), an argument reinforced by the fact that CORRTEX monitoring is useful only in close proximity of acknowledged tests and not for clandestine tests, thereby also not useful as a stepping stone towards a CTBT (ibid.). CORRTEX is intrusive but less so than nearly any imagined on-site monitoring system because it provides data on yield only and not composition.

This period therefore began with high international tensions that gave way to bilateral arms control agreements between the US and USSR but little real progress on a test-ban agreement. The incentives for a comprehensive treaty, though, were also smaller than a decade before: only one more state had tested a nuclear explosive device (India) and there were approximately the same number of latent nuclear states and states with nuclear weapons programs (Chapter 3). However, nuclear activities were increasingly taking place where civilian activities could be occurring (and hide weapons programs) or where the US and others had little access. For the Indian nuclear test, for example, it is believed that only three individuals outside of the weapons scientists themselves were aware of the program at all and US imagery analysis had missed identifying the test location (Richelson 2006b). These developments signaled greater data diffusion by the late 1980s but also the limited ability of the US or any other individual state to independently monitor proliferation activities.

Period 4: 1990-2006

With the fall of the Soviet Union, international politics moved first into a state of post-Cold War euphoria and then to disillusionment as the post-Gulf War process of disarming Iraq and then the North Korean nuclear crisis foretold a future plagued by demands for nuclear, and possibly chemical and biological, weapons proliferation. Almost overnight the number of states with nuclear weapons and the number of potentially latent states increased by half, counting not only post-Soviet inheritor states but also the proliferation of centrifuge enrichment technologies to many states that began with Pakistan's successes in the late 1980s (Chapter 3 and Jo and Gartzke 2007). The world was also surprised by South Africa's announcement that it had constructed 6 nuclear weapons in a secret program (which was subsequently dismantled under IAEA supervision).

Meanwhile, the NPT was at risk of lapsing unless the 1995 NPT Review Conference chose to extend it. As states like the US exerted significant pressure to get the NPT extended (indefinitely this time), NNWS were torn between abandoning a failed strategy for NWS disarmament and losing the normative barrier to proliferation by other states. To gain NNWS support at the Review Conference extending the NPT, the NWS committed to – and achieved – concluding a CTBT by 1996. The CTBT was intended to provide multilateral assurances that states were not testing nuclear weapons through delegation of management of a testing-specific International Monitoring System (IMS) to an IO, the CTBT Organization (CTBTO). Compared to the 16 monitoring stations the US had access to in 1973 and the 30 that would have been acceptable in negotiating the CTBT in 1979, the IMS plans to employ 321 facilities, including 50 seismic stations (another 120 will make their data available upon request), 11 underwater hydroacoustic stations, 60 above-ground infrasound stations, and eighty radionuclide air-sampling stations.

The CTBT, however, has yet to come into force as it is awaiting ratification by nine key states (including the US). While awaiting its entry into force, the members of the Preparatory Committee for the CTBT agreed to begin constructing the CTBTO as a "Provisional Technical Secretariat" (PTS), a fully functional international organization with a large staff and which collects annual assessments to fund its operations, including the nearly completed IMS. As of April 2007, over 200 stations were actively transmitting data to the CTBTO's International Data Center, which in turn transmits both the raw data and data products to the signatory states. The IDC interprets the data using US-provided software: "a $100 million gift in software, hardware, expertise" ("a $100 million gift in software, hardware, expertise", see: Official 2005a).

Summary

The four periods reflect the continuing technological limits to producing the information needed to verify nuclear testing activities. In particular, even the United States lacked the number of stations needed, access to locations crucial for monitoring, and data necessary to interpret some of the information it did acquire. US attempts to monitor Soviet testing were confronted with too many potential targets. The large number of US seismic and environmental sampling stations (relative to others) and its fleet of air-sampling planes, even supplemented by satellite and other intelligence systems, were inadequate for the scale of the monitoring problem. Though the US invested heavily in assets specific to nuclear test monitoring, the data gathering challenge only worsened with time as more states embarked on nuclear programs and tested nuclear weapons.

Only with the negotiation of the CTBT was there the collection into a useful monitoring network of sufficient number and types of monitoring stations to verify testing at all possible ranges. However, the immense scale of the system also serves to highlight the inadequacy of the previous national attempts. The investment in specific assets required, though, has been correspondingly great. The immense cost of the data analysis system also shows that this capability was out of reach of most states. This point is further emphasized by the desire of many Pacific Rim states to apply the CTBT's IMS for earthquake monitoring after the 2004 tsunami disaster in Southeast Asia.

Parsing the Data: NBCW Data Diffusion & Asset Specificity

The hypotheses posit a relationship between geographic diffuseness and functional differentiation of the information and the efficiency gains from delegating to an informational agent. I essentially offer three types of data to make the data diffusion argument: number of firms, the volume of industry sales and volume of output. To test the effects of geographic diffusion, market data from nuclear, biological and chemical industries is supplemented with systemic-level data on the number of NBCW latent and program states (Chapter 3). To test the functional differentiation argument, I use patent data to proxy for the evolution – and therefore the changing cost of acquiring expertise – within the respective industries.

These data provide limited proxies for testing the correlation between information costs and delegation to international organizations within each regime. Further, because two of three datasets are available for some slice of each of the nuclear, biological and chemical markets, there is some capability to conduct cross-case comparisons among the NBCW nonproliferation efforts by triangulation. Cross-industry comparisons are very useful given the expected curvilinear relationship between scale, efficiency and start-up costs: increasing returns to scale may make efforts more efficient and affordable at higher levels of production but also pose increasing start-up costs for new systems.

Industrial Diffuseness: The Data

The chemical industry is by far the oldest of the three. By the latter half of the 19th century chemical firms were already shifting from laboratory- to industrial-scale production. Major industrial expansion began with a post-WWI push for national autarchy in chemical production and continued as the petrochemical industry began to offer replacements for natural rubber in WWII. After WWII, the industry pushed into new areas in part because of new technologies for analyzing chemical compounds but also because post-war overcapacity led to the search for more synthetic replacements for natural products (Bensaude-Vincent and Stengers 1996; Brock 2000). Data on the number of facilities internationally or in some sub-population is unavailable. Therefore, I proxy the diffusion problem using an alternative indicator of size: total international sales of the top ten and top fifty chemical companies (data was compiled by the author from semi-annual industry reports published in Chemical and Engineering News, 1972-2007: C&EN various). While the chemical industry as a whole as grown since 1945, the aggregate sales growth data show a chemical industry that appears to have sales stagnate for thirty years but is quite large in absolute size: the OPCW reports that there are more than 4000 facilities that could require inspection in CWC states (Akiyama 2005).

The nuclear industry did not really exist, of course, prior to the Manhattan Project in WWII. Nuclear power reactors required another decade for development and two decades for commercial deployment. Nuclear facilities, from mining to reactors and weapons production sites, increased in number quickly as the US exploited its nuclear monopoly and others sought to break it. Nuclear technologies appeared to be the wave of the future and there was substantial pent-up demand until the US Atoms-For-Peace program freed Canada, the UK and US to match commercial transfers being pursued by France and the USSR.

Still, the massive investment in nuclear technologies in these first years had slowed to a trickle within two decades. Growth by the 1990s was negative as often as not. However, important changes in the nuclear industry came with the spread of fuel cycle technologies from the late 1970s as assurances weakened about the security of the US as a supplier (Brown 1982). Industrial growth and decline is measured as annual change in the number of nuclear facilities known to the IAEA and the total capacity of those facilities, including power reactors, research reactors, fuel cycle production and processing facilities, and other experimental and/or demonstration plants from the IAEA's INFCIS, PRIS, and "Nuclear Research Reactors in the World" databases (IAEA 2007c; IAEA 2007d; IAEA 2007e).[139] The global number of nuclear facilities is roughly comparable to the capacity of nuclear facilities as measured by the electricity output of power reactors and throughput tonnage of fuel cycle facilities.[140] The absolute number of nuclear facilities is illustrated in Figure 5.1 (with biotech facilities also for comparison) whereas the annual change in the number of nuclear facilities is illustrated in Figure 5.2.

Excluding elements of the chemical industry already discussed above, the biochemistry and molecular and cell biology fields are relatively new. As illustrated in

---

[139] Data supplemented from select sources ((EC)2003; ASN 2001; IAEA 2006). Capacity data or size for nuclear reactors is kilowatt/hours and for nonreactor production and storage facilities is annual throughput of material in tons.

[140] Of course, not all facilities are of the same size or of even comparable designs. For example, CANDU-type nuclear reactors are more difficult to monitor than many others because, unlike most other reactors, swapping fuel rods can occur without stopping the reactor's operations.

Figure 5.1, the biotechnology industry has grown from only a handful of startups in 1973 to number more than 1500 firms, including diversifying large chemical and pharmaceutical firms, in just three decades (Ernst & Young Biotechnology reports 1986-2006: EY Various). BW-relevant activities are more difficult to delineate because they can include everything from chemically synthesized pharmaceuticals to vaccines and even some industrial-scale food production. The Soviet Union, for example, despite the advanced nature of its BW program reportedly used butter-cream separators, such as one might find at an industrial dairy, to extract anthrax from its growth media (Allan 2007). Further, a wide variety of research and development laboratories contribute to these activities. Still, global sales of the members of the major pharmaceutical industry organization, PhRMA, represents a useful proxy for the diffuseness (number) of BW-related industries. As shown in Figure 5.3, sales of pharmaceutical firms increased 687% from 1967-2001 (PhRMA 1991:3; PhRMA 2007:47) and sales by biotechnology firms increased 594% from 1989-2004 (EY Various).

To compare, the US Food and Drug Administration reported in 2000 that its mandate included regulating some activities in more than 17,600 human drug firms, 7,700 animal drugs and feed firms, 4,200 "biologicals" firms, and another 1,500 firms for other human dietary supplements.[141] This number is seven times the global number of facilities that should be inspected under the CWC and still excludes non-US facilities ad US firms that do not produce directly for human or animal consumption, such as

[141] Cite: http://www.emedicinehealth.com/fda_overview/page3_em.htm (accessed 14 April 2007). In 2006, the FDA Official Establishment Inventory included the following number of establishments by type: Human drugs 19,114; Animal drugs & feeds 19,977; Biologics 5,505; and Vitamins 4,218 (Pers Com email of 13 April 2007).

corporate and university research laboratories that are capable of biological weapons work. At the other end of the spectrum, there were only 1273 nuclear facilities worldwide and about 360 in the United States in 2000.

Industrial Diffuseness: Results

The data on the scale of the monitoring problem for each of the three industries suggests the diffusion problem is today smallest for nuclear industries and about double for the chemical industry, but an order of magnitude greater for biologicals. These broad-brush comparisons provide a sense of the scale of the differences in the monitoring problem for nuclear, biological, and chemical weapon-related industries, even entirely excluding whatever activities are occurring in undisclosed government laboratories around the world.

Delegation, however, as measured for the three issues appears negatively correlated even without statistical analysis: there is no BW-issue delegation 1945-2002, CW issue delegation comes only in the mid-1990s, and nuclear delegation is significant since 1957. Still, the theoretical expectations can be reconciled with the cross-industry empirical data. First, the threshold for first encountering economies of scale from industry monitoring may be so low that year-to-year changes over the limited range available cannot be expected to correlate with changes in delegation. Second, as significant as the economies of scale to monitoring may be, there is likely a curvilinear relationship: the global chemical and biotechnology industries were so large that by the time CBW threats were realized in the 1980s, the barriers to entry for a monitoring agent were too great.[142] If this is the case, we might expect to observe a plethora of limited informational agents: agents that have segmented the informational market by specializing in particular producer types, geography, or other characteristics. In short, the CW- and BW-relevant industries were already so diffuse that implementing a “fair” monitoring system represented too costly a step, holding constant other factors such as state preferences and threat levels.

The statistical tests yield relatively poor results. This poor performance is perhaps not surprising given that there are few good proxies available for the diffuseness of the chemical, biological and nuclear industries. Nuclear industry size measured as either the number or size of facilities, for example, is not a significant cause of NW delegation (Table 5.1). The results do not improve when industry size characteristics are tested controlling for the level of nuclear threats or the distribution of NBCW preferences. Despite CW delegation containing only a single major event in the delegation index and only a few years where the index is not observed as zero, the results are in the predicted direction (though only significant in the univariate model in Table 5.2). Finally, BW delegation lacks any variation to test.

To gauge the robustness of these results, I employ a second proxy for the diffusion problem: the number of potential targets for information gathering. There is a strong and positive correlation between nuclear delegation and the number of latent states and weapons program and possessor states (Table 5.3). This relationship is most

[142] This, of course, assumes a political component: no state wishes to accept the full costs of being the solitary (or nearly so) target of monitoring for the many years it could take to actually reach monitoring “production” at profitable levels where economies of scale are reached. Even the OPCW has had to segment the CW market by focusing first on monitoring disarmament before verifying nonproduction.

significant with the number of latent states and persists even when including the threat and preference variables. The relationship for CW delegation and the number of CW intelligence targets is negative but very small and insignificant (Table 5.4).

Asset Specificity & Functional Diffuseness: Data and Results

Search costs should increase as the expertise necessary to conducting the search becomes harder to acquire. The hypotheses propose that as a field of knowledge diversifies – as the number of intellectual fields required to be an expert in increases – the expertise required to monitor that field similarly increases. The cost of expertise also increases as the pace of advancement within those fields increases: greater investment in expertise is required for intellectual fields experiencing high rates of advancement and dynamism. As with the diffusion of data problem, I expect a curvilinear relationship: No delegation for expertise will be observed when such expertise is very cheap and delegation will increase as the costs increase. At some point, however, cost and uncertainty becomes too great and delegation to an informational agent is not observed until costs again decline.

In this section I utilize basic reviews of the three industries to demonstrate the number of relevant fields in which expertise is required. I also use patent data to illustrate the rate of technological change within these industries.[143] Specifically, I use two indicators derived from the total number of patents issued by the US Patent and

---

[143] The use of patent data as a proxy for an industry's pace of intellectual change can be criticized to the extent that some industries may rely upon secrecy and not patents to protect valuable information. However, there is still value in using patent data as a proxy rather than have no proxy at all.

Trademark Office (Hall, Jaffe, and Trajtenberg 2001).[144] The share of patents by industry is illustrated in Figure 5.4. First, I use an industry's share of the total number of patents, a measure of change by definition relative to other sectors of the economy. Second, I use the industry's share of patent citations (patents are "more important" if they are cited more by than others by later patent applications, see: Hall, Jaffe, and Trajtenberg 2001).

For all its complexity, the nuclear weapons-relevant nuclear industry is relatively simple. As an overview, nuclear energy production occurs within a nuclear fuel cycle: uranium ore is mined, enriched and made into fuel assemblies, deposited within a nuclear power plant as fuel for heat production, then removed and allowed to cool for several years, and finally, the radioactive waste is either buried or reprocessed to extract remaining fissile materials (primarily plutonium) and the remainder then buried. Nuclear weapons require at a minimum highly enriched uranium or plutonium, which can be extracted at the two points in the fuel cycle where they are enriched or reprocessed, as well as materials common for conventional explosive bombs and, for advanced nuclear weapons, also some more novel materials (beryllium, tritium, etc.).

While the engineering techniques for a nuclear weapon are different than for a nuclear power plant, the physics behind critical and super-critical reactions are quite similar. Once the basic physics of nuclear weapons became understood in the 1950s and then was applied to nuclear power plants, there have been declining levels of innovation or novel engineering solutions. As measured by nuclear industry's share of patents, the

[144] The US Patent and Trade Office grants patents to US and to foreign entities. There are other patent-granting organizations, particularly the European Patent Office, but reliance on USPTO data is sufficient to generate a relativistic indicator that should be generalizable to the global economy. Using the year of application extends the data backwards in time but also causes an artificial drop-off at the end of the data set.

rate of technological change in the nuclear industry has declined significantly since the 1960s. In most cases, valuable nuclear secrets were engineering solutions for efficiency rather than innovations in the underlying technologies. Statistical tests show this relationship is significant: there is a strong, significant and inverse correlation between the increase in delegation for nuclear nonproliferation and both the nuclear industry's declining patent share and the declining importance of nuclear patents (see Table 5).

Chemical weapons production, like the production of any other toxic chemicals, can occur in small laboratories such as at universities or a resourceful person's garage, but the quantities are unlikely to be sufficient even for terrorist activities, much less military, without months of production (Chapter 3). While the chemical industry has adjusted to make its plants more flexible for the production of a greater variety of chemicals (Reeps 2005), most accept that the number of chemical weapon-suitable compounds has not increased or only increased by one in the past several decades and that the protocols for their manufacture are so well-known that the lack of supply of precursors is the major barrier to interested parties.

The chemical industry benefited from strong dynamism in the early post-1945 decades, as measured by the share and importance of US patents received by the chemical industry. For example, chemical industry patents comprised a full 20% of those received in 1961 in the NBER database, compared to the nuclear industry's <2% after the mid-1950s. The dynamism in the 1950s and 1960s largely occurred in the petrochemical industry and reflected the attempts to replace natural materials with synthetic rubbers and plastics.[145] The overall share and the importance of chemical industry patents, however, have declined since the early 1960s. The results are statistically not very significant (see above note regarding the limits of the dependent variable), but are strong and negative (Table 6), similar to the nuclear industry.

What was true for the nuclear and chemical industries cannot be said for industries related to the materials and technologies for BW production and this appears to be relevant in explaining the absence of delegation for biological weapons nonproliferation. On the one hand, the biotechnology industry that is most conventionally connected to the BW threat did not exist prior to the 1970s. When Stanley N. Cohen and Herbert W. Boyer developed a laboratory technique in 1973 for splicing and cloning (amplifying) DNA, they started the biotechnology revolution that continues to grow and play a major economic role three decades later (Hughs 2001). Measured using patent data, as done above for the nuclear and chemical industries, biological industry patents have grown to be an important part of the economy from being nearly nonexistent. The direction and pace of change, as shown in Figures 4 and 5, are almost perfectly inverted versions of the decline of the chemical industry.

To further complicate matters of estimating the scope of the monitoring problem, the examples illustrated so far show the diversity of the industries that could be involved in BW production. While the aforementioned biotechnology industry is an obvious location to grow pathogenic viruses and bacteria, militarily significant quantities could be cultured by also pharmaceutical firms, industrial-scale dairies, and commercial beer and

---

[145] While purely anecdotal, movie aficionados will remember the importance in *The Graduate* (1967) of one word: “plastics”.

wine makers. Assuming someone could acquire seed stock of such pathogens, quantities significant to terrorist actions could be grown in any small laboratory: hospitals, university labs, and even garages. The effects are, of course, not statistically testable given the absence of variation in the dependent variable.

Results and Conclusions

Historically, a major hurdle to negotiating equilibrium strategies for nuclear, biological and chemical weapons threats has been the difficulty of learning what strategies are successful and which actors are proliferating. States seeking this information must pay costs to produce, collect, analyze and employ this information in the policy process. Search costs increase when gathering information about nonproliferation requires costly investments because relevant behaviors are hard to observe or differentiate (asset specificity argument) or is difficult because of the number and diversity of targets (diffusion argument). This chapter argues an international agent may be valuable for producing, collecting, and disseminating information on nonproliferation (or any other policy area) is technically costly. As these search costs increase, the value to any individual actor of employing an informational intermediary also may increase to the extent that an agent can eliminate redundant investments in the time, equipment and expertise necessary to produce information about the market.

Interpreting the results as supporting or refuting the strategic and functional reasons hypothesized for international delegation to nuclear, biological and chemical weapons nonproliferation institutions generally depends upon an unobservable: at what point do the start-up costs for new monitoring systems overcome the efficiency gains of using an IO as an informational agent? The case study on nuclear test ban negotiations directly supports the hypotheses on asset specificity and target diffusion: historical evidence on what the US knew about various states' nuclear programs shows US intelligence became increasingly limited for new nuclear actors despite continuous innovation in technology and increasing effort.

However, while the diffusion of the number and other qualities of potential monitoring targets should make cooperation more efficient (economies of scale), statistical results indicate start-up costs present a large barrier to entry into the market as an informational agent. Monitoring of the nuclear industry for nonproliferation purposes began when the industry was very small, but it remained clear that multiple, overlapping monitoring systems were more costly, inefficient, and subject to gaps in coverage relative to a coordinated system. The weakness of the statistical results may be in part attributable to the empirical fact that the first major expansion of the nuclear industry was caused by (or was the anticipated effect of) the first nuclear delegation event: the creation of the IAEA. By comparison, chemical and biological industries were already very large when states identified an interest in cooperating to reduce the CW and BW threats. Further, the BW-relevant commercial industries have only become more diversified with time, posing an additional barrier to investing in assets useful to differentiating BW activities from peaceful activities.

Therefore, while increasing threats from NBCWs and converging preferences over strategies for coping with those threats determines the interest in international cooperation, the technical costs of searching for information about proliferation was a major reason for delegation to nuclear institutions, was a barrier to CW delegation, and remains a continuing barrier to delegation of monitoring of BW-related agreements.

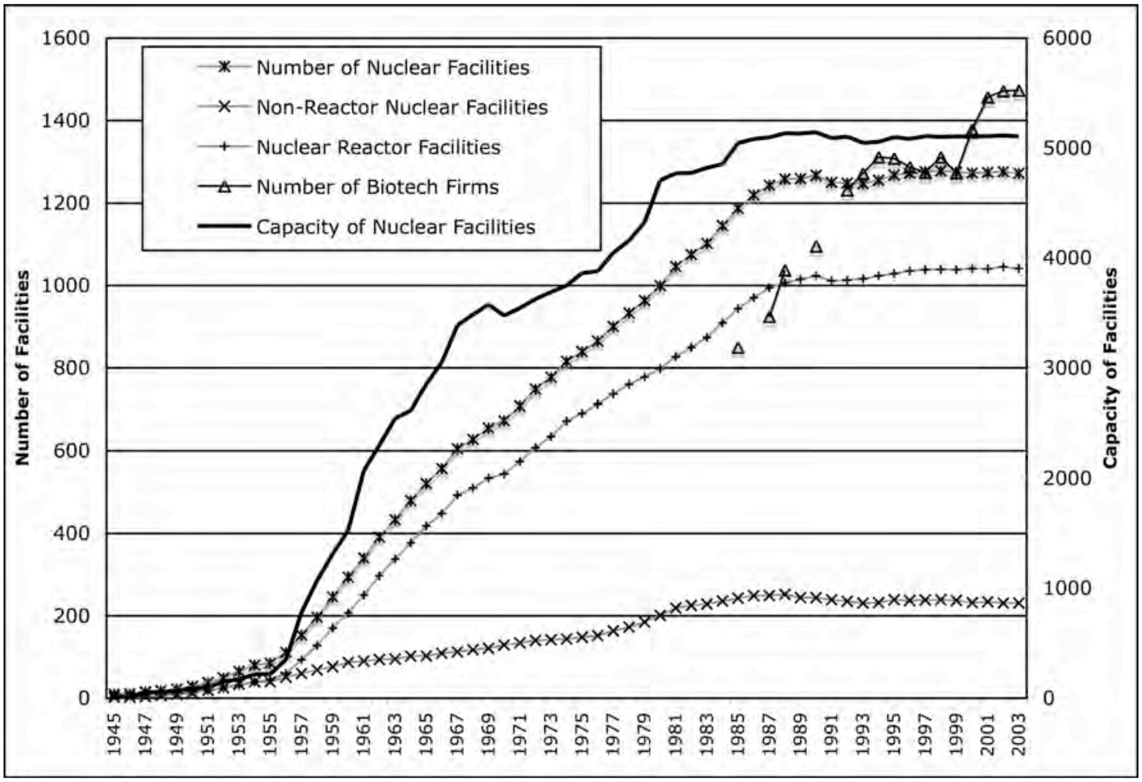


Figure 5.1: Industry Size (Nuclear and Biotechnology)

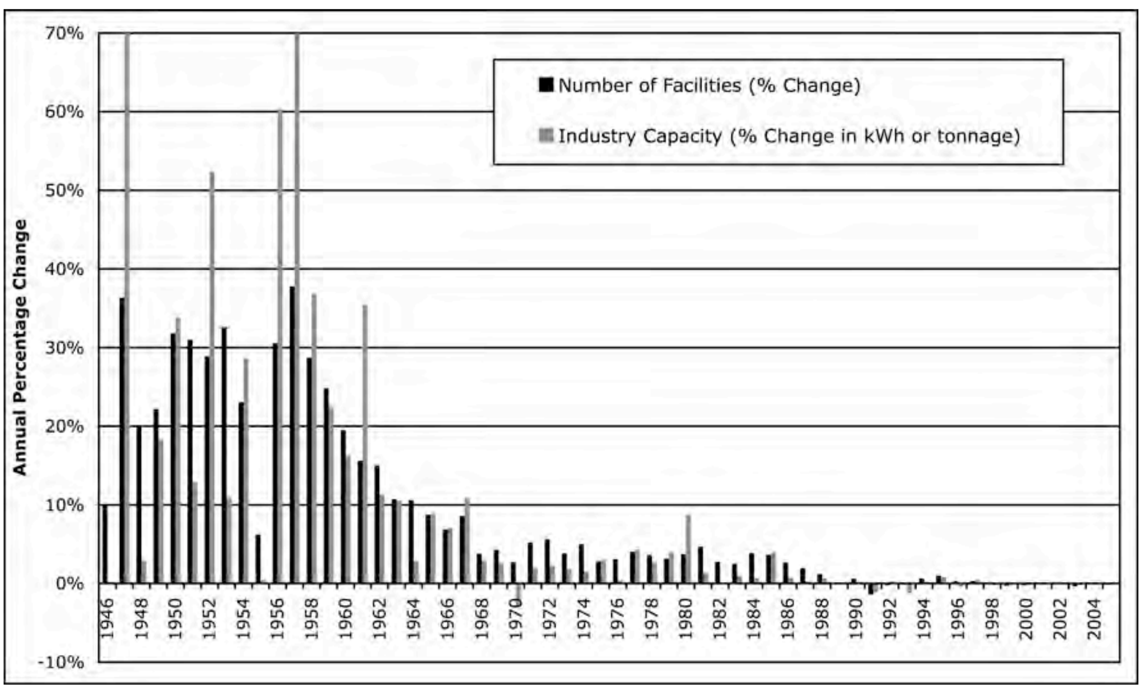


Figure 5.2: Change in Nuclear Industry Size

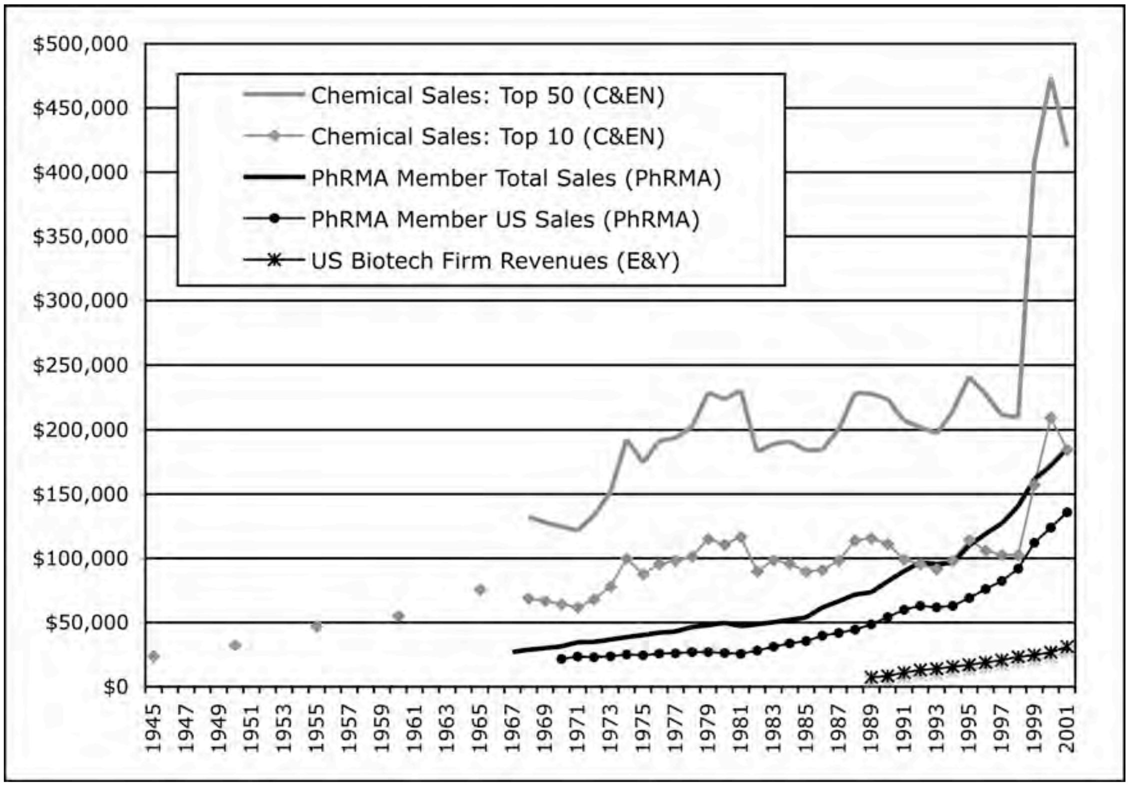


Figure 5.3: Industry Size by Sales, Chemical and Pharmaceutical Firms (2003 $m)

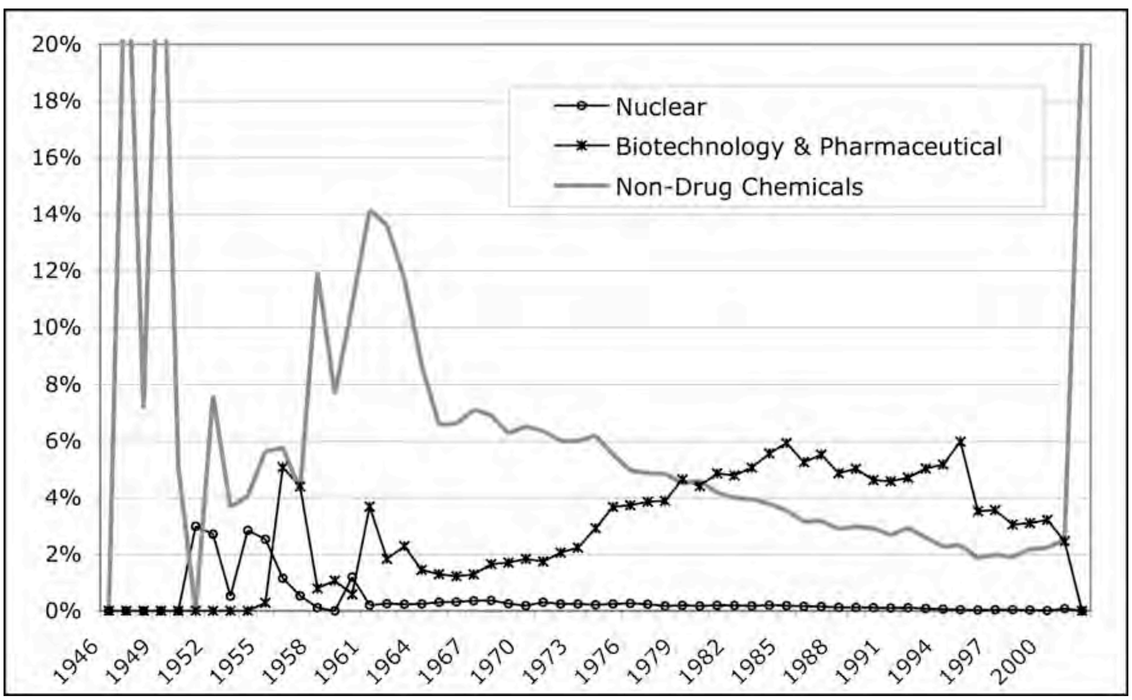


Figure 5.4: Industry Share of Annual Patents by Application Date

Table 5.1: Industry size and nuclear delegation

	Number of facilities		Facility Capacity	
Industry Size				
Lag1	.17*	.11	$1.25\text{x}10^{-5}$	$1.11\text{x}10^{-5}$
	(.09)	(.10)	$(8.5\text{x}10^{-6})$	$(9.8\ \text{x}10^{-6})$
Lag 2	-.18	-0.09	$-7.8\text{x}10^{-6}$	$-6.4\text{x}10^{-6}$
	(.17)	(.17)	$(1.4\ \text{x}10^{-5})$	$(1.5\ \text{x}10^{-5})$
Lag 3	.05	0.01	$-2.5\text{x}10^{-6}$	$-1.9\text{x}10^{-6}$
	(.09)	(.09)	$(1.4\ \text{x}10^{-5})$	$(1.5\ \text{x}10^{-5})$
Lag 4			$7.1\text{x}10^{-6}$	$-3.9\text{x}10^{-6}$
			$(8.2\ \text{x}10^{-6})$	$(9.2\ \text{x}10^{-6})$
Distributed effect of size	0.038	.03	$1.42\text{x}10^{-5}$	$1.6\ \text{x}10^{-6}$
NW threats		1.87**		1.64†
		(.89)		(.93)
NBCW Preferences		19.08		17.01
		(15.21)		(14.61)
Constant	.724	-4.38	1.48	3.39
Adj. R^2	.88	.84	.87	.84
N	56	44	55	44

Note: † p<0.1, * p<0.05, ** p<0.01, *** p<0.001, Standard Errors in parentheses

Table 5.2: Industry size (chemical industry sales) and CW delegation

	Sales of Top 50 Firms ($ billions)		Sales of Top 10 Firms ($ billions))	
Sales ($ billions)				
Lag 1	0.08***	0.05	0.16***	0.13
	(0.01)	(0.04)	(0.02)	(0.13)
Lag 2		-0.10		-0.03
		(0.15)		(0.28)
Lag 3		0.15		0.12
		(0.15)		(0.26)
Distributed effect of size	0.08	0.10	0.16	0.22
CW Threats		1.51		5.94
		(43.77)		(43.0)
NBCW Prefs		-57.20		-58.29
		(30.84)		(30.60)
Constant	5.76**	23.06	-4.76**	21.89
	(2.03)	(18.85)	(1.71)	(18.48)
Adj-R2	0.56	0.42	0.53	0.38
N	32	27	3 8	28

Note: † p<0.1, * p<0.05, ** p<0.01, *** p<0.001, Standard Errors in parentheses

Table 5.3: Number of Nuclear States and Nuclear Delegation

NW Deleg	Latent Nuclear States		NW Program States		NW Possessor States	
Number of States						
Lag 1	0.78***	0.34†	2.99***	-0.13	3.69***	-0.04
	(0.04)	(0.17)	(0.47)	(0.53)	(0.46)	(0.63)
Lag 2		-0.04		0.67		0.49
		(0.23)		(0.53)		(0.65)
Lag 3		0.32†		0.42		1.51*
		(0.18)		(0.49)		(0.64)
Distributed effect of number of states	0.78	0.62	2.99	0.96	3.69	1.96
NW Threats		0.85		4.80***		3.15**
		(0.74)		(0.92)		(0.89)
NBCW Prefs		8.59		44.00**		40.99***
		(9.20)		(13.87)		(11.14)
Constant	7.26***	8.32*	3.35	-8.99	7.22*	-6.00
	(1.47)	(3.75)	(4.72)	(5.31)	(3.40)	(4.65)
R-squared	0.88	0.88	0.42	0.68	0.54	0.75
N	56	45	56	45	56	45

Note: † p<0.1, * p<0.05, ** p<0.01, *** p<0.001, Standard Errors in parentheses

Table 5.4: Number of CW States and CW Delegation

	CW Program States		Latent CW States	
Number of States				
Lag 1	-0.272†	0.024	-0.001	-0.000
	(0.159)	(0.280)	(0.002)	(0.002)
Lag 2		-0.369		-0.000
		(0.354)		(0.002)
Lag 3		0.040		-0.000
		(0.275)		(0.002)
Distributed effect of the number of states	-.272	-.305	-.001	-.0000
CW Threats		-10.588		-5.458
		(24.042)		(28.813)
NBCW Prefs		14.610		5.472
		(11.249)		(10.547)
Constant	6.242**	-0.044	3.580**	0.545
	(1.955)	(6.782)	(1.190)	(7.180)
Adj-R2	0.033	-0.011	-0.015	-0.114
N	58	44	59	44

Note: † p<0.1, * p<0.05, ** p<0.01, *** p<0.001, Standard Errors in parentheses

Table 5.5: Nuclear Industry and Patent Data Tests

	Share of Annual Patents		Share of Annual Patent Citations	
Functional Diffusion				
Lag 1	-367.0***	-755.9***	-1054.0***	-468.8
	(90.75)	(207.2)		
Lag 2		19.36	-524.23	-185.8
		(199.75)		
Lag 3		-301.01†	-573.25*	-371.3
		(180.460)		
Lag 4	-367.05***	-755.9***	-75.76	260.1
	(90.75)	(207.2)		
Distributed effect of diffusion			-2227.2	
NW threats		3.15***		4.35***
		(0.84)		
NBCW "S"		35.50**		60.49***
		(11.04)		
constant	34.44***	14.27*	41.32***	-5.57
	(2.31)	(6.46)		
N	0.22	0.77	54	44
Adj. R^2	56	45	.47	.77

Note: † p<0.1, * p<0.05, ** p<0.01, *** p<0.001, Standard Errors in parentheses

Table 5.6: Chemical industry patent shares and chemical delegation

	Share of Annual Patents		Share of Annual Patent Citations	
Functional Diffusion				
Lag 1	-57.80*	-29.88	-16.44	6.08
	(24.40)	(70.04)	(21.80)	(64.81)
Lag 2		-15.46		-86.53
		(105.77)		(53.0)
Lag 3		-37.28		-30.08
		(73.58)		(71.87)
Distributed effect of Diffusion	-57.80	-82.62	-16.44	-109.63
CW Threat		4.10		12.71
		(24.92)		(26.27)
NBCW Prefs		-2.27		0.29
		(11.0)		(10.39)
Constant	7.73***	9.32	4.16*	6.27
	(2.21)	(7.85)	(1.74)	(7.15)
Adj-R2	0.07	0.04	-0.01	0.03
N	57	44	57	44

Note: † p<0.1, * p<0.05, ** p<0.01, *** p<0.001, Standard Errors in parentheses

Chapter 6: Delegating to Minimize the Political Costs of Information

> The International Atomic Energy Agency confirmed in the 1990s that Saddam Hussein had an advanced nuclear weapons development program, had a design for a nuclear weapon and was working on five different methods of enriching uranium for a bomb. The British government has learned that Saddam Hussein recently sought significant quantities of uranium from Africa. Our intelligence sources tell us that he has attempted to purchase high-strength aluminum tubes suitable for nuclear weapons production. Saddam Hussein has not credibly explained these activities. He clearly has much to hide.
>
> …With nuclear arms or a full arsenal of chemical and biological weapons, Saddam Hussein could resume his ambitions of conquest in the Middle East and create deadly havoc in that region. …Evidence from intelligence sources, secret communications, and statements by people now in custody reveal that Saddam Hussein aids and protects terrorists, including members of al Qaeda. Secretly, and without fingerprints, he could provide one of his hidden weapons to terrorists, or help them develop their own.
>
> -- U.S. President George H.W. Bush,
> 2003 State of the Union Speech

Whenever information must be communicated to others, the underlying interests of the reporting actor can bias its communication (Lupia and McCubbins 1994). In his 2003 State of the Union speech, US President George H.W. Bush made claims about Iraq's nuclear, biological and chemical weapon (NBCW) activities and the two ways they were "a serious and mounting threat to our country, and our friends and our allies": Saddam Hussein's "ambitions of conquest" and links to international terrorism (Bush 2003). The process of crafting the State of the Union entails the review of every statement in the speech by multiple executive branch agencies. The usual result is that observers believe the claims made therein by the President are basically "true". However, in this particular State of the Union, it appears motivated interests caused claims to be included that most would have judged false, far beyond being simply politically-colored facts that are true if favorably interpreted at the margins.

This problem is likely to recur. Since the International Atomic Energy Agency (IAEA) discovered unusual traces of highly enriched uranium – a key ingredient for a nuclear weapon – in Iran in 2003, the IAEA and various states have offered differing interpretations of Iran's nuclear program and its implications (du Preez and Sobrado 2004; ElBaradei 2004a; IAEA 2004; Sokolski 2004). The partial retraction of US allegations in the November 2007 US National Intelligence Estimate on Iran shows how difficult it can be to rely upon other states' information for making policy decisions about an important security issue such as proliferation (Karon 2007; Moore and Blomfield 2007; NIC 2007).[146]

When faced with conflicting reports from what are essentially alternative informational agents, which should states believe and why? Why create an international organization (IO) like the IAEA to conduct monitoring that some states could accomplish on their own? While international institutions and IOs are included as factors in many analyses of proliferation, the role they play is underspecified (Jo and Gartzke 2007; Sagan 1997). One purpose of IOs is to serve as informational agents. At the international level, IOs can take an active role in producing and reporting information to their state principals in order to enable cooperation amongst them (Hawkins et al. 2006). While wealthy states have the resources to produce information about proliferation, IOs can be

[146] National Intelligence Estimates are generally secret documents that report the consensus of the US intelligence agencies on a national security issue.

designed to produce and report information that is less likely to be biased by national interests.

I analyze at the systemic level why national governments cooperate to control proliferation threats by delegating to IOs to reduce information asymmetries about who is proliferating, how they are proliferating, and what strategies may be useful to stop them. If the risk of search bias were the only concern facing states, the solution could be to increase transparency. However, transparency risks revealing information that is supposed to remain private, compromising other sovereign interests. Participants face these twin information problems in cooperating on nuclear nonproliferation: states want a process that reveals information relevant to the bargain but protects information necessary to its pursuit of national security or economic goals.

I argue the risks of search bias and of compromising national security and confidential business information create incentives for states to delegate authorities and provide resources to international informational agents under information-poor conditions. IOs designed and motivated to have relatively public, fixed and narrow interests can produce less biased reports on NBCW proliferation and better protect unrelated information. IOs should therefore be most attractive, and delegation to IOs most likely, when governments have incentives to be opportunistic in the collection and reporting of information used to facilitate cooperation in a nonproliferation cartel.

I first explore how and when international agents should be more attractive than national agents and derive three specific hypotheses. I then examine the US case for war against Iraq in 2003 for evidence of these hypotheses. Most countries in the world chose to rely upon the investment by the US, IAEA, and UNMOVIC in information and expertise on Iraq's nuclear programs. Formally or informally, they delegated informational authorities to these agents, but also weighted the value of their competing reports differently when the time came to join or stand apart from the war effort that began in 2003. I then develop indicators to quantitatively test the hypotheses on the risks of search bias and of compromising sensitive national information.

Information Collection Dilemmas and Delegation Solutions

The limited independent monitoring capability of all states concerned with proliferation means that if cooperation on nonproliferation is to work, some mutual monitoring system is needed to reduce information asymmetries by revealing relevant private information (Aoyagi 2002; Carpenter, Bowles, and Gintis 2006; Compte 2002a). A recurring problem for arms control negotiations has been how to decide what private information is needed to cooperate and how it can be revealed while keeping other information private. International institutions can reduce transaction costs of bargaining (Keohane 1982) and help solve bargaining problems from opportunism, uncertainty, asymmetric information, and enforcement (Haggard and Simmons 1987). In Chapter 5, I argued there are technical incentives to centralize monitoring activities, such as within an IO, to exploit economies of scale in information production.

Even if states could agree on a consistent definition of nuclear proliferation, monitoring proliferation has historically proved to be difficult and judgments susceptible to political influence. Policy-makers must make decisions in many disparate policy areas and cannot afford to invest much in any particular decision. They must rely upon the advice and information of others because they have little time or inclination to become experts in every area in which they must make decisions (McCubbins and Rodriguez

2006). Not all information is equally valuable because the collection and reporting of information by any actor means that actor's preferences become a source of bias, whether deliberate or accidental (Calvert 1985).

From the perspective of a state considering participation in a mutual monitoring system to effect cooperation in a cartel, the biases of the informational agent can create two problems. One, an outward-looking concern, states must be concerned that the agent will gather different information or interpret the information differently to satisfy the agent's preferences over outcomes. This is the risk of search bias. Two, an inward-looking concern, states will consider the risk of the collateral damage when valuable national security or business information is revealed by cooperation. States will seek to maintain their freedom of independent action – sovereignty – except when such constraints on national policy brings clear advantages. To the extent a mutual monitoring system also causes collateral costs by revealing military secrets (constraining future military strategies) or commercial secrets (sacrificing the economic growth that supports national independence), it harms a state's sovereignty. I refer to this collateral damage as the "sovereignty costs" of cooperating on nonproliferation.[147] Search bias is an outward-looking information problem while the inward-looking concern is with sovereignty costs.

States can consider four categories of design elements in a delegation contract to control the collection and reporting of private information: screening and selection of agents, rules limiting agent discretion, monitoring agent activities, and agent motivation with rewards and punishments (Kiewiet and McCubbins 1991:27-34). Variation in design across prospective agents will affect how they produce and report information. Most

[147] Sovereignty costs may be paid in many ways; this definition is not all inclusive.

states lack the ability to collect useful information about proliferation and even the most capable are not omniscient. States must therefore rely on external agents for this information but recognize, despite their broadly shared preferences for nonproliferation, that differences or changes in interests may cause states to exploit information asymmetries to hide proliferation (a false negative) or misrepresent it (to cause enforcement of a false positive). I demonstrate in the next section that design and control elements common in NBCW IOs should result in consistent differences in the gathering and reporting of information required to effect an NBCW cartel, relative to national agents.

Theory

Search Bias

When there is strong evidence of proliferation (or not), then most agents state this. However, when information is incomplete or unclear there is a risk of bias in interpretation causing *search bias*. An agent biased against finding proliferation, either generally or with respect to a particular actor, is less likely to report proliferation is occurring than an agent that is neutral or biased in favor of finding proliferation. Search bias in information collection and reporting has international distributional consequences because it changes which states are targeted for nonproliferation strategies.

Proliferation biases, like the incentives to proliferate, can result from differing perceptions of the threat environment (Jo and Gartzke 2007; Kroenig 2007; Sagan 1997; Singh and Way 2004). For example, it was widely believed outside the Middle East that Israel's unique security concerns justified a nuclear weapons program (Hirdman 1972; Nacht 1981), providing a rationale for a pro-Israeli bias in reporting on proliferation in the region. Bias can also be caused by the multidimensionality of most actors' interests. An informational agent with "narrow" preferences is better able to resist using irrelevant criteria as informational shortcuts, e.g., friendliness with major powers, form of government, conflict propensity or other characteristics. If screened to lack interests over irrelevant issues dimensions, an agent has no interest in communicating or basing judgments upon irrelevant information acquired during the process.

These are the two possible sources of search bias. With delegation to an internal agent, such as an intelligence agency, states employ the four design elements so that they can often rely upon the investment in information. States may still face two problems. First, national organizations usually define national interests in broadly similar ways but are often quite opaque with regards to the possible sources and extent of biases. For example, it is quite debated whether the 2007 NIE on Iran took a radical shift because of changes in information available to US intelligence agencies or if there was a political decision to pursue a more conservative interpretation of the information (Karon 2007). The agent's value for information purposes, therefore, is only apparent in advance if the principal knows how it is biased. Even professional bureaucracies may be captured by those with extreme or, sometimes worse for decision makers who must decide whether to rely upon their reports, unclear ideal points. Many face incentives to reduce costs in information collection and monopolize information to maximize their leverage in bureaucratic politics (Rich and Oh 2000). For example, Douglas Feith was criticized for the strategic misuse of information in reports on Iraq in 2002-2003 by the Department of State Office of Special Assessments. Without transparency in its motives and processes, an agent may be the most capable *within* a state but may not be trusted to accurately report the relevant information.

Second, multilateral cooperation requires a state to persuade others whose support is necessary or useful. Like their national bureaucracies, states possess reputations for a degree of bias that may make others suspicious. States could increase the credibility of their reporting with evidence that is more detailed and/or more easily corroborated by others but often resist sharing intelligence that can threaten their information sources. A US House Armed Services Committee staffer interviewed for this project stated that when US allies share intelligence information, "they come over here and tell us something or show us something…but we don't know how to evaluate it. What quality is the intelligence? Are they trying to manipulate us?" (Representatives 2004) The fundamental problem remains, however, that application of the design elements is not transparent. A state could instead signal the value of their information to others by selecting a capable agent whose preferences are known to be relatively closer to their preferences and therefore presents less of a risk of search bias (Letterie and Swank 1997).[148]

Relative to national agents, IOs can be attractive as informational agents. First, IOs are designed as technical bodies, wherein staff are selected to be expert and unbiased in their employment of specific, publicly known processes for information collecting and criteria for reporting and, in some cases, judging compliance. For example, the IAEA and Provisional Technical Secretariat of the Comprehensive Test Ban Treaty (CTBT-PTS)

[148] This argument is similar to Milner's, who examines the role of domestic interest groups as low-cost signalers to the legislature about the benefits of an international agreement (Milner 1997).

require the head of the bureaucracy, and in some cases the senior advisors and division heads, to be selected by their respective executive bodies. Bureaucratic heads then have more or less autonomy over who is hired as staff. Staff whose interests are revealed to be too divergent from those of their managers can be sanctioned (else the managers, who must maintain the confidence of their principals, may be sanctioned).[149] Principals may directly monitor a sample of the agent's activities and require regular reporting. Agents may also be monitored indirectly, such as when they compete with the efforts of other international, national or non-governmental agents. In this sense, these IOs are designed to have relatively fixed and public (known) preferences over outcomes.

The same design features create agents who are expected to pursue their information mission without concern for non-technical political issues. Unlike the IAEA, the CTBT requires a state party to formally request an inspection, a request that must be approved or rejected by the Executive Council, and there are constraints on the data that may be made public or used for raising questions about or judging compliance. The CTBT-PTS has little discretion in the technologies, techniques or locations of monitoring stations. The first Director-General of the Organization for the Prohibition of Chemical Weapons, the IO monitoring compliance with the Chemical Weapons Convention, was removed from his post by the Executive Council for financial mismanagement (Official 2005d) and the subsequent Director-General found his powers substantially constrained. In this sense, these IOs also have relatively narrow preferences.

---

[149] Collective principals, fearing exit by individual principals, should be actively attentive to agency slack that results in excess bias. Individual principals in some cases have the unilateral power to affect search bias: IAEA rules provide, for example, states with the power to bar individual inspectors whose interests are suspect.

Together, fixed, known and narrow preferences result in agents whose reports are recognized as being less politically motivated and less biased with respect to individual targets.[150] This appears to create a virtuous circle as states appear more willing to share information with unbiased agents than biased ones. As a result, a consistent motivation of even the most powerful states is the ability of IOs to penetrate difficult information targets. The US has been supportive of the CTBT-PTS monitoring system because it has been able to put monitoring stations in places which the US couldn't otherwise access (Senate 2004). The US has similar respect for the IAEA, as one retired US Assistant Secretary of State for Non-Proliferation stated:

> The IAEA has the ability to go in, inspect, ask questions, and look at specific transactions. …We know a great deal and do share some intelligence but they have capabilities we don't. IAEA members get information from IAEA reports and it has greater credibility than if we assert it. (Wolf 2004)

The risk of search bias should increase as states' interests become more dissimilar. While converging preferences on NBCW issues facilitates cooperation on NBCW issues (and is shown in Chapter 4 to be strongly correlated with delegation), the risk of states exploiting information acquired for one policy area (e.g., NBCW nonproliferation) to create illicit gains in another issue area (e.g., commercial or military advantages) increases as preferences over outcomes on those two dimensions diverge. Therefore, holding constant the mean NBCW preference of states in the international system (*iwmdS* from Chapter 4), greater spatial distance between the mean NBCW and non-NBCW preferences should increase the risk of search bias.

---

[150] Rodrik argues states use multilateral lending institutions like the World Bank and IMF because the staff's autonomy from national governments also distances them from pressures to bias conclusions or lend for political purposes (Rodrik 1995).

As the risk of search bias increases, the incentives to delegate to an agent with fixed, known and public interests should also increase. The relationship between delegation to nonproliferation IOs and differences in interests should be positive only to a certain point and then decline: large differences in broad political perspectives should overwhelm the effect of shared preferences on any single issue such as proliferation. Therefore, for a given level of convergence on NBCW issues:

> *H1a: As the distance between states' preferences on NBCW and other issues increases, the risk of search bias increases and the likelihood of delegation to an international agent for NBCW issues increases.*

States do not face a stark choice between going it alone and delegating informational authorities to an IO. States often choose to rely upon the costly investments in information made by others, especially powerful states such as the US. While others also invest in and share information, the US since 1945 has possessed the resources and interest in monitoring proliferation on a global scale. States appear to consider very seriously US statements about the state of proliferation, such as the weight given to the declassified 2007 NIE on Iran.[151]

As a result of its investment and relative willingness to make information public, the US has been informally delegated an informational role on proliferation issues. As long as US interests do not diverge too greatly from their interests, others are content to rely heavily upon the US as a public good provider. However, when US interests become too divergent from others' interests, this increases the relative value of an IO with public, fixed and narrow interests. States may choose to delegate not because IO agents are

[151] Within days of the declassification of the summary, it had been cited and discussed by many world leaders (Karon 2007).

inherently better, but because the alternatives become worse. Therefore, for a given level of convergence on NBCW issues:

> *H1b: As US preferences diverge from all other states' preferences, the risk of US search bias increases and delegation to international agents for NBCW issues becomes more likely.*

Sovereignty Costs

Some states appear to accept the risk of their proliferation activities being accidentally exposed by a mutual monitoring system (Lehman 2004). IAEA inspections of Iran that found traces of highly-enriched uranium in 2003, for example, probably revealed more than Iran had wanted about its uranium enrichment program (Wolf 2004). However, even states that are not proliferating face the risk that monitoring activities related to nuclear proliferation can mean monitoring activities that are *not* related. States have multidimensional interests and would be expected to use information obtained for nonproliferation instead for economic or security advantages. This creates the risk that the reporting required under export control or trigger lists can reveal confidential business information about trade practices. Similarly, inspectors could learn engineering secrets for reactors or missile systems. While there are a number of sovereignty costs from international cooperation, one is the risk that monitoring will compromise national security or business information unrelated to verifying a nonproliferation bargain and thereby reduce a state's future freedom of action. I focus here on confidential business information: economically valuable information created by or for a state's nuclear, biological and chemical industries.[152]

---

[152] The desire to protect national security information is difficult to empirically separate from broader security concerns. I focus on CBI because I believe the implications of the argument to be more observable.

When economic returns to an industry are due in greater part to scientific and process (engineering) advancements, the risks of transparency are greater. While screening and selection of national monitoring agents from the Internal Revenue Service or Food and Drug Administration may be less transparent, they are subject to national law enforcement when they commit acts of theft or fraud in the course of official activities. However, such provisions do not apply to international agents who are generally accorded diplomatic immunity.[153] For example, Brazil was concerned that IAEA monitoring of its new centrifuge enrichment facilities would allow "technological piracy" (Massarani 2004). States have little ability to unilaterally punish foreign or international inspectors, only diplomatic pressure, withholding contributions, or withdrawal from the agreement (Moore 2004).

A stronger role for law enforcement, a form of punishment, is only necessary because of a weaker ability to use other design elements to minimize agency slack. The same features IOs use to minimize search bias also minimize sovereignty costs. When IAEA inspections were first negotiated, transparency was risky: technology in the nuclear industry was rapidly evolving, governments had a dominant role, and there was heavy government supervision of any non-military facilities for safety and security purposes. To minimize the risk of sovereignty costs, IAEA inspectors are screened first when hired and again when states have the option of rejecting individual inspectors whose personal or national ties make their participation in inspections a commercial or national security risk. Then, when inspectors arrive, the safeguards system is designed to shelter proprietary knowledge. The technique of "mass balancing" allows limits on the tools and

[153] This is to prevent their being harassed in the course of carrying out treaty-related monitoring.

techniques used in verification as long as inspectors can determine no fissile materials have been diverted.

International agents constrain themselves because, as an organization, allowing information to be leaked puts at risk their future access to information. IOs maintain access to high quality information because they have the autonomy to limit communication with their principals to summary reports sufficient for collective decision-making relevant to the institution's mission (Rodrik 1995). The risk of sovereignty costs is not eliminated but is lowered with IOs. If inspections were conducted by foreign governments, the ability to screen inspectors, limit the scope of inspections, and protect information acquired would be severely limited.

In summary, the transparency required to implement a nonproliferation agreement creates a risk of sovereignty costs that increases as the value of sensitive commercial information increases. The desire to cooperate interacts with this increased risk to create increasing incentives to delegate to an international agent whose narrowly defined interests reduce the risk of sovereignty costs. Therefore, if states perceive benefits from cooperation in the first place:

> *H2: As the value of information in an industry increases, the sovereignty costs of transparency increase and delegation to international agents becomes more likely.*

I employ a multi-method process for testing the validity of these three hypotheses. In both qualitative and quantitative tests, I employ an interrupted time-series study design of three similar cases, comparing nuclear, biological, and chemical weapons against each other across an extended period of time. First, I conduct a study of information on Iraq's NBCW programs from the late 1970s to 2004. By comparing what international agents

(IAEA and UNSCOM/UNMOVIC) and US-UK intelligence reportedly believed during the observation periods to each other and to later determined "truths", we can qualitatively test the effect of search bias upon decisions by the international community to delegate the verification and disarmament of Iraqi NBCW programs and stockpiles.[154] I argue in Chapter 5 that differences in the cost of generating information about NBCW threats and solutions explains differences across the three issue areas in the utility of delegating information production to an international agent. This analysis should also, then, generate additional evidence on what technical strategies are useful and how costly it is to verify a state's nuclear behavior as compared to its BW or CW activities. Second, I test the search bias hypotheses quantitatively using data on international preferences from 1950s-2001. Third, I generate data on the economic value of nuclear, biological and chemical industries, also from 1950 to 2001, to test hypothesis H2 on sovereignty costs.

Iraq, 1991-2004

International experience with Iraq's NBCW programs provides an excellent case for testing the hypotheses on information costs and delegation to IOs as a solution. Iraq is known with certainty to have pursued NWs, BWs, and CWs and the international community should have been sensitive to the risks of search bias in the production and reporting of information about Iraqi NBCW programs. Iraq has also been exposed in recent decades to multiple treatments (exogenous shocks) and multiple pre- and post-

[154] While this study compares the potential search bias from the US and IOs, the United States should not be singled out as solely responsible for false, misleading or incomplete statements about the NBCW activities of certain proliferators. In the particular case of Iraq, states such as France and Russia have been accused of being biased in the opposite direction, ignoring facts for financial gain through increased commercial relations with Iraq.

treatment observations that specifically examined what was known (and by whom) about Iraq’s NBCW activities.

The key historical treatments in this interrupted time-series include the Iran-Iraq War (1980-1988), the First Gulf War (1991), the expulsion of international inspectors from Iraq (1998), the return of international inspectors (2002), and the Second Gulf War (2003-). The analysis therefore divides the intelligence and information challenge into five pre- and post-observation periods: pre-1988, 1988-1991, 1991-1998, 1999-2002, and 2002-2004. This case study relies primarily on the Review of Intelligence on Weapons of Mass Destruction (Butler et al. 2004), the Iraq Survey Group (ISG) Comprehensive Revised Report with Addendums on Iraq's Weapons of Mass Destruction (Duelfer 2004), and analyses on Iraq’s NBCW programs conducted by the Nuclear Threat Initiative (Fields et al. 2006; McCarthy et al. 2006a; McCarthy et al. 2006b).

Iraqi Proliferation, Stage 1: Pre–1988

It was believed that Iraq began laboratory-scale efforts at CW production in the early 1970s and accelerated its program at the start of the Iran-Iraq War in 1980 with the assistance of European suppliers (Terrill 1991:118,119). After early military defeats in 1981 and 1982, Iraq began using CWs against Iranian forces and Iraqi Kurds (McCarthy et al. 2006b; SIPRI 1982).[155] Even though many knew of the attacks, there was little attempt to interfere. Many believed CW use was acceptable because the serious threat from a post-Revolution Iran was judged to be politically worse than Iraq’s CW use. For example, US Senator Jesse Helms later stated the US had evidence establishing Iraq’s

[155] 5,500 Iranian soldiers were killed with tabun during 12 months from 1984–1985 and 16,000 with mustard gas during 1983-1986. In the later 1980s, Iraq attacked its Kurdish population, including one attack against the Kurdish town of Halabja in 1988 that killed about 5,000 civilians.

guilt in violating the Geneva Protocol but withheld it in order to protect national security intelligence services (US Senate 1989b). The justification is evidence of search costs but, given US antipathy towards Iran, it is also a reflection of US search bias.

The US suspected Iraq was also seeking NWs by the 1970s when it began to seek facilities from abroad, including a medium-sized research reactor for Osiraq (Fields et al. 2006; Samore 1994). This would have to be accomplished clandestinely since it had ratified the NPT and the reactor would be subject to IAEA inspections. In the 1980s, especially after India's 1974 nuclear test, the international community was focused on the threat of threshold states – those which had acquired sufficient advanced nuclear capabilities that they were only a political decision away from a weapons program – but still had little consensus on coping with this legal form of proliferation. The US pressed others to limit nuclear trade with Iraq and sought strong IAEA safeguards, but Israel believed the IAEA would be too slow to uncover the program and decided in 1981 to destroy the facility (IAEA 1998:17; Samore 1994). This, combined with the distraction of Iran-Iraq War, dissipated the nuclear threat. We can infer Israeli beliefs were shared by France, which refused contracts to reconstruct the facility, and by the US, which withdrew from the IAEA in 1982 to protest attempts to isolate Israel. The US rejoined in January 1983 after deciding the only alternative was to recreate the IAEA (Scheinman 1985).

As a direct result of Iraq's CW activities, the UN Conference on Disarmament agreed in 1984 to pursue a Chemical Weapons Convention and 19 Western states agreed to form the Australia Group.[156] The interest in pursuing the Australia Group as a NSG analogue was not surprising given the fact that the CWC was blocked for years over concerns about protecting national security and private industry information (Bernauer 1990). The lack of direct pressure on Iraq shows that, whereas many developing states were increasingly concerned about the risk of CW proliferation (Chapter 3), the focus by the major powers on Iran became a source of search bias as they were more concerned Iraq not lose to the radical Islamic regime in Iran. Stage 1 of the study supports H1.

Iraqi Proliferation, Stage II: 1988-1991

After the Iran-Iraq War, Western intelligence agencies in 1988-1989 saw evidence that, despite its economic problems, Iraq was continuing CW production and was again pursuing a nuclear program, including attempts to acquire gas centrifuge and other facilities. The US tried to block these efforts with direct diplomatic pressure on Iraq and indirect pressures on others (Samore 1994:18). A UK intelligence assessment in September 1990 stated Western beliefs that Iraq was 4 years from having a small stockpile of 3-4 NWs (Butler et al. 2004:43), but the only direct threat was the diversion from safeguarded research reactors of HEU sufficient for a single device (Samore 1994:18).

It was also suspected that Iraq had initiated a BW program. Intelligence appeared limited to knowledge that key individuals at a suspected BW facility in a failed 1970s effort had resurfaced in the early 1980s at a new facility and that Iraq had been denied export licenses for industrial-scale fermenters (Pearson 2006:177) and seed stocks of

[156] The USSR also practiced export controls over states in its sphere of influence through the "Leipzig Group" and the Soviet Trade Association (Bernauer 1990:46).

anthrax and other potential BW agents (Miller, Engelberg, and Broad 2001). This evidence was tenuous, but Iraq's signature to the BWC was perceived as little barrier given Iraq's apparent level of respect for the Geneva Protocol and the NPT.

Information on Iraq was limited during this period because of the Western focus on events in Europe and the USSR as the Cold War ended. In support of the arguments in Chapter 5, Western intelligence agencies would require greater investments to cover the larger number of necessary intelligence targets. As in the previous stage, then, and supporting H1, the action against Iraq for potential proliferation activities was minimal because the US and other Western states attached a more serious risk of war to defection by states from the Soviet empire.

Iraqi Disarmament, Stage I: 1991-1998

The US and its allies, preparing to use military force to expel Iraq from Kuwait, were worried about the prospect of Iraq using CWs and even BWs, but not NWs. In its planning, the US determined it was unable to provide its own troops in the region sufficient defensive clothing against CWs or vaccinations against possible BW agents and feared strategic use of these defenses would discourage participation by other nations' forces (Miller, Engelberg, and Broad 2001; Spiers 1994). Per the argument in Chapter 5, this implies that while there were strong suspicions about Iraq's programs, there was too little information on BWs to plan adequate responses.

The Gulf War was officially terminated when Iraq accepted a ceasefire under UN Security Council (UNSC) Resolution 687 (3 April 1991). The ceasefire included a requirement that Iraq verifiably destroy its nuclear, biological and chemical capabilities and any missiles 150km or more in range. Disarmament and verification authority was delegated to the IAEA for its nuclear capabilities and to the UN Special Commission for Iraq (UNSCOM) for its CBW and missile capabilities.[157]

Because it was expected to be of limited duration, UNSCOM began without a formal budget and from 1991-96 was funded at first by the transfer of frozen Iraqi assets held by the US (Buchanan 2005) and afterwards by voluntary contributions of UN member states (UN). UNSCOM cost about $75 million per year to run, approximately $25-30 million in direct funds and $50 million in in-kind contributions such as equipment and salaries from the US, UK, Germany and others (Jones 2003:201-201; Saikal 2002).[158] This assistance was also more limited than it could have been. For example, due to US concerns that the multinational nature of UNSCOM and the IAEA could lead to compromises of US intelligence capabilities, the US decided it would not help interpret U2 pictures and or share its full intelligence on Iraq (Oudraat 2002). After oil sales were permitted in 1996, UNSCOM began to receive 0.8% of the $2b in sales allowed every six months (translating to $32m a year, about what UNSCOM what spending in 1996).

Funding constraints meant UNSCOM formally hired only about 20 professional staff and a small administrative staff (22 individuals in 1992 and 36 in 1993). Instead, it relied on experts seconded by states willing to pay for their participation in UNSCOM activities (Buchanan 2005). UNSCOM would plan a series of disarmament monitoring or weapons inspection activities and then petition states with the appropriate expertise for individuals to staff the mission; these individuals would then stay with UNSCOM for a

[157] UNSCOM's mandate is described in UNSCR 687 (1991) and was subsequently modified by UNSC Resolutions 707 (1991), 715 (1991), 1051 (1996), and 1154 (1998).
[158] UN report S/1996/848 states that UNSCOM spent USD$120m between 1991-1996, about $22m per year (UN various).

period from a couple of weeks to as much as six months (Buchanan 2005). Large portions of UNSCOM's data were provided and/or interpreted by the CIA (Saikal 2002).

The reliance on seconded staff created a two-way flow of information that helped UNSCOM plan missions and kept key states appraised of UNSCOM's findings but also allowed UNSCOM to be penetrated by national intelligence agencies, including allegations that staff acting on behalf of the US government wiretapped communications by UNSCOM inspectors (Findlay 2003). This became a source of sovereignty costs to Iraq as it suspected the US and other states of using UNSCOM to plan for further military actions. That distance between Iraqi and other states' preferences on non-NBCW issues resulted in sovereignty costs for Iraq supports the sovereignty cost hypothesis (H2).

UNSCOM's ad hoc funding and reliance on seconded staff deprived it of the design features necessary for an IO to have fixed, known and narrow preferences. The weakness of staff screening and the inability to control resources left it vulnerable to external pressure and with weaker control over its "staff". UNSCOM is perhaps more an example of ad hoc cooperation under an international façade than it was a true IO.

Verification was complicated by both Iraqi hostility and its unilateral disarmament. Iraq's first declaration on CWs, required under UNSCR 687, reported that it produced 3,859 tons of CW agents and more than 125,000 filled and unfilled special munitions between 1982 and 1990 (NTI 2007). By December 1998, UNSCOM inspectors had destroyed 38,537 filled and unfilled chemical munitions, 690 metric tons of CW agents, more than 3,275 metric tons of precursor chemicals, hundreds of pieces of production and analysis equipment. Even if Iraq had been truthful about its unilateral destruction of CW agents and munitions, unaccounted for were potentially hundreds of tons of CW agents and thousands of CW munitions. UNSCOM could not verify what had been produced, used, or destroyed, all necessary to verify what might still be possessed. In particular, UNSCOM's final report to the UN Security Council in 1998 noted discrepancies regarding CW use during the 1980s, numbers of R-400 aerial bombs reportedly lost after the Gulf War, and inadequate accounts of Iraq's production of VX agent or the disposition of VX precursor chemicals (NTI 2007). As much as was known to have been destroyed, US and UK intelligence agencies' doubts about CW disarmament only become stronger, especially after the revelations about Iraq's BW program (Butler et al. 2004:48).

Early inspections for BWs led to Iraqi admissions of past BW activities about which the US and UK intelligence could previously only have guessed, but the real uncovering of its programs occurred only after an important defection in August 1995 (Black 2002:290). Within 10 days, Iraq offered a revised declaration detailing BW weaponization, more BW agents, more storage facilities, and other relevant activities (Black 2002:295). The defection permitted a clear reconstruction of past activities: a decree in 1974 initiated construction of the first BW facility, but practical BW work began only in 1985 when Iraq acquired bacterial strains and basic lab equipment. Further, large-scale production of multiple agents began only in January 1989 after fermenters were transferred from a veterinary research facility elsewhere in Iraq (Pearson 2006).

US and UK intelligence took these new declarations as a sign of progress on verifiable disarmament. However, as the Butler Report notes, the inability to reconcile international findings with Iraqi declarations strengthened doubts (Butler et al. 2004). As long as Iraq remained obstructionist, it could hide significant stocks or capabilities from what was, at least to date, the most intrusive disarmament regime ever implemented. The verification of CW and BW activities was more costly, and required more intrusiveness, than anyone had previously expected. This difficulty later informed the US position in negotiations on a verification protocol for the BWC, leading it to determine in 2001 that a monitoring regime could only be effective with unacceptable levels of intrusiveness and spending.

By any measure, the IAEA inspection process was successful. After Iraq denied having a clandestine nuclear program, the IAEA quickly discovered Iraq had pursued multiple uranium enrichment routes simultaneously. The IAEA determined that Saddam Hussein had in 1991 ordered a “crash program” (Project 601) to extract Iraq's stock of safeguarded HEU for a nuclear device to be used against either Israel or coalition forces. Iraq’s team was confident it could extract 26kg of HEU – enough for one bomb – by the year's end (Fields et al. 2006). However, lead IAEA inspector Hans Blix could declare in 1996 that, “All quantities of special nuclear material [highly enriched uranium or plutonium] found in Iraq have been removed and the industrial infrastructure which Iraq had set up to produce and weaponize special nuclear material has been destroyed” (Fields et al. 2006).

The Iraqi nuclear program was apparently further advanced than any had suspected, successfully exploiting dual-use trade to create its programs and probably moving beyond the point at which export controls or political measures alone could have stopped them. The implication of this revelation, along with recent developments in South Africa and North Korea, was that states circumvented IAEA's safeguards with apparent ease and the US and others were unable to acquire reliable information despite their heavy investments.

The IAEA responded with a multilateral conference on strengthening the safeguards system, where it determined it needed greater support from national intelligence agencies (IAEA 1998; Rockwood 2002), received approval by its Board of Governors to revise the INFCIRC/153 safeguards system in 1997 and to extend the IAEA's verification authorities with the INFCIRC/540 Additional Protocol in 1998 (IAEA 1998). Also, the NSG was reconvened and agreed in 1992 to cover more dual-use items (Thorne 1997), and in 1993 to require comprehensive safeguards as a condition for nuclear exports (IAEA 1997). UNSCOM continued on CBW disarmament until the disarmament process ended when UNSCOM and the IAEA were expelled in December 1998 after a year of tense crises. At the time, most believed Iraq was, with all likelihood, sufficiently disarmed that it was not an NBCW threat to others but was continuing to resist to maintain any regional status it derived from standing up to the US and UK. Of course, Iraq was able to expel the UN Security Council's Special Commission (UNSCOM) for Iraq because of growing divisions among the UNSC permanent members over continuing the harsh sanctions regime, its proper role in Kosovo, and in dealing with the DPRK, rather than divergent preferences over the advantages of disarming Iraq of NBCWs per se.

While the US was later critical of the international disarmament effort as ineffective, the UK Butler Report's review of UK intelligence was quite clear that "Iraq was a very difficult intelligence target" for which international efforts were invaluable (Butler et al. 2004:107). The Butler Report further stated that IAEA and UNSCOM reports were, from 1991-1998, “The most authoritative information on the status of Iraq’s nuclear, biological, chemical and ballistic missile programmes …derived from their inspection activities on the ground” (ibid.:42). The report also noted, “the intelligence agencies contributed to a steady flow of intelligence covering Iraqi procurement activities, attempts to break United Nations sanctions, concealment of prohibited programmes and plans for handling UNSCOM and IAEA inspections” (ibid.:42). There was a significant intelligence cost to the expulsion of international inspectors, because afterwards,

> …Information sources were sparse, particularly on Iraq’s chemical and biological weapons programmes… SIS did not generally have agents with first-hand, inside knowledge of Iraq’s nuclear, chemical, biological or ballistic missile programmes. As a result, intelligence reports were mainly inferential. (Butler et al. 2004:107)

Doubts remained in the UK and US about Iraqi CBW programs. Critically, however, this resulted in the intelligence agencies compensating for their incomplete information by using a different “burden of proof” in interpretation and being less receptive to alternative hypotheses, particularly the possibility that Iraq had been completely disarmed (Butler et al. 2004:107).

This ex post revelation demonstrates clearly that US-UK biased interests caused their biased reporting (H1). While Iraq noted increasing Anglo-American search bias, the risk was also underscored by the broad international preference divergence as France, Russia, and others sought to end sanctions and disarmament efforts in order to exploit investment opportunities (and others sought to avert humanitarian crises among sensitive populations affected by the sanctions). While cause and effect become difficult to disentangle if US decision-makers came to believe their own biased reporting, US interests in seeing Saddam Hussein's regime deposed or significantly altered also created incentives for the US to behave opportunistically with information acquired from Iraq's disarmament (H2).

Iraqi in Limbo: 1999-2002

Judgments during 1999-2001 regarding Iraq's NBCW programs were based upon a couple of human intelligence sources, reports of continuing recruitment, and imagery that indicated increased activities at some former or suspected NBCW facilities. However, the Butler Report's review of UK Joint Intelligence Committee (JIC) reports does not make it clear when there was direct access to information sources; in a number of cases it was indirectly reported, e.g., by a "liaison service". The human intelligence was derived from questionable sources, including opposition groups like the Iraqi National Congress (NTI 2007).

The rationale behind H1 is that as information becomes increasing incomplete or uncertain, the informational agent's prejudices and other interests will become a source of bias in interpreting the results. The interpretation by the US and UK of any new intelligence occurred within the belief that, despite the efforts of UNSCOM and the IAEA, Iraq had retained capabilities. The UK suspected active procurement activities for its nuclear program, including now-infamous reports that Iraq attempted to acquire uranium during a trade mission to Africa, procured aluminum tubes for centrifuges (Butler et al. 2004:107), and had "recalled its nuclear scientists in 1998" (Butler et al. 2004:107). However, the JIC cautioned in 2001, "We have no clear intelligence" on Iraqi nuclear weapons activities (ibid.).

The JIC stated that there was only a "limited" picture of Iraqi CBW activities but judged it "could have hidden dual use precursor chemicals, and production equipment" for CWs (Butler et al. 2004:57). Based on reports from two sources of some VX nerve gas weaponization in 1998 and the partial restoration of a former CW production facility, the JIC judged Iraq had an active CW program (ibid.:58). More strongly than for NW or CW capabilities, US and UK intelligence believed "Iraq has retained sufficient expertise, equipment and materials to produce BW agents within weeks." Again, however, "there is no intelligence on any BW agent production facilities" and these judgments were largely based upon intelligence reports from 1997/1998 and intelligence from a "liaison service" that Iraq was using mobile BW facilities, as later noted in US Secretary of State Powell's presentation to the UNSC (ibid.:59).

In short, Western intelligence had limited information in 2002. The Butler Report states that those with access to UK intelligence would have been led to believe:

> a. The continuing clear strategic intent on the part of the Iraqi regime to pursue its nuclear, biological, chemical and ballistic missile programmes.
>
> b. Continuing efforts by the Iraqi regime to sustain and where possible develop its indigenous capabilities, including through procurement of necessary materiel.
>
> c. The development, drawing on those capabilities, of Iraq's 'break-out' potential in the chemical, biological and ballistic missile fields, coupled with the proven ability to weaponise onto some delivery systems chemical and biological agent. (Butler et al. 2004:63)

While international verification had ended in 1998, the underlying institutions were maintained. In December 1999, the UNSC replaced UNSCOM with the UN Monitoring, Verification and Inspection Commission (UNMOVIC), a body with essentially the same mandate but greater oversight by the UNSC and the UN Secretary

General.[159] Correcting some of the design flaws of UNSCOM, the UN made funding for UNMOVIC more secure by committing a fixed share of Iraqi oil sales made under UN licensing. UNMOVIC could, therefore, also be less reliant on seconded national experts and began to recruit and train its own experts in preparation for whenever it would be allowed to re-enter Iraq. Applying the operationalization of delegation developed in Chapter 2 and summarized in Table 6.1, delegation to UNMOVIC was in theory greater than to UNSCOM because of its greater autonomy and greater resources.[160] The increased delegation to UNMOVIC was a solution to the search bias problem (H1) and sovereignty costs (H2) permitted under UNSCOM, supporting both hypotheses. The IAEA also maintained its Iraqi body. UNMOVIC and the IAEA reported that advances in detection equipment and data analysis techniques in the intervening years would yield marked improvements upon past verification efforts, reducing search costs (Findlay 2003).

Iraqi Disarmament, Stage II: 2002-2004

After George W. Bush was elected President in 2001, the US put increasing pressure on Iraq and the other members of the "axis of evil" by threatening regime change. Even then it was clear the US would be extremely skeptical that these countries could be good global citizens. It was also clear that the US, with its interests diverging, would receive little support from its allies and some outright opposition from Russia and China. In the aftermath of the September 11th attacks in 2001 by Al Qaeda, the Bush

[159] UN Security Council Resolution 1284 (17 December 1999).
[160] This delegation is largely theoretical because, as shown below, UNMOVIC had little opportunity to test its authority. A full study of the UNSCOM and UNMOVIC delegation measures is available from the author upon request.

administration’s view of the world became even more extreme. The US invaded Afghanistan but quickly returned its attention to Iraq, claiming Saddam Hussein’s regime was connected to Al Qaeda and therefore, by extension, to the attacks of September 11th.

US threats overcame Iraqi resistance to the resumption of UNMOVIC and IAEA inspections, which returned on 25 November 2002 with 11 inspectors to start (Findlay 2003). By 18 March 2003, UNMOVIC conducted 731 inspections of 411 sites, 88 of which had not been inspected previously. UNMOVIC found and destroyed additional missiles, missile engines, warheads, expired BW growth media, and other items that had not been destroyed by 1998 and some of which had been acquired since (Findlay 2003). Further, the UNMOVIC inspections were able to verify the destruction of between 30%-39% of Iraq's declared stockpile of 1.5 metric tons of VX and identify a small number of CW munitions produced prior to 1990 (NTI 2007).

Iraq’s alleged NBCW programs became a major rationale for war. As evidence of this resurgent threat, President Bush cited in his 2003 State of the Union speech Iraqi acquisition of aluminum tubes for uranium enrichment centrifuges, the attempted acquisition of uranium ore from Africa, and Saddam Hussein’s ties to the Al Qaeda terrorists responsible for the September 11th attacks. Days later, US Secretary of State Powell presented to the UNSC evidence that Iraq had mobile BW production laboratories, CW stockpiles in bunkers (inferred from “chemical decontamination units” that turned out to be fire trucks), and presented other evidence of active NBCW programs.

As the US-led coalition prepared for war, the JIC conclusions in September 2002 were reportedly based on “judgment and assessment” and “common knowledge” rather than direct intelligence (Butler et al. 2004: 74-75). Further, analysis was affected by "Iraq-specific factors": its past use of CWs and its sustained program to deceive UN inspectors (pp.112). The UK government dossier, *Iraq's Weapons of Mass Destruction*, was published 24 September 2002 as a means of educating policy-makers and the general public about the need for stronger action on Iraq but omitted the warnings and caveats about the uncertainties and gaps in intelligence included in the original assessments (see pp.81,84).

On 7 March 2003, however, IAEA Director General Mohamad ElBaradei reported to the UN Security Council that, "After three months of intrusive inspection, we have to date found no evidence or plausible indications of the revival of a nuclear weapon program in Iraq." Hans Blix, head of UNMOVIC, reported that same day that Iraq was cooperative with the process but not in substance and identified more than 100 still unanswered questions about Iraq's WMD activities (Findlay 2003). Succinctly, however, the IAEA and UNMOVIC concluded there was no evidence of continuing or new WMD programs (NTI 2007). The US refused to accept the validity of IAEA and UNMOVIC conclusions. While the US-UK and IAEA-UNMOVIC reports were each based on different evidence, political bias caused their different conclusions: search bias.

Only days later, on 18 March, the US informed international inspectors that they should leave Iraq and Operation Iraqi Freedom began the following day. The US effort to prove Iraq's NBCW capabilities followed within days with deployment of three separate survey teams (Task Force 20, Site Survey Teams, and 75th Exploration Task Force) which were then replaced by the ISG under David Kay (Cleminson 2003). While an end to major combat operations was declared on 1 May, the ISG's work continued for nearly two years with little success in proving the earlier US allegations. David Kay resigned in January 2004, stating that the intensive effort demonstrated to him that Iraq no longer had NBCW programs or stockpiles. Rather than accept that US-UK pre-war analysis had been wrong, President Bush named Charles Duelfer as his replacement.

The differences between the international and US-led efforts were striking. Whereas UNMOVIC in November 2002 had a few dozen people and an *annual* budget of $80m, the ISG had a staff of nearly 1400 and a *monthly* budget of $100m (Rosenberg 2004). International inspectors had to operate under negotiated access while the USG had unfettered access with full military support. Finally, the results of the international inspections were received by the international community as being neutral while the US-led effort was expected to elevate even minimal evidence as proof of Iraqi duplicity and as justification for the war effort. Still, Charles Duelfer submitted on 30 September 2004 the ISG's final report[161], which summarized the key findings of the US, UK and Australian teams' investigations of NBCWs in Iraq (Duelfer 2004). The ISG found that there were limited attempts to retain capabilities that at some future point could be useful, but found no evidence of continuing or new NBCW programs.

Iraq Conclusions

The Iraq case demonstrates the influence of search bias (H1) in the collection and reporting of information and judgments by different informational agents, focusing on the IAEA and UNSCOM/UNMOVIC effort and the US-UK effort as the primary alternatives. This study shows that the US was willing to put little pressure on Iraq

[161] Iraq Survey Group operations formally continued until January 2005 and Duelfer submitted an Addenda to the Final Report on March 2004.

regarding its programs in the 1970s, limited by US competition with the USSR and Iraqi support for a more secular pan-Arab movement. By the 1980s, when Iraq was valued for containing Iran, there was interest across Cold War lines in ignoring Iraqi proliferation. The US and the international community had reason to be suspicious about Iraq's NBCW activities after post-Gulf War findings by international inspectors from UNSCOM and the IAEA were viewed in conjunction with Iraqi obstructionism. As a result, the US was not seen as particularly biased on Iraq in its support for continuing international efforts, only for its later resistance to easing sanctions despite disarmament successes. Increasing search bias and sovereignty costs under the UNSCOM model became a major cause for its replacement with the more autonomous and less permeable body UNMOVIC in 1998. Search bias was again a factor as the US and UK reported to the international community in 2001-02 that Iraq was engaged in a resumption of its NBCW programs when this judgment was based on extremely limited and poor quality information.[162] The problem of search bias is clear throughout, as is the relatively lower risk of bias posed by the international inspectors.

This study also shows the risk of sovereignty costs (H2), albeit to a lesser extent. When "cooperation" by Iraq on NBCW disarmament was exploited by actors seeking to otherwise constrain Iraq's international and domestic autonomy of action, delegation was retracted. Western states, particularly the US, penetrated UNSCOM operations in order to gather intelligence on unrelated Iraqi military and other government activities for use in planning additional military actions. Sanctions related to NBCW disarmament were also

[162] Also, it was found that Iraq had no ties to Al Qaeda or connection to the September 11th attacks.

used to interfere in Iraqi domestic politics by weakening the regime and fomenting internal opposition. The perception by some on the UN Security Council that the sovereignty costs were too great and was a valid point for Iraqi resistance, led many to conclude delegation was too costly: UNMOVIC was held in abeyance until Iraq saw the sovereignty costs of admitting UNMOVIC to be less than the alternative cost from a US invasion.

The preceding study also demonstrates the search costs required to monitor or verify nuclear activities relative to CW- or BW-related activities (Chapter 5). First, looking across the three cases, nuclear activities were easier to verify than CW and CW easier than BW. This may be in part due to the greater international experience with nuclear verification but is also a function of the limits on observability of these activities because of relative facility size, dual-use applications, and need for weaponized stockpiles. Second, within cases but across time, there have been technological advances supporting the detection of all three weapon types, but only for nuclear verification does the cost, on balance, appear to have decreased because of new monitoring techniques and IAEA advances in information systems and the range of data being gathered. Meanwhile, CW and BW detection technologies have advanced but continue to suffer from problems distinguishing current activities from past activities or background noise.

Quantitative Data and Hypothesis Testing

In this section, I develop quantitative proxies for the concepts of search bias and sovereignty costs. These indicators are employed in statistical tests of the temporal relationships to delegation to nonproliferation IOs.

Delegation and Search Bias

Significant differences in national interests make states less likely to rely upon other states to produce and report information on proliferation-relevant activities. These differences also create incentives to rely more upon international agents with nonproliferation interests known to be narrow and neutral. To measure the significance of preference differences in increasing the risk of search bias and causing delegation, I use three indicators of the similarity (or "S") of preferences (Signorino and Ritter 1999) developed in Chapter 4: general preferences using all UN General Assembly votes, NBCW preferences using NBCW treaty ratifications and UNGA votes on NBCW issues, and non-NBCW preferences using all non-NBCW votes in the UNGA. As a reminder, as these "S" scores are for the system-year, as preferences of states in the system become more similar, the mean "S" score shifts away from -1 (complete heterogeneity) towards +1 (complete congruence).

I argue that while the movement of the mean score of NBCW preferences towards unity (+1) proxies the capacity to cooperate on proliferation, differences on other issue dimensions creates the risk that information revealed in the process of cooperating on proliferation may be used strategically: search bias. For example, though international preferences on NBCW issues become remarkably similar through the 1980s and were quite stable in the 1990s, differences on other issues created a risk of search bias in the international approach to Iraq in the late 1990s: humanitarian effects of sanctions, intervention in Kosovo, etc.

Therefore, controlling for the similarity of NBCW preferences, the spatial distance between the mean NBCW and non-NBCW "S" scores proxies for the salience of these differences. In Figure 6.1, I illustrate the effect of the change in preferences by a single actor (A) relative to other actors in the system (B, C, D, and E): A is a reasonable informational intermediary at A_0 (if it possesses the resources and expertise) because its preferences on NBCW and non-NBCW issues are viewed as moderate. However, if we hold NBCW preferences constant and allow A's ideal point to change from A_0 to A_1 (e.g., if the US became a theocracy) then other states would suspect A would exploit information asymmetries on NBCW issues to gain advantages on other issue dimensions.

For simplicity, I refer to the absolute value of the difference between the system-year means of the NBCW and non-NBCW preference scores as the "preference gap". As illustrated in Figure 6.2, NBCW preference or "S" scores vary from 0.2-0.65, on all other issues the preference score varies between 0.3-0.75, and the preference gap varies from zero to 0.3. Even though proliferation preferences converge from 1976-1990, the fact that preferences remain less shared on proliferation issues than on all other issues during that same period highlights issues of disagreement during this period.

Hypothesis 1a predicts that, controlling for the level of threats and the similarity of preferences over NBCW issues, if the median preference score for proliferation issues diverges from the score for all other issues, states should increase their delegation to international agents in order to achieve shared interests on nonproliferation and prevent others from exploiting these interests opportunistically. I find the gap between proliferation preferences and other preferences has the expected positive effect upon nuclear delegation. Table 6.2 shows that when states are weighted by their nuclear capabilities, a one-point increase in the preference gap should cause a 37.12 point increase in delegation. Given the small range of the preference gap proxy (0-0.3), it is more realistic to state that a 0.1 point increase in the preference gap should cause a 3.4 point increase in delegation (5.9 points without controls included). A 2.5 point increase in delegation would correspond, for example, the change in delegation to the IAEA that occurred in 1994 when the IAEA's inspection authority was increased (1 point), as was its ability to base compliance decisions upon broader sources of data (1 point) and to resist state pressures in hiring (0.5 points). The results are basically similar for CW delegation, though not significant (Table 6.3). H1a is supported.

Hypothesis 1b proposes that increasing gaps between the proliferation preferences of the US and the rest of the world ("ROW") should be positively correlated with delegation to IOs. Table 6.4 shows that a 0.1 increase in the US-ROW preference gap should cause nuclear delegation to increase 1.5 points when controlling for the effect of nuclear threats and proliferation preferences (3 points without controls). The coefficient is small but realistic and in the expected positive direction. The results for CW delegation are again weaker (less significant) but also smaller: a US-ROW preference gap does not appear to explain CW delegation. Of course, this is not surprising given the timing of the CWC's entry into force. H1b is supported.

The differences caused by the weightings used in the models are important. They highlight the difference in approaches between advanced and developing states: the coefficients are higher when capabilities are accounted for, but the difference between NBCW and NW weightings indicates CBW – but not NW – capable states' preferences are most important to predicting delegation. These results are evidence for arguments that smaller and/or developing states prefer cooperation through IOs because this form of cooperation allows them greater voice and control over outcomes. The data show that

CBW-capable but not NW-capable states are more likely to prefer delegation as a solution to informational barriers to cooperation because they are also more likely to be the 2nd-tier proliferators who become the targets of nonproliferation efforts. The support for the H1b adds further depth to this story: states may be willing at times to rely upon their most powerful allies but not when the ally's preferences become increasingly divergent. Therefore, even if the United States were capable of producing all necessary information about NBCW-relevant policies and behaviors of others, as other states preferences diverge from the US and create (for them) the risk of US search bias, they will prefer to delegate to an IO for NBCW issues.

Delegation and Sovereignty Costs

The risk that monitoring nonproliferation will reveal valuable commercial or national security information and, thereby constrain a state's future independence of action, creates incentives to rely upon international agents who are narrowly interested in producing information on proliferation-relevant activities without revealing unrelated information. The risk of sovereignty costs from the loss of commercially valuable information should therefore be a function of how reliant the value of the industry is upon protecting proprietary information. To construct a proxy for the reliance of industry value upon proprietary information, and therefore a proxy for the risk that commercial information could be revealed by inspections, I interact a proxy for industry size with an indicator for rate of technological change. Large industries with rapid technological development place a premium on protecting information. Conversely, proprietary information is less important for large industries with no evolution or areas of technological change but no economic value.

One indicator of an industry's rate of technological chance is its patent activity. Patents are filed to protect the rights to commercially exploit an idea or investment. As argued in Chapter 5, the greater the number of patents approved in an industry, as a share of the total in the economy, the greater the relative importance of new ideas to an industry. Patents granted to the nuclear industry were not a large share of the total even at their peak in the 1950s and only decline afterwards. Similarly, chemical industry patent applications represent an increasing share through 1960 (reaching a 20% share), decline rapidly in 1961-65 to about 9% and then continue a slower decline to about 3% by the late 1990s. Biological patents have done the reverse, going from relative insignificance to increasing importance since the 1970s.

The indicators for nuclear, biological and chemical industry size are from Chapter 5. To review, chemical industry size is measured as annual sales of the top 50 chemical industry firms as identified by Chemical and Engineering News (C&EN various:1972-2007). The size of BW-relevant industries is proxied by US biotechnology firm revenues (Ernst & Young) and pharmaceutical sales (PhRMA). The size of the nuclear industry is proxied by the global capacity of all known nuclear facilities, measured as the annual total of megawatts of electricity produced by reactors and tons of throughput in fuel cycle facilities (megawatts of electricity produced by reactors and tons of throughput in fuel cycle facilities as reported by the Power Reactor Information (PRIS) Database, IAEA 2007e). The values are illustrated for all three industries in the previous chapter, Figures 5.1 and 5.3. The resulting interaction term of industry size and industry patent share is illustrated in Figure 6.3.

Hypothesis 2 predicts that increasing the sovereignty costs of transparency, measured as the value to an industry of proprietary information, should cause increasing delegation to nuclear IOs. Table 6.5 shows the causal effect of the value of proprietary information to the nuclear industry is in the expected positive direction, though the coefficient is small and not significant. Of course, the nuclear industry has always been subject to strong government oversight. In the US, for example, all nuclear reactors must have their design pre-approved by the Nuclear Regulatory Commission. Further, most international nuclear cooperation was subject to bilateral safeguards from the start and then, from 1957-68, states which believed facilities were at greater risk from international oversight could maintain bilateral safeguards (and states which didn't trust their supplier state could press for safeguards from the IAEA or EURATOM). Only after the NPT entered into force in 1970 were non-nuclear weapons states required to open for international inspections. H2 is supported, though the historical record suggests the small coefficient understates reality.

A somewhat similar historical story can be told for the chemical industry. Since the 1970s, the chemical industry has (unrelated to CW issues) been subjected to increasing government monitoring while, controlling for inflation, chemical sales growth has been in slow decline. In the US, the American Chemical Society accepted by the early 1970s that inspections could result from an anti-CW agreement and reversed its opposition to a CWC in 1970 "because of a shift in the public's view of CWs humaneness" (US Senate 1974). By the late 1980s, the Chemical Manufacturers Association actively supported the CWC because the industry was self-consciously avoiding a pro-CW image (after decades of criticism for its pollution record). Opening to international inspections was little threat to an industry already subject to heavy government inspections to enforce safety and pollution laws (US Senate 1989b) and for which the basic chemical processes were already well known (Official 2004a). The CMA remained concerned, however, about any treaty's ability to protect proprietary information and the direct costs to manufacturers of preparing for and hosting inspections (US Senate 1989b). The results for a test of H2 on the chemical industry are reported in Table 6.6. The coefficients are in the expected direction but, given the nature of the data for the dependent variable, not very significant. The results are interpreted as weakly supportive of H2.

What was true for the nuclear and chemical industries cannot be said for BW-relevant industries and this appears to help explain the absence of delegation for biological weapons nonproliferation. When Cohen and Boyer developed a laboratory technique in 1973 for splicing and cloning DNA, they started the biotechnology revolution that continues to grow and play a major economic role three decades later (Hughs 2001). Perhaps as important as sales growth is the reliance on long, risky and expensive research and development programs that make proprietary information the difference for these firms between life and death (Smithson 2004a).

Inspections in biological industries from food production to biotechnology and pharmaceuticals is focused on the safety of the workplace and of the end products made available to consumers. Industry is therefore heavily regulated but not monitored in ways useful to detecting diversions or dangerous intermediate products. For example, pharmaceutical firms bringing new drugs to the market must receive FDA approval but the FDA does not conduct the studies itself, relying instead on studies by private actors to prove their safety and claims. Therefore, while there is no variation in data on the dependent variable to test statistically against these data, the incredible acceleration of the biological industry (as well as the range of facilities that would have to be safeguarded) indicates the hypothesized curvilinear relationship exists: the biological weapons-relevant industries have been so valued relative to the perceived minor threat that the commercial risks were simply too great.

Conclusions

States seeking to cooperate on nuclear nonproliferation require information to design, monitor and enforce compliance with that bargain. Proliferation is a complex issue about which information is scarce and expensive to produce. The poor quality informational environment creates incentives for states to exploit informational agents – IOs or other states – as efficient sources of information.

However, states face two adverse phenomena. First, the interests of the informational agent may diverge from their principal's interests, creating a risk of search bias: when the evidence of proliferation is not overwhelming (and sometimes even then), the agent may offer advice that is not necessarily in the principal's interest. The result can be errors in enforcing nonproliferation agreements. Second, cooperation on nonproliferation requires transparency, which creates a risk that unintended information of commercial or national security value is revealed: a sovereignty cost. I argue states collectively delegate authority to IOs in order to produce and report information necessary to cooperate on nuclear nonproliferation. When design characteristics of an IO combine the autonomy necessary for expertise with the screening, monitoring, and correcting of IO agents, they are capable of lowering the risk of search bias and of sovereignty costs relative to the risks presented from monitoring by foreign governments.

I employ a multi-method analysis to provide evidence for the validity of my hypotheses. First, I utilize a study of Iraq's proliferation and then disarmament from 1970s-2004 as evidence of search bias. Analyzing the reported intelligence available to the US, UK, and international community regarding Iraqi NBCW activities during five historical periods, I find that political biases of the holders of information affected the interpretation and reporting of that information. The unbiased nature of NBCW IOs – the IAEA, UNSCOM and UNMOVIC – made their reports more trusted and, in the end, closer to the truth. The non-NBCW interests of the key UN Security Council states became a source of sovereignty costs for Iraq as these states opportunistically exploited disarmament efforts for gains on other issue dimensions. The increased delegation as the international community replaced UNSCOM with UNMOVIC reflected the use of delegation to reduce search bias and sovereignty costs.

Second, I analyze the differences between state preferences on NBCW issues and on other issues for quantitative evidence of a relationship between search bias and delegation. I find that when holding constant nonproliferation preferences, a larger "preference gap" (spatial distance between NBCW and non-NBCW preferences) creates incentives to delegate information production to IOs. Further, an increasing gap in preferences between the US and the rest of the world also makes others less likely to rely upon US information and more likely to rely on (delegate to) an IO.

Third, I analyze data on the nuclear, biological and chemical industries for evidence of a relationship between the risk of sovereignty costs from opportunism and delegation as a solution. The evidence, both statistical and historical, indicates that the sovereignty costs of participating in NBCW cartels are positively correlated with state interest in using IOs to monitor NBCW-relevant behavior. However, supporting the intuition that the relationship may be curvilinear, one reason BW delegation has not occurred is the overwhelming and increasing risk of valuable commercial information being compromised.

These findings are significant because they confirm IOs are important to catalyzing international cooperation not merely because they are efficient fora for bargaining or for producing information. IOs in the area of NBCW issues are delegated authorities from their state principal because they can produce information with less bias and less risk of opportunistic behavior by the informational agent. These findings have implications for future modifications to nonproliferation and disarmament regimes for nuclear, biological and chemical weapons as well as for the implementation of international bargains on other security and non-security issues.

Figures and Tables

Table 6.1: UNSCOM and UNMOVIC Delegation Measures

Category		UNSCOM		UNMOVIC
		1991	1997	2002
1. Agent Services	1a. Policy Info: Largely constructed its operating rules but no formal processes outside UNSC.	2	2	2
	1b. Private Info: Anywhere-anytime inspections equivalent to "special inspection" power.	5	5	5
	1d. Compliance: No compliance decisions but reports inconsistencies (using any information).	1	1	1
	1c. Enforcement: UNSC mandate but no enforcement powers.	0	0	0
2. Agent Resource Autonomy	2a. Staff autonomy: Staff largely seconded but only leadership required approval by UNSC.	0.5	0.5	3
	2b. Budget autonomy: Evolution from voluntary contributions to UNSC quasi-taxation of Iraq.	1	3	3
	2c. Size of staffing	1.93	2.20	1.79
	2d. Size of budget	0	.74	-.05
3. Management Autonomy: Major policy decisions require consensus among permanent UNSC members		0	0	0
4. Obligation		4	4	4
	Total:	**15.43**	**18.45**	**19.74**

Notes: Measures are described in Chapter 2. Full study is available from the author.

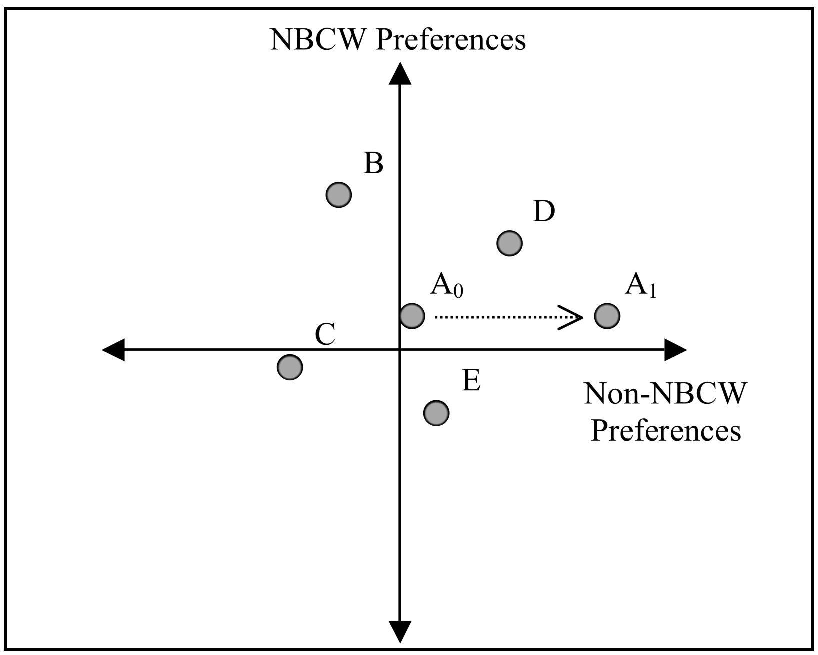


Figure 6.1: Preference Gap Illustration

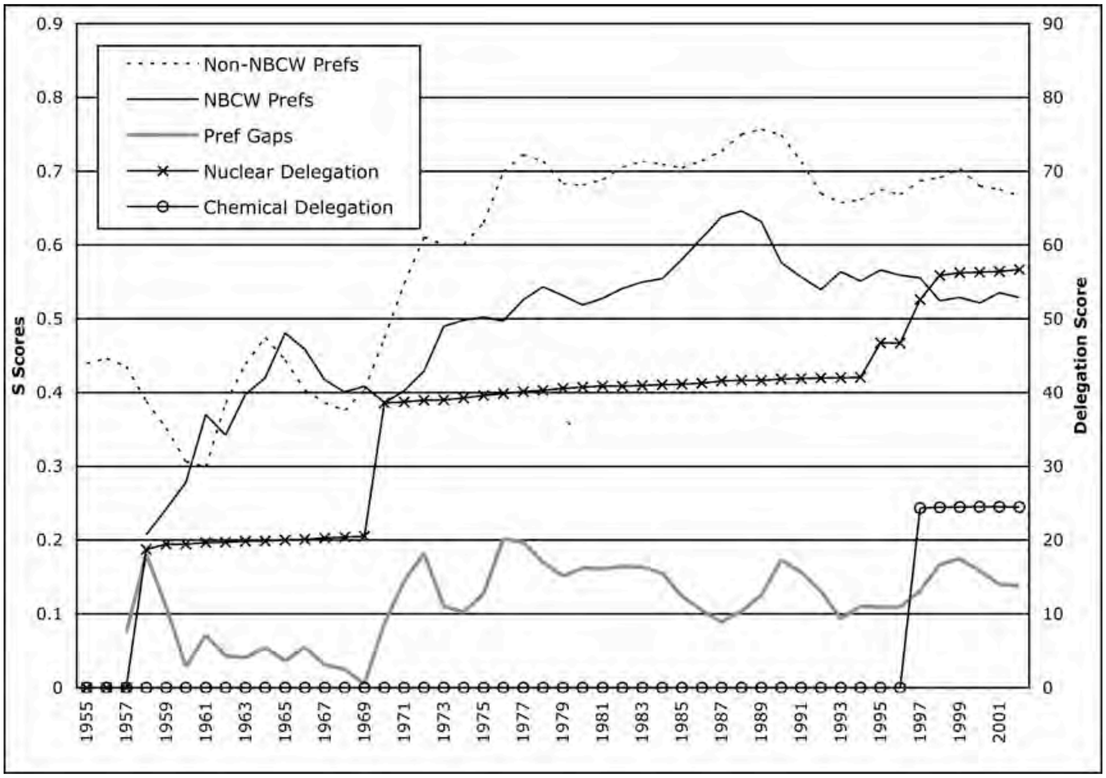


Figure 6.2: NBCW Preferences, Non-NBCW Preferences, and Preference Gaps

Table 6.2: Preference Gaps and Nuclear Delegation (absolute difference of NBCW and non-NBCW-preferences)

	NBCW Capability Weighting		NW Capability Weighting	
Preference Gap				
1-Year Lag (t-1)	14.39***	-6.16	18.74***	18.75**
	(3.76)	(8.85)	(4.29)	(7.41)
2-Year Lag (t-2)		4.80		4.00
		(10.13)		(6.95)
3-Year Lag (t-3)		5.88		2.21
		(9.76)		(6.43)
4-Year Lag (t-4)		19.72*		12.16*
		(9.30)		(6.96)
Distributed Effect of Preference Gap	14.39	24.24	18.74	37.12
NW Threats		56.263***		22.82*
		(14.239)		(12.37)
NBCW Preferences		3.477***		2.70***
		(0.691)		(0.621)
Constant	41.94***	5.32	42.40***	18.03***
	(2.03)	(8.57)	(1.95)	(6.19)
Adj. R^2	0.259	0.622	0.317	0.722
N	40	30	40	30

Note: † $p<0.1$, * $p<0.05$, ** $p<0.01$, *** $p<0.001$, Standard Errors in parentheses

Table 6.3: Preference Gaps and CW Delegation (absolute difference between NBCW and non-NBCW-preferences)

	No Weighting		NBCW Weighting	
Preference Gap				
Lag 1	4.10	5.56	2.79	31.99
	(21.65)	(39.08)	(27.05)	(44.51)
Lag 2		-14.15		29.60
		(41.74)		(40.69)
Lag 3		-14.28		23.48
		(35.11)		(37.81)
Distributed Effect of Pref Gap	4.10	-22.87	2.79	85.07
CW Threats		9.01		9.07
		(66.01)		(57.19)
NBCW Prefs		-11.80		11.49
		(28.15)		(19.57)
Constant	2.47	12.46	2.54	-11.51
	(3.32)	(18.86)	(2.67)	(15.32)
R^2	-0.02	-0.18	-0.02	-0.10
N	42	28	46	34

Note: † p<0.1, * p<0.05, ** p<0.01, *** p<0.001, Standard Errors in parentheses

Table 6.4: Absolute difference in NBCW preferences between the United States and all others

	NW Delegation (No Weighting)		CW Delegation (CBW Weighting)		
Preference Gap: US-ROW					
Lag 1	29.93*	3.31	8.01	34.41†	21.92
	(11.20)	(13.66)	(5.80)	(18.80)	(20.07)
Lag 2		-10.88		-19.55	-21.76
		(12.33)		(26.71)	(27.98)
Lag 3		-17.40		-12.65	-0.80
		(11.55)		(19.52)	(20.93)
Lag 4		21.08			
		(15.90)			
Distributed Effect of Pref Gap	29.93	14.56	8.01	2.21	-0.64
NBCW Prefs		36.51†			13.40
		(20.43)			(49.01)
Nuclear Threats		4.88***			1.72
		(0.87)			(23.05)
Constant	30.67***	6.84	0.83	2.41	0.46
	(3.35)	(9.77)	(1.84)	(2.61)	(12.29)
Adj. R^2	0.16	0.70	0.02	0.02	-0.12
N	33	21	46	36	34

Note: † p<0.1, * p<0.05, ** p<0.01, *** p<0.001, Standard Errors in parentheses

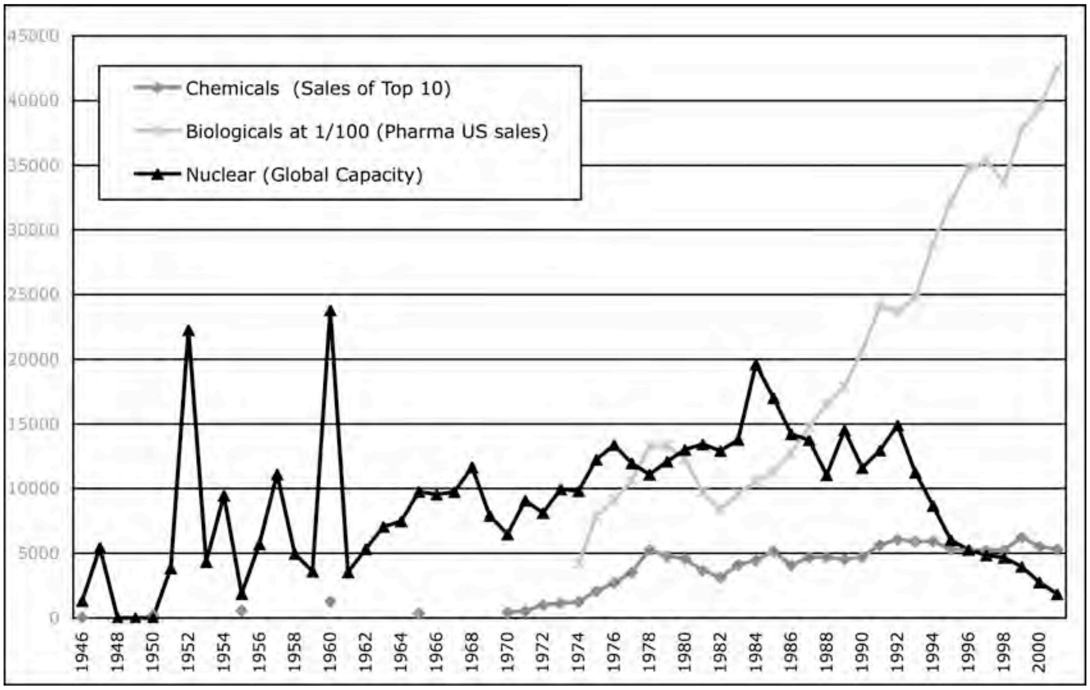


Figure 6.3: Sovereignty Costs Interaction Term: Industry Size * Patent Share

Table 6.5: Sovereignty costs and nuclear delegation: Interaction between nuclear industry size and technological change

	Share of Patents X # of Facilities		Share of Patents X Capacity of Facilities	
Sovereignty Costs				
Lag 1	1.14	0.24	0.001	0.0001
	(1.85)	(1.50)	(0.000)	(0.0003)
Lag 2		-1.39		-0.0004
		(1.71)		(0.0003)
Lag 3		0.67		0.0003
		(1.52)		(0.0003)
Distributed Effect of Sov'ty Costs	1.14	-0.48	0.001	0.000
Nuclear Threats		4.803***		4.808***
		(0.964)		(0.953)
NBCW Prefs		64.033***		62.908***
		(14.789)		(14.325)
Constant	28.696***	-8.508	25.721***	-8.795
	(4.582)	(5.725)	(4.773)	(5.705)
R^2	-0.011	0.641	0.012	0.649
N	56	45	56	45

Note: † p<0.1, * p<0.05, ** p<0.01, *** p<0.001, Standard Errors in parentheses; simple interaction terms: y=(x1 * x2)

Table 6.6: Sovereignty costs and chemical delegation: Interaction between chemical industry size and technological change

	Share of Patents x Sales of Top 50 Chemical Firms		Share of Patents x Sales of PhRMA Firms	
Sovereignty Costs				
Lag 1	2.11†	1.40	0.004	0.006
	(1.11)	(1.19)	(0.006)	(0.007)
Lag 2	-0.66	-2.76	0.001	0.002
	(1.82)	(2.61)	(0.012)	(0.013)
Lag 3	0.82	3.74	0.002	-0.000
	(1.52)	(2.33)	(0.008)	(0.012)
Distributed Effect of Sov'ty Costs	2.27	2.37	.007	.008
CW Threats		11.79		6.59
		(52.13)		(44.52)
NBCW Prefs		-78.11†		-46.32
		(39.33)		(29.56)
Constant	-10.55	31.23	-6.421*	17.60
	(5.77)	(22.67)	(2.801)	(17.95)
R^2	0.29	0.11	0.519	0.36
N	29	27	30	28

Note: † p<0.1, * p<0.05, ** p<0.01, *** p<0.001, Standard Errors in parentheses; simple interaction terms: y=(x1 * x2)

Chapter 7: The Enforcement Powers of International Agents

States face economic and security incentives to proliferate NBCWs. However, they recognize preventing and rolling back proliferation is a public good with wide-ranging security benefits. Nonproliferation strategies for NBCWs are essentially cartels that attempt to raise the costs to states of acquiring NBCW capabilities. NBCW cartels are often implemented through international institutions and IOs.

The literature on international institutions argues they can facilitate cooperation by reducing transaction costs and removing information asymmetries (Keohane 1984). That is, they enhance compliance with bargains by enabling states to negotiate bargains made better because they more fully account for the interests of the participating states. As self-enforcing as such bargains may be designed to be, we know states sometimes ratify (or otherwise commit) with the intention to defect or their interests change and make defection more attractive. Cooperation is difficult to enforce when defection does not automatically end the benefit stream or the benefits are inherently not excludable. States have the option of directly punishing defectors but choosing to enforce an international contract can be very costly to a state.

IOs facilitate cooperation by reducing the cost of contract design and implementation by producing information about the policy area and state behavior (Chapter 6 and 7). This informational role can improve compliance with international agreements. The theoretical expectation of most IR scholars, however, is that IOs have no autonomous effects upon enforcement because the literature assumes IOs do not trade, cannot tax, and are unable to conscript militaries. IOs, they argue, cannot "use force" and therefore any enforcement authorities are purely normative, relying on third-party enforcement.

States should delegate enforcement powers to IOs if this increases the probability that states will be compliant with NBCW nonproliferation bargains because they face greater costs for defecting from agreements. I argue IOs, as agents of their state principals, may also be able to reduce the cost of contract enforcement if they can suffer and impose costs on their behalf. I demonstrate that IOs directly defray the costs to states of enforcing a NBCW cartel by absorbing costs of calling for enforcement or by possessing the resources independent of their state principals in which to apply towards directly imposing costs upon violators. This chapter explores enforcement of international agreements through international organizations by articulating their role relative to national enforcement, describing their limited but real enforcement authorities, and exploring this authority in practice in two cases of the enforcement of international NBCW agreements.

IR Theory, Institutions and Enforcement

IR theory has long had a problematic time explaining the ability of states to cooperate, much less their decisions to enforce their agreements. Chayes and Chayes (1993), for example, argue that states comply with agreements because it is in their interest to do so (otherwise, why did they sign?) and are observed breaking their international commitments because of a failure of the agreement itself to be sufficiently specific, because compliance is somehow out of the state's power, or because domestic implementation has simply not been able to occur. If this is the case, then writing better agreements rather than negotiating stronger punishment mechanisms improves compliance.

The conflict literature focuses instead on the distance between the actors' ideal points and the power they have to force each other to change their policies. The Realist approach is a stripped down version of this model because international institutions are generally viewed as creations of the most powerful states and persist only as long as the most powerful states are able to coerce compliance (Mearsheimer 1994). As a result, the policy (distribution of gains) produced by international cooperation is going to reflect the distribution of power at its creation (Krasner 1991). This assumes a direct correlation between national power (itself an underspecified concept) and the ability to impose and suffer costs (a false conflation, see: Powell 1999). This also assumes that the institutions themselves will have no independent effect upon state power and have no ability to change the distribution of gains (Strange 1983). New Institutionalists accept most of the core assumptions of Realists regarding the world, with the difference that international institutions can assist cooperation by providing forums for resolving the distributional effects of enforcement actions (Morrow 1994). Through international institutions, states can agree in advance what behaviors should be punished and can even agree on processes and measures in advance to facilitate overcoming the second-order cooperation problem of implementing enforcement (Abbot and Snidal 1998).

Even those most accepting of the independence of IOs from their state principals, however, do not view these IOs as possessing autonomous enforcement powers. The primary mechanism by which IOs "enforce" agreements is by shaming the target and legitimizing retaliatory behavior (Alter 2008). One example of which is the World Trade

Organization, which has been delegated the authority to adjudicate among parties to a trade dispute and can authorize retaliation proportional to the harm inflicted by the offending party (Cortell and Peterson 2006). To avoid the need for enforcement, states try to structure agreements to account for the participating states' interests and thereby be self-enforcing (Martin and Simmons 1999).

Still, whenever states select a policy bargain, they consider the problem of enforcing compliance if the commitment devices may not be sufficient to make the bargain self-enforcing (Fearon 1998). States face incentives to misrepresent their interests, their interests change, or the strategic environment changes to make alternative strategies more attractive. The threat or use of sanctions of various kinds may be necessary to align the negotiating parties' incentives towards contract fulfillment. Enforcement occurs to compel a change in behavior: the threat or imposition of costs by a "sender" to a "target" to realign the target's interests such that it wishes to return to compliance (Martin 1992a).[163] Enforcement, though, is a process. It requires an individual or collective actor to determine a violation of expectations has occurred, decide upon an appropriate punishment mechanism that will be (probabilistically) useful to bring the violator back into compliance, and then implement that punishment. This is the familiar realm of power politics where states appear not to hesitate to use their power and influence for enforcement, or to press others to support enforcement, whenever it is beneficial to do so (Martin 1992a).

[163] Enforcement may occur also as a signal to domestic audiences or to other, future possible violators abroad (Baldwin 1985)

It is common to treat enforcement in IR as a Prisoners' Dilemma game in which the threat of future reciprocal defection from cooperation is a useful strategy for preventing present defection (Axelrod and Keohane 1986). Counter- and non-proliferation strategies against NBCWs are certainly a collective action problem: production requires the positive contribution of many actors. However, rather than being an n-player prisoners' dilemma game, it is a public goods provision problem because just as one state's enjoyment of nonproliferation does not reduce its value to others, those who shirk cannot be excluded from enjoying its benefits. Even more specifically, nonproliferation is a common pool resource problem because enforcement is time sensitive.[164] While a one-time defection on a trade agreement produces a one-time gain for the violator, a single defection from a nonproliferation agreement produces effects that are very costly to verifiably remediate.[165] As a result, states seeking to raise the probability that enforcement occurs could benefit from enforcement being initiated closer to the detection of noncompliance. Enforcing nonproliferation agreements therefore requires complex punishment strategies and is time-sensitive.

Collective Enforcement of Collective Action

Unilateral enforcement is procedurally simple because states are internally organized to judge the behavior of others, select a course of strategy, and implement that strategy, including the use of economic sanctions or military violence. Implementing enforcement unilaterally, though, is politically and financially costly. Proposing

---

[164] Common pool resources are increasingly degraded over time until proper management reverses this decline. Delays result in long-term harm and further the contraction of the Pareto frontier (Ostrom 1990).

[165] In fact, a common assumption of the nuclear arms control literature is that the nuclear genie can never be put back in the bottle.

collective enforcement to others is costly because an actor must provide evidence of noncompliance and make a public accusation. Leaders offering such proposals may find it necessary to reveal information about the violator that damages past investments in information. Implementation requires an agreement on the costs to be imposed on the target, which is usually also costly to the sender. Proposing and implementing enforcement risks domestic electoral punishment for the leader and international retaliation for the state. Because enforcement is costly, and because state leaders must weigh nonproliferation goals against other competing domestic and international interests, states are likely to delay or reject enforcement of nonproliferation norms and agreements that they otherwise support.

Multilateral enforcement may require a compromise over outcomes, but can reduce the cost to individual states of achieving an outcome if it distributes the costs to others and/or imposes costs more efficiently. However, multilateral enforcement does not occur spontaneously. Enforcement presents a second-order collective action problem: having agreed in principle upon a bargain and standards for behavior, punishing noncompliance must still be proposed or negotiated and then implemented.

I argue IOs can reduce the costs to states of proposing and implementing enforcement. Decisions to delegate sanctioning power to an international organization, however, occur in advance of specific noncompliance episodes: potential senders of sanctions decided to alter the probability of enforcement prior to particular sanctioning events. Delegation of enforcement authorities therefore represents a strategic calculation based on probabilities of noncompliance occurring, the ability of an agent to suffer costs and impose costs upon a defector, and of that agent choosing to utilize its enforcement authorities.[166]

Calling for Enforcement: IOs as Agenda Setters

Threatening to impose costs before doing so allows a sender to inform the target of its interest in the target changing its behavior. If credible, a threat starts a bargaining game that seeks to change the status quo without requiring the sender to pay the costs of actually implementing punishments. Senders may also use public threats to put a proposal before the community of potential senders for multilateral or collective enforcement. In a collective principal, such as in many international institutions that lack bureaucracies, proposals for enforcement must originate with individual states within the collective principal. The UN Charter, for example, provides standing for placing items on the agenda of the UN Security Council to all recognized states (UN 1945:VI,Art.35). Established processes can reduce the transaction costs to proposing multilateral action (Haggard and Simmons 1987), but individual states often remain the source of calls for enforcement.

IOs with access to credible sources of information and the independence and expertise to objectively evaluate this information can be a source of valuable advice. An informational agent capable of raising questions or make a legal decision about compliance can serve as a "trigger" for enforcement by setting the agenda on considering violations by a state. This delegation occurs when the agent may place proposals for

[166] Delegation of nonspecific enforcement authorities therefore contrasts with Thompson's concern with the conditions under which states, through the UN Security Council, delegate enforcement authority to the United States for a particular threat to international security (Thompson 2006a).

enforcement before its principal. For example, the secretariats of the IAEA and OPCW may place items on the agenda of their respective executive bodies if they have concerns about compliance with their respective international agreements. These executive bodies, themselves agents of their collective principals (see Chapter 1), may then act to compel compliance but may also place their concerns before the UN General Assembly (the IAEA also before the UN Security Council). The Director General of the IAEA may choose to send his reports directly to the UNGA or UNSC, enabling enforcement without positive action by the Board.

An agent with enforcement trigger authorities can force the IO's principals to consider enforcement questions and either pursue or reject enforcement. This authority has an effect upon state behavior because states delegating the power to call for enforcement must agree at some point upon what behaviors should trigger enforcement and then tie their hands on specific future calls for enforcement. Therefore:

> *H1: If an IO is already an informational agent, then it is likely to be delegated the authority to call for enforcement.*

As expertise is a necessary condition for evaluating compliance, the basic intuition is that if an IO has expertise, it is more likely to be delegated authority to set the enforcement agenda with public consideration or judging of compliance.

However, questions may remain about the effect of this delegation if, as the literature often portrays, IOs do not have independent effects upon behavior because they are controlled by the most powerful states. If IOs have the enforcement capacity to affect behavior independent of their principals, we would expect to observe this in the timing of proposals for enforcement and in strategic behavior by the targets and other potential senders.

First, if states control their agents, we would expect to observe agent actions – such as proposals for enforcement – only occur when they would be in the interest of the most powerful states. However, if IOs have independent effects and their actions are not dictated by the most powerful states, then states will also not control the timing of proposals for enforcement. The null hypotheses – IOs do not have independent effects because states control their behavior – can be restated as a positive hypothesis:

> *H2a: If principals are unable to prevent proposals for IO enforcement from occurring at inopportune times, then IOs have independent effects upon state behavior.*

There are reasons why we would expect agents to pursue enforcement even though the specific timing may be bad for the greatest sources of enforcement action. Whereas states can dissemble regarding what evidence they possess and when they possess it, IOs with fixed, narrow and public interests (Chapter 5 and 6) are more constrained: inspectors have fewer opportunities to acquire information and the timing of these events is often publicly observable (inspections). By design, formal rules and actual behavior both stress the automatic way the secretariat's directors are supposed to transmit their inspectors' reports, bypassing political actors. Inspectors are aware that choosing to make an accusation may incur the wrath of those who would prefer calls for enforcement be delayed or squelched. However, withholding such a report would create broader doubts about the agent's capability to fulfill its mission. Even if states were to attempt to suppress reports, as we shall see in the study below, IOs also suffer from a degree of permeability that allows transparency into when inspectors have serious questions and prevents political pressures from burying unpalatable reports. Therefore, IO enforcement proposals will not be correlated with the interests of states that could make enforcement more likely.

Second, if states anticipate enforcement proposals will have independent effects, this should result in strategic behavior by both the agent and the potential targets of enforcement. While agents are more constrained than states, they possess autonomy that allows for strategic behavior that facilitates returning states to compliance. Rather than immediately reporting initial findings, IOs may return to the target seeking additional information. The OPCW and IAEA may ask the target to explain inconsistencies between declarations and data, for example, and the IAEA may also schedule additional inspections seeking its own answers. If the authority of the IO to call for enforcement is real power – states anticipate it to lead to real costs – we should observe bargaining between targets and the IO to precede proposals for enforcement. This is a sign of the power of their authority, not their weakness:

> *H2b: If the autonomous enforcement trigger authority of an IO has an independent effect upon state behavior, then the IO can more easily engage targets in internal reviews of compliance questions.*

Some states argue this allows politics to intrude upon what should be a purely technical consideration. However, from the perspective of the collective principal, autonomy can be deployed specifically to avoid enforcement of false positives and of "accidental noncompliance" (Chayes and Chayes 1993). For example, IO officials state in interviews that small countries may not file required declarations because they don't know they are supposed to or lack the capacity to prepare them. This occurred with NPT states that had previously been exempted from declarations because they had no significant nuclear activities and were asked to sign the IAEA Additional Protocol, which requires additional reporting (Official 2005b). It is therefore advantageous to the principals when the agent can identify cases of possible noncompliance and take proactive steps to resolve its questions without triggering a formal compliance review.

Third, it is theorized that state leaders who make commitments suffer costs from domestic audiences. Audience costs are partly costs a leader pays to get the domestic electorate to pay attention to an issue, much as a commercial firm purchases advertising time on television. The leader may also be punished by the electorate after policy failures through declining support for their policy agenda and for re-election (Schultz 1999). These costs create incentives for leaders to be discriminating when they make proposals. States may also signal to each other that their preferences over outcomes are more extreme than previously suspected, reducing the value to others of future proposals.

IOs can, and do, suffer costs from errors in proposing enforcement: leaders are replaced, the rules and procedures governing the IO are revised, and the resources may be restricted or otherwise redirected. For example, the first Director-General of the Organization for the Prohibition of Chemical Weapons (OPCW) was removed from his post by the Executive Council for financial mismanagement (Official 2005d) and the subsequent Director-General found his powers substantially constrained.[167] In short, the IO will experience recontracting with its principals but are rarely destroyed.[168] This makes it costly for IOs to propose enforcement. IOs are valuable as agenda setters for

[167] After pushing for the replacement, the US increased its contributions to demonstrate its actions were not intended to weaken the institution (Senate 2004).
[168] States may seek to unilaterally recontract with the agent by withdrawing from the IO, such as North Korea did with the NPT.

enforcement when this allows states to strategically avoid the domestic and international audience costs of making such proposals.

> *H2c: If an IO has enforcement trigger authority and has jurisdiction over a noncompliance event, then proposals for enforcement will come from within the IO.*

The intuition, in short, is that if IOs can pay the costs to propose enforcement, states should alter their behavior to avoid the costs of proposals when they can, e.g., when they believe another actor will bear that cost instead.

Implementing Enforcement: Private, Public and Competitive

Within domestic politics, enforcement is "private" to the extent that private actors are empowered to directly pursue and benefit from the enforcement of contracts. In the United States, this commonly includes the right to sue in civil courts for damages, of self-defense, or of whistle-blowers to receive a portion of the fine imposed on the violators they expose (Polinsky 1980). Private enforcement is possible when private (non-governmental) actors are able to identify wrongdoing and determine the cost of enforcement is less than the benefit. Reliance on private enforcement can result in low levels of enforcement when individual rewards are trivial. For example, rules in the US facilitate class action lawsuits to create incentives for trial lawyers to overcome the diffuse costs of violations against consumers which produce concentrated benefits for producers. Private enforcement at the domestic level is usually limited to calls for enforcement; through under some circumstances – notably self-defense – individuals are empowered to directly enforce social contracts. At the international level, behavior is usually regulated through private enforcement: retaliatory defection or the direct application of diplomatic, economic or military pressure against a target.

Alternatively, purely public enforcement occurs domestically when government actors have the exclusive authority to apprehend, prosecute, judge, and punish contract violators (violators of social contracts are often called "criminals").[169] Public enforcement is attractive when society judges private enforcement would result in socially unacceptable levels of enforcement, types of enforcement (it may be undesirable to ask or allow private actors to use force), or undue exposure of private actors to retaliation or retribution (Polinsky and Shavell 2006). Public enforcement can be said to exist at the international level when a supranational or international agent possesses any of these rights. There are growing numbers of international (ICJ, ICC) and regional courts (ECJ) that *adjudicate* claims though they lack autonomous enforcement powers.[170] Reliance on public enforcement may reduce many negative externalities but also may ignore the possible contributions of private actors.

To overcome their individual weaknesses, many domestic polities provide for competitive enforcement by exposing violators to both private and public law enforcement. There are numerous areas of law in which victims may sue for civil damages independently of governmental decisions to prosecute for criminal activity: environmental damage, commercial contracts and even violent crime.[171] Competitive enforcement can increase the probability of enforcement by recognizing that private

[169] The government is the agent of a collective principal: the nation's citizens or electorate.
[170] By this definition, even many domestic courts lack enforcement power because they rely upon police and prison officials to enforce their rules. For example, note the conflict in Los Angeles between municipals judges and the Sheriffs Department over the length of sentences for celebrities such as Paris Hilton and Nichole Ritchie. In the case of the former, the judge argued his sentencing orders had been disregarded and in the latter the Sheriff negotiated the sentence in advance with the judge.
[171] O.J. Simpson was found not guilty of the murder of his wife but still liable for damages to her family.

principals and public agents may each be better at detecting different contract violations. For example, private individuals more easily detect some violations of environmental laws than others.

There is a second, intermediate type of enforcement: "quasi-public" enforcement occurs at the domestic level when the government may require private individuals to enforce social contracts, such as mandating that landlords or employers enforce immigration laws. At the international level, quasi-public enforcement occurs when public actors (international agents) may authorize or require private third parties to sanction violators. The WTO, as discussed above, extends its adjudication power by authorizing victims of illegal trade practices to use retaliatory trade sanctions. An IO may also be designed to require third parties to a dispute to impose costs on its behalf. For example, UN Security Council Resolution #418 (1977) decreed an embargo upon arms sales to South Africa considered mandatory for all UN states (Hufbauer, Schott, and Elliot 1990). Quasi-public enforcement presents a secondary enforcement problem but reduces enforcement costs by employing an IO to first provide a trigger and then overcome the coordination problems in selecting a punishment strategy.

These distinctions are useful, first, because the costs of proposing and implementing enforcement are distributed differently. The costs to propose enforcement are borne by private individuals in private enforcement but are distributed across the population in public and quasi-public enforcement. Alternatively, the costs of implementing enforcement are distributed across the population in public enforcement but are suffered by individuals participating in private and quasi-public enforcement. Second, competitive models allow the probability and severity of public and private enforcement to be independently manipulated to produce the desired deterrent effect.[172] The anarchic nature of international politics creates the concern that the probability of private enforcement will be too low to ensure quasi-voluntary compliance with international social contracts (Levi 1988). After all, like domestic private actors, states must determine the probable costs of enforcement are outweighed by their individual returns. Theoretically, however, if there is a fixed probability that private actors (states) will punish noncompliance, the addition of a public actor (an IO agent) with an independent and positive probability of punishing increases the probability that the violators is punished.[173]

While all IOs are characterized by bureaucracies that provide services to their principals, not all IOs possess enforcement powers. The delegation of enforcement implementation requires an agent to have autonomous enforcement powers. This requires delegation by the collective principal to some level of its agent – the executive body or the secretariat – of the authority and capacity to impose costs without the express contribution or consent by the collective or individual principals.[174] Most IOs can impose

---

[172] The deterrence goal is familiar to many IR scholars: crime may be reduced or even eliminated as the probability increases that severe punishments will be imposed upon violating actors (Garoupa 1997). Of course, in domestic law enforcement the balance of the cost of enforcement lies in apprehension and prosecution of criminals whereas the act of punishment itself is treated as a costless transfer of a fine (the economic assumption of indifference between monetary fines, imprisonment and corporal punishment). In international politics, the costs are reversed: talk is cheap and violence is costly.

[173] This is an elementary exercise in probability: If the probability that actor A will detect and punish noncompliance (*N*) or not detect and enforce noncompliance (report compliance or *C*) are each 50% ($Pr(N_A)= 0.5$, $Pr(C_A)= 0.5$) and the probabilities for actor B are the same ($Pr(N_B)= 0.5$, $Pr(C_B)= 0.5$), then the likelihood of either A or B enforcing is 75% ($Pr(N_AC_B, C_AN_B, N_AN_B)= 0.75$) and the probability neither will detect and enforce noncompliance is only 25% ($Pr(C_AC_B,)= 0.25$).

[174] The distinction made in Chapter 1 is again important: executive boards, such as the IAEA's Board of Governors, are comprised of some sub-set of the individual principals and are

at least low-level costs by denying membership benefits that are conditional upon compliance with the organization. If international institutions are valuable to states for their ability to reduce transaction costs, "reciprocal defection" by the agent should be a real cost. Perhaps more importantly, these states experience reduced capacity to affect future institutional outcomes. For example, states not in good standing with the OPCW may not request challenge inspections of others Parties and are not entitled to assistance in the event they become a target of a CW attack. This suggests that delegation for enforcement should be more likely if participation is its own reward for states. Therefore:

> *H3a: If IO participation is beneficial, and exclusion is costly, then delegation of enforcement implementation authority is more likely.*

Most assume only states can enforce because only actors engaged in economic activity have the ability to impose economic sanctions and only those actors with militaries can threaten or use coercive violence. This assumption is empirically false, however. The IMF can deny loans (an excludable or private good) to states judged to not be properly contributing to international monetary stability (a nonexcludable, public good, see: Barkin 2004). Similarly, the IAEA provides technical assistance in a variety of nuclear technology-related projects, from aid in nuclear energy projects to medical applications of nuclear technology. A military or paramilitary force could be added to an IOs repertoire if such a strategy appeared both useful and necessary to the state principals. The UN Charter, for example, provides for, but has never pursued, calling its own military forces (UN 1945: Chapter 7 Art. 43.1).

---

empowered to make decisions which are binding upon all principals even though they may prefer otherwise.

While an international agent can distribute the costs among the wider population, the cost of enforcement can also be reduced if enforcement actions are more efficient. Sanctions that target specific populations within a state may be more successful because those groups lobby their governments for change (Martin 1992a). IO enforcement may be more efficient when it possesses the resources or authority to target those sub-state actors who benefit most from violating the collective bargain. IMF bailouts protect the national (and international) economy without punishing particular stakeholders whereas states that violate the CWC see the direct punishment of CW producers and chemical-dependent industries through international controls against international chemical trade. Some treaties also require national legislation making treaty proscriptions a domestic criminal matter. Holding individuals criminally liable may increase some enforcement costs (apprehension and adjudication of an individual rather than holding the state government responsible) but lowers other costs (trial and punishment of an individual is cheaper than the costs of broad sanctions or military action).

An international agent, therefore, is more likely to be delegated enforcement implementation powers when it controls an excludable resource or an independent coercive capacity. Enforcement become more likely because the international agent absorbs the costs, and distributes them among the principals, without receiving their express consent or subjecting them to the distributional effects of private or quasi-private enforcement:

> *H3b: If an IO possesses the capacity to suffer costs or impose costs upon a target, delegation of enforcement authority is more likely.*

In reality, the probabilities are not fully independent. As with enforcement triggers, public IO agents and private state actors may each behave strategically in selecting proliferation cases for enforcement, but the ability of public agents to do so can be limited. The selective delegation of enforcement is a strategic choice in contracting with its enforcement agent. Just as private and public actors in the domestic context may each be suited to enforcing different violations of environmental laws, states recognize that they may face a harder time coping with minor but corrosive violations of international agreements because of questions about proportionality or threats to national pride.

IO enforcement may alter a violator's perceptions of the cost and benefits of noncompliance but also avoid escalation to socially inefficient levels of punishment. When senders impose low-level enforcement actions, they risk failure leading to greater levels of enforcement as states try to avoid failure and "gamble for resurrection" (Downs and Rocke 1995). Targets may similarly attempt to avoid domestic costs of policy failure by making recalcitrance an issue of national prestige. IOs limited practically to low-cost punishment strategies may avoid the escalating trap suffered by more resourceful actors of escalation to socially inefficient punishment levels.

> *H3c: Public and quasi-public enforcement actions should be less likely to escalate crises over noncompliance.*

Methodology

The hypotheses predict delegation to IOs for enforcement if IOs absorb or diffuse costs or can target costs more efficiently, reducing the costs to principals of proposing or implementing enforcement of international contracts. However, the expectation is not that

IOs will be able to unilaterally enforce nonproliferation agreements. First, no state can unilaterally enforce such agreements and every nonproliferation “success” has required concerted effort. Second, delegation to IOs for nonproliferation enforcement occurs with the expectation that national efforts will supplement international efforts (or vice versa). That is, provisions for international enforcement of nonproliferation do not exclude or preclude national efforts. Instead, it is expected that national efforts at enforcement will occur. Therefore, the appropriate standard for evaluating the enforcement power of IOs is to analyze not how IOs produce effective enforcement, but how the presence of delegation for enforcement reduces and/or redistributes the cost of enforcement.

The goal in enforcing nonproliferation is not to punish the target but to return the target to compliance and prevent proliferation. An effective enforcement regime will affect state’s calculations of their interests and reduce noncompliance below levels that would be observed with the same agreement without the enforcement provisions. International enforcement, especially private, is costly to the sender and target so is only likely to be observed when returning a target to compliance is not too costly but the target doubts the sender’s willingness to incur these costs. As a result, it is difficult to know when actors were weakly interested in proliferating but did not because they viewed enforcement as too likely and too costly. Further, states strongly interested in proliferating can simply not agree to be bound by the nonproliferation regimes.

To cope with selection effects, I have therefore identified two, similar cases for observation. Each case has twice been the target of enforcement of nonproliferation norms and rules. These two cases present the possibility of a quasi-experimental approach: two groups are examined before and after a “treatment” and the effects upon each group can be compared in the pre- and post-treatment worlds. The two selected cases are the Democratic People's Republic of Korea (DPRK, or North Korea) and the Republic of Korea (ROK, or South Korea).

The single experimental treatment is ratification of the NPT and IAEA full-scope safeguards. North and South Korea both joined the IAEA, ratified the NPT, and signed full-scope safeguards agreements with the IAEA sufficiently after the NPT's entry into force that bureaucratic or domestic political inertia cannot explain the delay. Prior to imposition of this "treatment", both states were suspected of pursuing a nuclear weapons program and their joining the NPT was to be a costly signal that their interests were otherwise. Both cases also demonstrated noncompliance with their international nonproliferation commitments after making these commitments.

The similarity of the two groups permits some ability to control for variables that may correlate with delegation of enforcement or the causal variables. In addition to a shared history and culture, the primary set of interested third-party states is the same: China, Japan, Russia and the US. Though there is some variation in these variables over time, this also controls for the international and regional balance of power because the same major states are involved and they share an aversion to North or South Korea acquiring nuclear weapons. Throughout the time period of the analysis, proliferation by either would have sufficiently similar regional repercussions that the other regional players would not experience significantly different distributional effects from allowing either to proliferate. Still, there is a remaining threat to internal validity from history as the end of the Cold War also intervenes between the pre- and post-test observations; I attempt to account for changes from the end of the Cold War in my discussion.

Enforcement of nuclear nonproliferation on the Korean Peninsula

I take the observations in chronological order: ROK pre-treatment, DPRK pre-treatment, DPRK post-treatment, and conclude with ROK post-treatment.

Pre-Treatment Observation: The Korean Peninsula Without the NPT

The ROK: 1960s-1970s

The ROK signed an IAEA safeguards agreement for its first commercial nuclear power reactor during its construction in 1970.[175] However, without having ratified the NPT (and without a Nuclear Suppliers Group yet formed to require them) the level of safeguards expected were low and piecemeal (INFCIRC/66 rather than the INFCIRC/153 full-scope safeguards). When broader international events heightened its sense of insecurity, ROK President Park Chung Hee initiated a secret nuclear weapons program in 1973 (Kang et al. 2005).[176] The ROK had a nuclear energy program but opened negotiations with Canada for a CANDU reactor and with France for a reprocessing facility because it lacked the national capabilities to acquire weapons-grade fissile materials.[177]

Only in the aftermath of India's April 1974 nuclear test, facilitated by its earlier acquisition of a CANDU reactor, did the US become concerned about the proliferation

---

[175] The ROK joined the IAEA at its formation in 1957, but this does not itself convey obligations.
[176] US President Richard M. Nixon's 1969 Guam Doctrine, calling for US allies to become more self-reliant for their security because of US problems in Vietnam, triggered growing ROK insecurity in the aftermath of recent DPRK threats. This insecurity was only heightened when the US withdrew the Seventh Infantry Division from the ROK and opened relations with China in 1971-1972.
[177] CANDU reactors do not need to be shutdown to replace their fuel supply. This permits easier diversion of spent fuel for reprocessing to extract the plutonium created.

potential of a number of countries, including the ROK.[178] Given the low level of IAEA safeguards, the IAEA was a poor informational agent and therefore could not identify noncompliance and therefore could not call for enforcement (H1). About three months after the India test, the US CIA was able to recruit an ROK nuclear physicist and learn of the secret weapons program (Pollack and Reiss 2004:262).

Once independent US efforts had identified the program, it quickly moved to prevent the ROK from acquiring nuclear weapons with a two-prong strategy. First, the US pressured major ROK nuclear suppliers – particularly France, Canada and Belgium – to terminate any nuclear technology transfers to the ROK. This required an intensive diplomatic effort, one that within months was repeated over European supply contracts for Brazil.

Second, the US pressed the ROK directly to sign the NPT and a full-scope IAEA safeguards agreement by threatening to end bilateral nuclear cooperation, but also to disrupt the broader US-ROK relationship. In addition to technical assistance for the construction of nuclear power plants, the US had provided a $98.6m loan from the Export-Import Bank (NTI 2004c). Then-US Ambassador Richard Sneider conveyed the threat, "If the [ROK Government] proceeds as it has indicated to date, [the] whole range of security and political relationships between the U.S. and ROK will be affected" (Pollack and Reiss 2004:263).[179] The US had 37,500 troops on the Peninsula since the Korean War and was a primary source of its defense materiel. The US sought not only a

[178] The ROK is not mentioned by US National Intelligence Estimates on the proliferation threat as late as 1966 but by 1975 is among the "threshold" states the US was worried could acquire nuclear weapons within a decade (National Intelligence Estimate No. 4-66 (20 January 1966, in: Burr 2005; CIA 2005).

[179] Primary source document: "ROK Nuclear Reprocessing", telegram from Embassy Seoul to Secretary of State, December 10, 1975, MLF MR case no. 94-146, document no. 53

political commitment by the ROK to nonproliferation, but also to engage a third-party trigger so that enforcement would be less disruptive to the US-ROK alliance (H2).

Under this pressure, the ROK in 1975 signed the NPT and a full-scope safeguards agreement with the IAEA (Kang et al. 2005). The ROK was also rewarded for its behavior. Within months of signing the NPT, Canada agreed to lend the ROK $300m towards the purchase of a $576m Canadian nuclear power plant (NTI 2004c). The US then followed with the promise of a $300m loan to support construction of the KORI-2 reactor complex. Relative to the magnitude of these loans, it is unlikely the IAEA itself provided significant point of leverage. Prior to the ROK's signing of the NPT in 1975, the IAEA had only one technical cooperation project for nuclear power plant safety that could be stopped (IAEA 2007b).[180]

The ROK apparently reconsidered its decision when the administration of US President Carter proposed additional troop withdrawals from the ROK. The US detected a suspicious line of nuclear research and development programs and threatened to cancel the $300m KORI-2 loan unless the ROK immediately ceased (Pollack and Reiss 2004:263). This threat also lead the ROK to cancel plans to purchase a reprocessing facility from France (NTI 2004c). With positive steps to embracing the NPT beyond ratification, the ROK again was rewarded by several billion dollars worth of nuclear assistance by the early 1980s.[181] Even then, all elements of the nuclear weapons research program may not have been dismantled until after the Reagan administration expressed

[180] The IAEA had made two visits to the ROK, in addition to safeguards visits, to consult on reactor design, placement, and financing (NTI 2004c).
[181] This included new loans from the US ($1.1b in February 1980) and France ($1.24b in credit in April 1981, see: NTI 2004c).

its support in 1982 for Chun Do Hwan (who came to power by a military coup, see: Pollack and Reiss 2004:263).

The DPRK: 1960s-1980s

The DPRK's pre-WWII industrial and economic advantages over the ROK had begun to erode by the 1960s. Soon after China tested its nuclear weapon in 1964, the DPRK leader Kim Il Sung requested assistance in acquiring a nuclear weapons capability (Solingen 2007:118). China declined and the DPRK began an independent attempt, building on a research reactor provided by the USSR. As in the ROK, only this reactor was under IAEA INFCIRC/66 safeguards, denying the IAEA access to information about other activities that may have been occurring. By the 1980s, the DPRK apparently also constructed small-scale test facilities for spent-fuel reprocessing to extract plutonium. As with the ROK, the IAEA was therefore a poor candidate for enforcing the international nonproliferation regime (H1).

China, aware that the DPRK wanted a nuclear weapons program in the 1960s, may have approached the US in the early 1980s to pursue talks on the DPRK's nuclear program.[182] While the US intelligence community believed the DPRK's clear need for energy excluded consideration of a nuclear program (Wampler 2003), the US wanted to see it and other prospective proliferators ratify the NPT. The US, however, had little leverage. The greatest pressure for DPRK ratification of the NPT came from the USSR, which had a good record of not allowing its allies to become proliferators. However,

[182] Robert A. Wampler provides evidence that China did approach the US, and was rebuffed by then US Assistant Secretary of State for East Asian and Pacific Affairs Paul Wolfowitz, though the specific document cited does not specifically mention nuclear issues as the cause (see Charles Freeman interview excerpts, in: Wampler 2003).

Soviet pressure in itself was probably not enough to overcome the DPRK's strong desire for the indigenous nuclear weapons capability (Solingen 2007). The USSR got the DPRK to sign the NPT in 1985 only by promising to build it additional reactors (Fischer 1997:288).[183]

The US intelligence community, building on its earlier premise, believed the DPRK delayed signing of an IAEA safeguards agreement, required within 18 months of a state's ratification of the NPT, to time its signature with some national nuclear power project such that it could "project itself as a nation with technological prowess" (CIA 1987). After the DPRK began operating at Yongbyon a 30 megawatt (MW) version of the UK's Calder Hall, a natural uranium-fueled reactor designed to produce a relatively high proportion of Pu-239, the US became concerned when reconnaissance photos taken in the mid-1980s showed construction underway of two larger reactors (Reiss 1995:234). Then, in 1988, the US detected the construction of what could be a large spent fuel reprocessing facility. When combined with a high-explosive testing range, also nearby, and intelligence that DPRK was recruiting former Soviet nuclear scientists, DPRK intentions for a nuclear weapons program finally appeared clear to the US (Reiss 1995:234).

With the end of the Cold War, the US, USSR and China each pressed the DPRK to verifiably abandon its nuclear weapon program by signing an IAEA safeguards agreement. It is important to consider the DPRK's domestic context: The DPRK had been cut off from previously substantial Soviet economic support at the end of the Cold War, it

[183] Fischer states that the Soviet offer reportedly included four WWER-440 MW(e) nuclear power reactors (Fischer 1997:319, note #143).

was isolated from the world economy, its economy was in shambles from a poorly executed command economy and the drain of supporting a huge military, and the agricultural sector was in such crisis that its population was suffering from famine. With few low-cost levers available to compel unconditional assistance by others, the DPRK used its nuclear program as a bargaining chip to extract greater security and economic concessions from abroad.[184]

The US tried to make the DPRK feel somewhat more secure by unilaterally withdrawing all its nuclear weapons from the Korean Peninsula and canceling major military training exercises in 1992 with the ROK.[185] As IAEA-DPRK "talks" dragged on, the US then pressed the ROK to pursue with the DPRK a nuclear disarmament agreement that would be verified bilaterally, not by the IAEA (Wit, Poneman, and Gallucci 2004:10). The USSR and China threatened to terminate their limited bilateral nuclear assistance unless the DPRK opened to international inspections (Solingen 2007). They also signed trade and diplomatic agreements with the South (that were not reciprocated by ROK allies with the DPRK) and threatened to end their objection to the separate ROK and DPRK entry into the UN (Reiss 1995:237). Also, Japan stated it wouldn't open formal diplomatic relations with the DPRK, or allow much needed economic support in the form of financial assistance, investment or reparations, until the DPRK signed its

---

[184] The DPRK's internal ideology of *juche* (self-reliance) and myth of success against the ROK has required strict isolation of its population from the intrusion demanded by foreign aid organizations to prevent diversion to the military. The DPRK is also wary of reforms that could result in the uncontrolled unraveling of the regime, as had just recently occurred to the USSR.

[185] The US had withdrawn only ground- and sea-launched tactical nuclear weapons from the rest of the world, unilaterally removing these and air-launched nuclear weapons from South Korea (Reiss 1995:237).

safeguards agreement (Reiss 1995).[186] Under this unusually coordinated East-West pressure, the DPRK finally signed an agreement with the IAEA for comprehensive safeguards in April 1992.

Pre-Treatment Evaluation

The DPRK and ROK pre-treatment cases demonstrate the problems states often face in cooperating without IOs. The two cases demonstrate the intuition behind the hypotheses and the results are summarized in Table 7.1. First, there was no single authoritative source of information about either states' nuclear programs. The DPRK was a somewhat easier information target in that there were few willing suppliers (reducing the collective action problem) and major facilities were observable to satellites. Nonetheless, those with information on the program – China, the US and the USSR – communicated uneasily at best. In the case of the ROK, only because of unrelated developments in a third country (India) did the US investigate and happenchance upon an individual who would allow the US to connect the dots and work to block the program (of only twenty working on the program, see: Pollack and Reiss 2004). Despite sharing broad geo-political interests, other Western states with potentially better information about ROK intentions faced a collective action problem in that choosing to enforce developing international nonproliferation norms only risked another supplier receiving valuable commercial contracts.[187] The distributional effects upon any individual state

---

[186] The DPRK sought reparations for Japanese colonization of Korea in the first half of the twentieth century. Japan and South Korea signed a settlement agreement in 1965 in which Japan provided compensation that included a $300m grant, $200m in low-interest government loans, and arranging $300m in private loans from Japanese banks (Manyin 2001).

[187] Canada was not unsupportive of international nonproliferation efforts but after it was revealed relatively weak safeguards on Canadian-supplied CANDU reactors were the source of fissile material for India's nuclear test, Canada became a proactive enforcer in the mid-1970s by

could be on the order of hundreds of millions of dollars or more (see intuition of H3b). Therefore, in the absence of a shared informational agent, interested observers had inadequate information and no agent could be a source of proposals for enforcing compliance with international nonproliferation norms by the DPRK or ROK. It was left to the initiative of individual states to define proliferation and call for coercion of states that had not accepted the associated international regime. This supports H1.

Second, the risk of retaliation made proposing enforcement (H2) and implementing enforcement (H3) potentially a high-risk decision. In both cases, major powers had to thread carefully between low-cost punishments, which could be interpreted as token slap-on-the-wrist, and heavy-handed approaches that might disrupt regional peace and stability. In both cases the confluence of historical events (détente for the ROK and the Cold War's end for the DPRK) made cooperation among the interested states easier, but interested states found engaging North Korea about its program difficult.

The US could press the ROK without risking a military conflict between them, but risked weakening the broader political relationship and could be interpreted by the DPRK as an invitation to challenge US nuclear and conventional deterrence policy on the Korean Peninsula. The ROK's compliance could not be assured without additional threats (canceling the $300m KORI-2 loan), positive incentives (promises of billions of dollars in nuclear assistance), and compromises of US foreign policy (supporting coups). While these threats were costly, lower cost threats of a more diplomatic nature were at high risk of emboldening the DPRK to be more aggressive. Enforcement risked escalating the

---

leveling unilateral sanctions against India and Pakistan, suspending uranium shipments to Europe and Japan until they bring their safeguards arrangements up to Canada's level (Hufbauer, Schott, and Elliot 1990). It was also a funding member of the Nuclear Suppliers Group.

disagreement out of proportion with the ROK and large distributional effects upon the Cold War balance in Asia.

For any state to propose enforcement against the DPRK would require navigating a complex diplomatic maze with a hard-line also risking either DPRK military action or being undercut by China, the ROK or Japan. The carrots and sticks used with the DPRK, already cut off from Cold War-era supports, were distinctly less fungible. Russia did promise to build between one and four nuclear reactors, though how good the terms were is unclear as both were suffering economic problems (Wampler 2003). The carrots offered by the US, ROK and Japan were largely diplomatic prestige: promises to talk and little more. However, these talks were necessary prerequisites to achieving the big payoffs sought by the DPRK: normalized diplomatic relations, economic ties, and aid. Lacking ties to others that could be broken, there were only limited enforcement strategies available to coercing the DPRK without risking peace on the peninsula. In short, for the actors most interested in preventing proliferation on the Korean Peninsula, to propose and implement enforcement of the international nonproliferation regime meant the possibility of high costs. Compounding, of course, was the unpredictability of a DPRK response. Again, any private enforcement risked retaliation (escalation) and severe distributional effects.

The Treatment: Enforcement under the NPT and IAEA

With the NPT ratified and IAEA safeguards agreements signed, the ROK in 1975 and the DPRK in 1992, both became subject to the delegation inherent in these contracts. The IAEA is built around two related, but in practice contradictory, missions: to provide assistance with the exploitation of nuclear technology and to guarantee (safeguard) this assistance against diversion to a weapons program. Once a state signs an IAEA safeguards agreement, the IAEA has the authority to make the legal declaration that a state is or is not in compliance with the agreement. Logically, though, this is conditional upon the IAEA's access to information relevant to gauging compliance.

Prior to the entry into force of the NPT, there existed a patchwork of bilateral safeguards, some state-state (state implemented) and others state-IAEA when suppliers demanded recipients request safeguards as a condition of supply.[188] After the entry into force of the NPT, all non-nuclear weapons states were required to accept "comprehensive safeguards", to be defined and implemented by the IAEA. The NPT makes no provisions for its own enforcement beyond delegating to the IAEA the authority to monitor and report on compliance-related behavior "in accordance with the Statute" of the IAEA. Reports by the inspectorate are supposed to be impartial and technical (see Chapter 6). The reports are transmitted via the IAEA Director General to the Board of Governors and to the UNGA and UNSC, each of which may choose to do anything it wants with the report.[189] The Board may confirm the Secretariat's report and call for a return to compliance, it may table the issue and call for the Secretariat to investigate further (and provide time for diplomatic resolution), or it may reject the report as incorrect or politically insignificant. Having acquired the expertise and infrastructure to serve as an informational agent, it appeared natural to also ask the IAEA to use its information to trigger enforcement against noncompliance states (H1).

---

[188] There were also trilateral safeguards, under which a recipient state accepted IAEA safeguards but the supply contract included provisions for, under certain conditions, safeguards reverting to state-state implementation.
[189] The Board is composed of 35 of the 144 member states, selected by a complex formula factoring in advanced nuclear capabilities and geographic representation.

Calls for enforcement by the IO are procedurally simple from their origination in the IO bureaucracy, avoiding politicization that occurs in inter-state politics. This should reduce the cost of enforcement proposals to the IAEA's principals because the IO itself accepts any audience costs from its proposals (H2). This also helps insulate the interested parties from a target's responses (H3).

The Statute provides for enforcement to be implemented within the IAEA as well as the expectation of broader interest by the international community in seeing violators returned to compliance. To enforce compliance, the IAEA may "suspend any non-complying member from the exercise of the privileges and rights of membership", end or suspend "assistance being provided *by the Agency or by a member*", and call for "the return of materials and equipment made available to the recipient member or group of members" (IAEA 1957:Art.XII,Para. 7C). The first mechanism corresponds to "reciprocal defection" by the IO (H3a), whereas the latter two show that the IAEA Statute explicitly provides for public and quasi-public enforcement (H3b). These enforcement actions are internal to the PA relationship within the IAEA and are costly to the extent the target relies on IAEA assistance or is interested in other issues before the IAEA (e.g., possible noncompliance by another state).

The external enforcement power of the IAEA follows from the provision of the Statute which calls upon the Director General to transmit his reports to the UN General Assembly, Secretary General, and Security Council if, at his discretion, he believes noncompliance to constitute a threat to international peace and security. The Board, having made the legal decision that a state is in violation, may increase international pressure further by requesting UN, especially UNSC, assistance in enforcing the nonproliferation regime (H2c). As such, the IAEA serves "as a trigger mechanism. It can tell the world and should tell the world when the possibility of proliferation is something we should be worried about in a particular country." (Statement of Dwight Porter, former US representative to the IAEA, in: US Senate 1977a)

It is also important that neither the IAEA Statue nor the NPT states (or implies) that enforcement was to be exclusively public (or quasi-public). From the outset, the "IAEA statute left the question of forcible sanctions primarily to the United Nations or to a state or group of states" (Bechhoefler 1973:29).[190] The paucity of discussion in the NPT text, another decade hence, reinforced the expectation that the likely responses to violations, beyond UN actions, would be reciprocal denunciation of NPT or the threat or imposition of intervention by those threatened by the violation (Szasz 1973:116). Private enforcement was not excluded; it was expected. The provision for competitive enforcement should increase the probability of enforcement.

The IAEA, therefore, possesses an agenda setting power that is reserved for recognized states and UN organs (the Secretary General, General Assembly, and other UN bodies), but does not otherwise provide standing to NSAs.[191] Experts differ on the effect of the Board's power to refer states' noncompliance to the UNSC/UNGA. Linda Gallini, as Acting Director of Office of Multilateral Nuclear Affairs in the US Department of State Bureau of Nonproliferation, stated that the IAEA Board is at the

---

[190] Bechhoefler implies negotiations over enforcement provisions of the IAEA Statute, like those of the UN a decade previously, reflected Soviet fears of the IO being captured by imperialistic and more numerous Western states and therefore an unwillingness to delegate a monopoly on enforcement powers.

[191] Other independent international organizations with an official relationship with the UN include the WTO, which has connections to the International Court of Justice (ICJ), and the OPCW and PrepCom of the CTBTO, which both report to the UN General Assembly (see: http://www.un.org/aboutun/unchart.pdf; accessed 28 February 2005).

very least useful by legitimizing US suspicions “so the US isn’t pointing its finger alone” (Gallini 2004). The Board provides “a mechanism for taking action”, and, even when states are unwilling to act, “the IAEA is able to produce a collective view on something when the Director General takes an answer” (Gallini 2004). George Bunn, a negotiator for the US to the NPT, argues that the ability of the IAEA to call for enforcement by making a determination of noncompliance is “a tremendous assistance” (Bunn 2004).

Post-Treatment: The NPT, IAEA, and Enforcement

The ratification of the NPT by the ROK (1975) and the DPRK (1985) and subsequent signing of an IAEA safeguards agreement constitutes the “treatment” in this quasi-experiment. It is expected that delegation of enforcement powers to an IO will reduce the cost of proposing (H1, H2) and implementing enforcement (H3) of nonproliferation regimes for the state principals. The first hypothesis (H1) predicts that an IO already serving as an informational agent is likely to be delegated enforcement trigger authority. Having already been delegated such authority, an IO affect the noncompliance and enforcement decisions of others (H2, H3).

<u>The DPRK: 1993-1994</u>

The DPRK ratified its INFCIRC/153-style safeguards agreement with the IAEA on 9 April 1992. The subsequent nuclear crisis was initiated by the IAEA, who then strategically maintained the crisis at high but not intolerable levels through four stages until the crisis was resolved.

The first stage began shortly after the IAEA began ad hoc inspections, so designated because they are designed to verify the accuracy of initial declarations (after which less-intrusive, “routine” inspections would be the norm), in May 1992 to verify the accuracy of the DPRK's declaration of its nuclear activities and inventory of nuclear facilities. Before it had completed six inspections, by the summer of 1992, the IAEA had identified inconsistencies with the declaration (Dembinski 1995:33). The IAEA had determined that the DPRK had conducted undisclosed reprocessing of spent fuel to extract plutonium. To implement safeguards, the IAEA would need to determine how much spent fuel had been reprocessed (and therefore how much plutonium had been acquired). Using US intelligence, it suspected that two buildings at the Yongbyon nuclear complex housed undeclared nuclear facilities.[192] The IAEA believed that the DPRK had used landscaping to hide a building suspected of being an old nuclear waste storage site (to hide a past diversion) and had buried pipes leading from its nearly completed reprocessing facility (to permit future diversions, see: Reiss 1995:246). The IAEA's expertise and access to DPRK-specific information provided the basis for credible suspicions and reason for these judgments to be attended to by the international community (H1).

Embarrassed recently by revelations that Iraq had an entire parallel nuclear program that had not been detected by the IAEA, it decided to pursue its suspicions regarding North Korea with greater vigor. IAEA Director General Hans Blix approached the North Korean government to request access to the two undeclared sites. Until this point, the DPRK had been resistant to "inspections" by "inspectors" for "verification" but had accepted surprisingly broad access for "visits" to a wide variety of facilities by "IAEA officials" for "transparency" (Reiss 1995:242-243). In this case, however, the DPRK refused Blix's informal demand. Blix signaled the significance of the issue by

[192] Constructing a full reprocessing facility without a pilot plant was unlikely (Reiss 1995).

leaking to the media at the beginning of February 1993 that he intended to officially request a special inspection of each of the facilities (Sanger 1993). Under the IAEA Statute and the comprehensive safeguards system, the IAEA inspectors "shall have access at all times to all places and data and to any person … as necessary to account for source and special fissionable materials" (IAEA 1957:Art.12 Para.6). However, such a special inspection had never previously been formally requested.[193]

When the DPRK refused Blix's 9 February official request, he asked the IAEA's Board of Governors to endorse his request during its next regularly scheduled meeting on 22 February. IAEA inspectors have this authority, so this was an extraordinary step to pressure the DPRK without actually escalating the crisis. The purpose was to simultaneously place the request on the agenda, putting the DPRK on notice that a formal request would occur without declaring it to be in violation of its nonproliferation commitments, and to force the states which comprised the Board to send a costly signal that it would support the secretariat.[194] At the meeting of the Board, an IAEA analyst first presented the IAEA's technical findings regarding inconsistencies with its declared plutonium reprocessing activities and then a senior IAEA safeguards official presented a slide show of (US) satellite images that refuted the DPRK's declaration and demonstrated its attempts to deceive the IAEA (Reiss 1995:249-250). After the DPRK was provided an opportunity to refute these findings, the Board endorsed Blix's request. Though the

---

[193] IAEA officials stated that special inspections had previously occurred, through apparently not as the result of a formal request.

[194] Hans Blix had sought in February 1991 an explicit confirmation by the Board that the Secretariat had the right of special inspections. Though initially blocked by a number of developing states, including Algeria, Cuba, India, Iran, Mexico, North Korea and Pakistan, the Board eventually approved a compromise resolution that did not take away this authority but also failed to explicitly support it (Dembinski 1995:32).

resolution was mild and lacked threats of enforcement, the DPRK had three months to comply. Though the IAEA judgment relied in part upon US intelligence, clearly the US had decided to follow the IAEA lead on enforcement and to be the lightening rod for DPRK rancor.

The challenge to DPRK interests posed by this internal review of its compliance was apparently significant enough to justify a major response: the DPRK within days announced its intention to renounce the NPT. Withdrawal would be as unprecedented as the special inspections request but is permitted under the treaty with three month notice if "extraordinary events… have jeopardized the supreme interests of its country" (1970:Art. X, Para. 1). Asserting its continuing authority, the IAEA informed the world that the DPRK's safeguards agreement would remain in force until its withdrawal went into force. The DPRK blocked further ad hoc verification but consented to "inspections" that amounted to maintenance upon safeguards systems already in place, primarily the replacing of batteries and film of monitoring cameras. The IAEA had argued that these visits were necessary to maintain the continuity of the safeguards already in place.

The first stage ended with the US achieving in June 1993, through direct talks, a DPRK "suspension" of its withdrawal from the NPT and agreement to reopen talks with the IAEA over resuming verification activities.[195] The US had resisted direct engagement with the DPRK to avoid rewarding its aggressive behavior and received these promises after offering little beyond the promise of additional bilateral talks. Throughout the first

---

[195] The DPRK argued that it had only "suspended" its withdrawal, doing so with one day remaining in the countdown, allowing the DPRK to occupy a unique position that it believed entitled it to unique treatment under the NPT (cite).

stage, the IAEA's authority to judge DPRK compliance was used as a lever to maximize its value as an informational agent (H2b).

The second stage began in September 1993 when the IAEA became impatient with DPRK delays in resuming verification and learned it planned to shutdown its operational 30 MW reactor in the spring of 1994. To arrive at a comprehensive picture of past activities, the IAEA would have to monitor the shutdown but also prior to the shutdown verify the DPRK's past activities, including inspect the two undeclared facilities. However, the DPRK would only the maintenance inspections to maintain the continuity of existing safeguards. While the IAEA had devised this strategy to get some access to the DPRK earlier in the year, now the DPRK had embraced the strategy as a means to keep the IAEA from getting what it wanted.

Hans Blix began to intimate in public appearances before the IAEA Board, as well as before the UN General Assembly and Security Council, that safeguards in North Korea were becoming increasingly attenuated, stating that "the area of non-compliance with the comprehensive safeguards agreement is widening" (Reiss 1995:257). However, he refrained from taking the threatened step of declaring the continuity of safeguards in North Korea was broken (and therefore the North was in violation). Blix's asymptotic approach to doing so continuously escalated the crisis in September-October 1993. It should be emphasized that the IAEA's ability to create a major international crisis existed only because the international community so valued the IAEA's informational agency that its judgments were taken as credible proposals for enforcement (H1 and H2).

While there was no doubt the Secretariat believed the DPRK was in violation of its international nonproliferation commitments, Blix was unable to simply declare this because the international community disagreed over what steps to take. It appears the IAEA Secretariat was waiting for some consensus to emerge on North Korea, all the while making it clear it was prepared to be the first line of attack – and the first to suffer casualties – when enforcement was called for (H3b). The US wished to phase in increasingly harsh sanctions, which China and Russia rejected without offering a way forward around which agreement could emerge. In November 1993, the US reluctantly began to engage the DPRK directly, offering new direct talks and to cancel the 1994 Team Sprit exercises if the DPRK accepted IAEA ad hoc inspections, resumed North-South talks, and accepted in principle to resolve all outstanding nuclear issues (Reiss 1995:261). The US knew it would be hard to get the DPRK to accept its demands.

The US also worried that its strategy of allowing the IAEA to decide when safeguards had degraded beyond repair gave the IAEA Secretariat the power to derail international negotiations (Reiss 1995:263). As the days of November and December passed by, Blix continuously appeared ready to close the door on the ability of any regular inspections system to verify the DPRK's past nuclear activities. Adding to the problem were reports first from the US and then from Russian and Chinese that intelligence agencies believe the DPRK may have actually constructed nuclear weapons (Milton and Kampani 2007).

Without a consensus on what the next step would be, the US advised Blix against declaring North Korea to be in violation (Mazarr 1995). Undeterred, the third stage began with Blix's apparent intention to finally declare – at the 21 February 1994 meeting of the IAEA Board – that the technical judgment of the IAEA inspectors was that continuity of safeguards in the DPRK was broken. The anticipated international price of such a judgment was sufficient to compel the DPRK to accept a US-offered bargain (H2): the "Agreed Conclusion", which included a partial resumption of IAEA inspections, a resumption of North-South talks and the suspension of the 1994 Team Spirit exercises (Snyder 1997:608).

However, when IAEA inspectors arrived on 1 March to resume inspections, the DPRK again blocked access to a reprocessing facility (Reiss 1995; Snyder 1997). The IAEA inspectors were encouraged to wait until US officials could pursue this diplomatically with the DPRK but they refused and left North Korea. The Board, responding to the inspectors' reports, transmitted through Blix, voted on 21 March 1994 to find North Korea "in further noncompliance with its safeguards agreement" and to direct Blix to inform the UN Security Council and General Assembly (H2c). The UNSC resolution that followed was weak and did not impose sanctions (China objected), but implied a six-week deadline for the DPRK.

With the clock again ticking, the DPRK began preparing to shutdown the 5 MW reactor at Yongbyon and remove the spent fuel rods. It announced the IAEA could monitor the process but, despite IAEA demands, would not allow sampling of the spent fuel rods despite IAEA demands that this was necessary to determine what past reprocessing activities could have occurred (DPRK 1994). Despite even these promises, the DPRK accelerated the project so that removal could not be observed and made future verification technically impossible by deliberately storing the spent fuel rods "haphazardly".[196]

[196] Knowing placement within the reactor core was necessary to the analysis, though the IAEA apparently determined none of the spent fuel rods had been diverted in this refueling.

The fourth stage began when IAEA Director General Hans Blix informed the UN Security Council on 31 May of the Secretariat's judgment that the DPRK is "no longer [officially] in compliance with IAEA safeguards." Blix was clearly leveraging the IAEA's informational agency by creating new ways to describe state behavior such that the IAEA could remain a central actor in the crisis (H2). On 10 June, the IAEA Board of Governors suspended technical cooperation assistance to the DPRK (H3b) and stated "the DPRK is continuing to widen its non-compliance with its safeguards agreement" (IAEA 1994). The resolution prompted the DPRK to withdraw from the IAEA (Snyder 1997).

Withdrawal would not affect the DPRK's commitments under the NPT; it only prevents the DPRK from receiving assistance or participating in decision-making. The past IAEA technical cooperation projects included: Cobalt-60 for treating cancer, radiotherapy facilities, gamma cameras for nuclear imaging, and radioisotopes for analyzing the efficiency of fertilizers for food production (Technical Cooperation Projects by Country database, IAEA 2007b). The IAEA also had paid half the $2.5m cost in 1985 to import a cyclotron for producing additional isotopes for medical diagnostic tests and to treat additional cancers (Albright 2007). These projects were worth only a few million dollars but included nuclear-related assistance its international isolation would make difficult to replace (H3a and H3b). Therefore, while the costs were not large, they were significant relative to the size of the economy and hit directly at the regime's ability to provide for its subjects.

The same day, June 10, the US again proposed sanctions at the UNSC, which Russia and China again blocked. Russia instead called for an international conference on the DPRK nuclear program with participation by Russia, China, North Korea, South

Korea, Japan, the United States, and representatives of the UN and IAEA (Devroy 1994). China, Japan and South Korea, though in favor of pressing the DPRK further, were apprehensive that sanctions were the proper route with the DPRK threat to view sanctions as the opening volley in war. Note that the IAEA's imposition of sanctions did not trigger this extreme form of retaliation, demonstrating its ability to impose costs without causing an escalatory spiral (H3c).

War appeared imminent by 15 June over the IAEA-initiated nuclear crisis. Even as the US Department of Defense stated that it was considering air-strikes, Russian counterintelligence officials reported North Koreans had been arrested attempting to obtain components for nuclear weapons, and South Korea's Minister of Defense announced detection of DPRK tests of nuclear weapon detonators (Milton and Kampani 2007). It was in this tense atmosphere that former US President Jimmy Carter arrived in the DPRK to negotiate with Kim Il Sung regarding the nuclear program. Carter was able to solicit a DPRK promise to freeze many of its nuclear facilities and allow IAEA monitoring in exchange for financing construction of a light-water reactor. As Mitchell Reiss states, the deal short-circuited US policy but also allowed the US to "reset" negotiations in a more useful direction (Reiss 1995:271).

The "Agreed Framework" outlined by Carter was negotiated and then signed on 21 October 1994. Under the agreement, first, a US-led international consortium would help North Korea replace its graphite-moderated reactors with two 1,000MW light-water reactors and compensate North Korea for the freeze on its graphite-moderated reactors by supplying 500,000 tons of heavy-fuel oil annually until the new reactors come online. Second, the US and DPRK would begin efforts to normalize their economic and political relations. Third, both would work towards a nuclear-weapons-free-zone on the Korean Peninsula. Finally, North Korea would remain in the NPT and allow the IAEA to implement the safeguards agreement (H1). To implement construction of the new reactors and provide the heavy fuel oil, the US, Japan and South Korea created the Korea Peninsula Energy Development Organizations (KEDO).

Many criticized the Agreed Framework because its negotiation bypassed the IAEA and UN Security Council at the enforcement stage and singled out North Korea for special compensation for its compliance. Further, it undermined the NPT by allowing an unprecedented phasing in of IAEA safeguards, which would reduce the IAEA's future ability to pursue safeguards in the DPRK (H1), and set a precedent for special deals outside the bargain that other NPT states had accepted (Snyder 1997).

<u>The ROK: 2004</u>

After South Korea ratified the NPT in 1975, it cancelled key projects that would contribute to a latent nuclear capability (especially fuel cycle facilities for enrichment or reprocessing) and placed all existing nuclear facilities under IAEA safeguards. The ROK appeared to be in full compliance with its safeguards agreement when it ratified the IAEA's Additional Protocol (AP) in April 2004. The AP provides an added layer of assurances through expanded rights of access to facilities, information and sampling. For example, it was Iran's voluntary acceptance in 2002 of the AP that led to inspections that identified suspicious traces of highly enriched uranium.

When the ROK ratified the AP, however, it disclosed that it had conducted several small-scale experiments legal within the NPT but not reported to the IAEA, a violation of the INFCIRC/153 (Corr.) reporting requirements. These experiments included uranium enrichment by chemical (1979-1981) and laser processes (2000) and plutonium separation (1981-82). They were conducted by the ROK's Korea Atomic Energy Research Institute (KAERI), reportedly without the authorization or knowledge of the Ministry of Science and Technology (MOST), the agency responsible for oversight (Solingen 2007:86). Fearful IAEA sampling allowed under the AP would show the undeclared activities had occurred, KAERI disclosed the experiments to MOST in June 2004 and then MOST informed the IAEA on 17 August (Kang et al. 2005).[197] This implies the ROK believed the IAEA could make judgments based on these facts (H1) and that there were significant costs to being exposed by the IAEA (H2).

After the ROK provided the IAEA with details regarding its experiments, the IAEA sent a team of inspectors to gather information about the experiments. The IAEA's task, as an informational agent, was to determine whether the unreported enrichment or reprocessing activities were a substantive violation (related to an illegal weapons program) or only a procedural violation (a reporting failure). Either may be serious, especially if a weak response to procedural errors encouraged other states to wait to be caught rather be normatively obligated to prove themselves as being in full compliance. Central is how IAEA enforcement powers worked as a political lever to coerce the ROK into credibly demonstrating that violation was merely procedural (H2b).

It became known that the IAEA was first suspicious after a 1988 inspection produced anomalous but inconclusive results. KAERI dismantled the test site and moved

[197] It is important to note that some of the experiments were not actually secret, they were simply not reported to the IAEA. The 1979-81 chemical uranium enrichment experiments were described in a report published in Korea and the 1981-82 plutonium separation experiments had apparently been tracked by the US and may have been known to some IAEA officials (Kang et al. 2005:44,47).

the equipment between 1998 and 2003 despite IAEA inquiries, indicating the researchers deliberately withheld the information from the IAEA (Faiola and Linzer 2004). Dafna Linzer, writing in *The Washington Post*, reported that KAERI had been blocking IAEA inspections related to these experiments for several years, denying requests for regular inspections at least twice since 2001 (Linzer 2004b).

Simultaneous to the ROK's admission to at least a procedural violation, the IAEA Board was debating sanctions against Iran for its nuclear programs and referral to the UN Security Council for action for its failure to disclose and then allow verification of enrichment activities.[198] There was real concern that the ROK's safeguards problems would derail ongoing international efforts on Iran but also on North Korea. The ROK reportedly pressed IAEA Director General ElBaradei not to reveal the information publicly and, attempting to impose "audience costs" (see intuition of H2c), allegedly threatened to undermine his efforts to lead the IAEA for a third term.[199] The ROK also asked the US to prevent the report from being transmitted to the Board (Kang et al. 2005; Pinkston 2004).

However, there was little flexibility available to the IAEA without threatening its legitimacy to act also on Iran and North Korea. Repeating the strategy used to pressure the DPRK in 1993 to increase its leverage with the ROK (H2b), the IAEA Secretariat leaked information about the experiments to the press just before the 10 September

[198] In addition to Iran, the three other continuing verification issues before the Board, based on the Director General's introductory comments, were verification in the DPRK, the disarmament of Libya, and the "application of IAEA safeguards in the Middle East", a reference to Israel (ElBaradei 2004a).
[199] The ROK believed it could be successful because of the US was similarly considering punishing ElBaradei for his opposition to the invasion of Iraq. This also, then, shows IOs can pay costs for their behavior, making their judgments a costly signal (H2c).

meeting of the Board at which they were to be officially reported (Kang et al. 2005). At the September Board meeting, ElBaradei reported that, "it is a matter of serious concern" that these activities were not reported to the IAEA (ElBaradei 2004a). However, perhaps drawing contrasts to the DPRK and Iranian verification experiences, noted:

> With the full cooperation of the ROK, the team was able, at each of the facilities visited, to examine the associated records available, perform measurements, take photographs, collect environmental samples, interview a number of the scientists involved, and view the dismantled equipment that the ROK stated had been associated with these experiments (ibid.)

ElBaradei made clear, though, the IAEA was not yet prepared to report its conclusions on the full extent of ROK noncompliance.

ElBaradei reported again to the Board on 25 November regarding the ROK's compliance issues. With a more conclusive report, some members of the Board were reportedly now considering referring the issue to the UN Security Council for sanctions (H2). ElBaradei reported that since the August 2004 admission, South Korea

> began providing information to the Agency on its previously undeclared nuclear experiments… has actively cooperated with the Agency in providing timely information and access to personnel and locations, and has permitted the collection of environmental and other samples for Agency analysis and assessment (ElBaradei 2004b).

Other analysts similarly noted that the ROK appeared to be cooperating fully with IAEA investigations and had implemented institutional reforms to prevent violations in the future (Pinkston 2004). The Board decided not to consider a resolution referring the issue to the UNSC, showing the Secretariat's leverage in preventing enforcement that it believed unnecessary. ElBaradei promised to report to the Board on the issue "as appropriate" (ElBaradei 2004b) and the issue quietly faded from attention.

Had the issue been reported to the UNSC, the ROK would be open to significant pressure regarding its program. The US was among those that were putting incredible pressure on the ROK to come clean because it was otherwise open to accusations of a double standard with the DPRK and Iran (H2a and H2c). If the ROK had fallen short of a complete accounting, the DPRK would have made an issue of it. Kang, et al., argue that the approach taken to the ROK's violations demonstrated strategic application of the safeguards process (H2b) but also the "reality that states will ultimately pay costs if they violate international rules and norms" (Kang et al. 2005:40).

Second, as regards the IAEA's ability to impose costs (H3), noncompliance could put at risk a number of technical cooperation projects the IAEA was assisting with in the ROK (H3b). The ROK was the recipient of more than 100 technical cooperation assistance projects between 1975 and 2003 (only 9 were cancelled, most 1984-88), compared to 15 technical cooperation projects completed and 14 cancelled (13 after 1994) for the DPRK in the same period (1978-1991) (IAEA 2007b). Given the ROK's much larger economy, however, the value of these projects is unlikely to be comparable. Also, while the DPRK can generally be said to have received more than it contributed to the Technical Cooperation budget, the ROK contribution was greater than what it received.[200] The greater cost to the ROK was its political embarrassment and any damage to efforts to denuclearize the DPRK (H2 and H3b).

---

[200] For example, the IAEA reports that for 2002, the ROK contributed $702,000 and was earmarked to receive $345,213, though there was a total of $662,526 in past and current but as yet unimplemented projects (IAEA 2003:49,60). It may be reasonable to assume the technical cooperation projects would have been more costly to purchase on the open market or accomplish indigenously.

The DPRK: 2002-Present

After the first DPRK nuclear crisis was averted with the 1994 Agreed Framework, there were some bumps in the road but the DPRK was making slow but positive progress on resolving outstanding questions about its nuclear program and improving its relations with others (Pritchard 2007:4). Of course, the Agreed Framework was quite notable for replacing an international approach to the DPRK with a regional or US-led approach because it retracted delegation to the IAEA of authority over safeguarding the DPRK's compliance with international nonproliferation rules (H1).

The agreement saw the return of the IAEA but under unique circumstances with a significantly circumscribed scope. The DPRK agreed in January 1996 to allow the IAEA to inspect all nuclear facilities declared under the Agreed Framework such that by 1998 the IAEA could report its "confidence" that the declared facilities were still "frozen" (Elliot, Hufbauer, and Schott 2008). However, the IAEA also reported it remained unable to draw conclusions about what the DPRK could be hiding because it knew it was still unable to access the suspected waste storage sites.

Seeking to resolve its questions, the IAEA continued its technical consultations with DPRK negotiators. Rounds of these meetings occurred about twice per year until November 2001, by which time seventeen rounds of meetings over seven years had failed to achieve what the NPT required states to achieve within ninety days (and had already been negotiated and agreed to in 1992). The DPRK stated that, under the Agreed Framework, it wasn't required to grant access until later in the process.

The IAEA lost its ability to safeguard any aspect of the DPRK program after it began on 22 December 2002 to destroy IAEA seals and monitoring equipment and then on 27 December ordered IAEA inspectors to leave the country (IAEA 2007a). As the IAEA states,

> Between 1994 and 2002, the Agreed Framework has been a tool that was aimed at bringing the DPRK into compliance with its safeguards obligations. However, the reports about a clandestine uranium enrichment programme, the end of the "freeze" pursuant to the Agreed Framework, and the expulsion of the IAEA inspectors have brought this phase to an end. (IAEA 2007a)

While the cause of this reversal by the DPRK is in part attributable to the IAEA Secretariat's request for information regarding alleged undeclared uranium enrichment activities, it was not a major cause.[201] In fact, the DPRK ignored IAEA faxes in 2002 and refused technical consultation meetings after November 2002, before again expelling the IAEA inspectors. Days after their expulsion, the IAEA Board adopted a resolution on 6 January condemning the DPRK's actions and calling upon it to cooperate with the IAEA, but delayed referring the DPRK to the UN Security Council for sanctions (Elliot, Hufbauer, and Schott 2008). The DPRK responded by announcing its immediate withdrawal from the NPT on 11 January, to which the IAEA Board responded on 12 February by declaring the DPRK "to be in further non-compliance with its nuclear safeguards obligations" and referring the DPRK to the UN Security Council.[202]

The international community's interest in enforcing the nuclear nonproliferation regime with respect to the DPRK was unaffected by the withdrawal but did change the

---

[201] The US had confronted the DPRK on its suspicions regarding uranium enrichment activities in a bilateral meeting in September 2002. After US officials believed DPRK negotiators admitted having the program, the US convinced the other KEDO partners to suspend shipments of Heavy Fuel Oil (Pritchard 2007:36-42).

[202] The DPRK asserted its withdrawal from the NPT could be accomplished within a single day because it had only "suspended' its withdrawal in 1994. Neither the depository states nor the States Parties have made a collective statement on the DPRK's announcement (IAEA 2007a); most states have chosen to simply not acknowledge the withdrawal.

institutions that could be brought to bear. This changed the treatment in this quasi-experiment. There has been little real progress on resolving international concern over the DPRK's nuclear program since the DPRK returned to Six-Party Talks in 2003 and the IAEA has released statements supporting multilateral talks and expressing hope that the IAEA would be invited back to implement safeguards (IAEA 2007a). While the UN Security Council did eventually level sanctions on the DPRK under UNSC Resolution #1718 (14 October 2006), this occurred as a result of the 9 October test of a nuclear weapon and the resolution was brought directly by a state without the intervention of an IO agent (H2c). The DPRK quickly returned to the Six-Party Talks and then invited IAEA Director General ElBaradei to visit in February and March of 2007, though this is most likely a result of China's strong displeasure over the test and not because of international condemnation or new international costs. The resulting agreements by the DPRK both with the IAEA and at the Six-Party Talks appear on track at this time to eventually return the DPRK to compliance with international nonproliferation norms.

<u>Summary</u>

Each stage of the first DPRK crisis (1993-1994) was initiated by IAEA pressure upon the DPRK to resolve questions about its compliance. As the crisis progressed, Hans Blix strategically used the IAEA's power to call for enforcement to maximize its informational mandate (H2). Unwilling to sacrifice the integrity of the IAEA inspection system, but unable to rely upon the Board pursuing enforcement measures, Hans Blix did not unambiguously report to the Board or to the UN that the DPRK was noncompliant, but invented intermediate levels of compliance. In particular, the IAEA ignored its inability to verify the complete accuracy of the North's declarations but focused instead on the continuity of the safeguards that were in place and in jeopardy of being broken. Keeping the IAEA central to verification of North Korea provided it with at least some access to the DPRK to detect future diversions even if past diversions could not yet be ruled out (H1). Though limited compared to the sanctions the UN Security Council could have chosen to impose, the Board's termination of IAEA technical cooperation and any other nuclear cooperation were significant costs to the DPRK (H3a and H3b). These sanctions also avoided an escalation of the crisis that appeared likely if the UNSC or individual states leveled additional sanctions (H3c).

Regarding H1, the IAEA inspection process provided the impetus for it to pursue enforcement of the NPT in North Korea. Independent of the other major players, the IAEA presented the DPRK and the international community with the timeline against which DPRK behavior would be marked. Regarding H2b, the authority to declare a state noncompliant provided leverage for the IAEA to demand access to the information needed for its reports to be viewed as accurate and complete. The autonomy and authority of the IAEA therefore made it the international community's phalanx against DPRK proliferation, the first to engage and the first to suffer the costs of doing so.

ElBaradei also used the discussion of the ROK issue to highlight that the strengthened safeguards regime was likely to lead to additional future reports that NPT states had failed to fulfill all their reporting requirements but also, in support of H2, that most cases can be adequately resolved through existing internal mechanisms without explicitly being brought before the attention of the Board (ElBaradei 2004b). The implication being that while verification may not be absolute, the IAEA's enforcement mechanisms provided sufficient leverage in most cases for the IAEA's delegated authorities to be a complete solution (H3). Of course, after the Agreed Framework and especially since the DPRK withdrawal from the NPT, the diminished role of the IAEA in North Korea reduced its ability to affect developments there. The results for the post-treatment analysis are summarized in Table 7.2

Comparing enforcement in other NBCW institutions

The IAEA, and by extension the NPT, are not unique in being delegated enforcement powers. In this final empirical section, I review the enforcement powers of other major institutions of the NBCW nonproliferation regimes. While there are no tests of the causes or effects of the delegation of enforcement authorities, they are described in order to demonstrate that the IAEA is not unique.

The Organization for the Prohibition of Chemical Weapons (OPCW)

The OPCW is the agent created by the 1995 Chemical Weapons Convention (CWC). OPCW enforcement authorities differ most significantly from the IAEA in that the Secretariat may only inform the Executive Council that it has "doubts, ambiguities or uncertainties about compliance" (OPCW 1993:Art.8 Sec.C Para.40), but not make decisions the legal decision that a state is or is not in compliance with the CWC. However, the Executive Council may, when there exists "a situation raising problems" with the compliance of a State Party, and measures taken by the State Party do not redress the situation, to consider "doubts or concerns regarding compliance and cases of non-compliance" (Ibid.:Art.8 Sec.B Para.20 and Sec.C Para.36).[203] Therefore, counter to the expectation of H1, the OPCW lacks a clear authority to call for enforcement despite

[203] The Conference of States Parties is similarly authorized. However, this body is the collective principal of the CWC and not its agent according to the definition of agency used in this project.

its informational role. The CWC, however, does provide for directly punishing noncompliance in ways that parallel the IAEA Statute: the violator's rights and privileges within the OPCW and under the CWC can be revoked, including voting rights, the power to request challenge inspections of others and the expectation of assistance from other Parties in the event of a CW attack.[204]

The other enforcement mechanisms may be more immediately costly and move beyond the costs the IAEA can impose. First, violators can be denied access to chemical imports and exports with other CWC parties. This is quite a costly sanction for many states. For example, if Iran were to be found in violation of the CWC – and many suspect is has a CWC program despite its ratification of the CWC – it could lose as much as $500m in exports (1997-2000 average) and $2b in imports (2007). Second, the Executive Council and the Conference of States Parties have the power to recommend collective action and inform the UN General Assembly and Security Council of issues pertaining to compliance of the CWC. This distinction was insisted upon during the negotiation of the CWC by the States Parties (Moodie 2004), though it is unclear the practical difference in agenda-setting power for enforcement that this creates. However, the language is vague regarding the boundaries of recommendable collective action such that the range of options appears much broader than the IAEA's limitation to terminating nuclear cooperation and assistance.

[204] Unlike the IAEA, special or challenge inspections may not originate in the Secretariat but require the positive request of a Party.

Comprehensive Test Ban Treaty (CTBT)

The Comprehensive Test Ban Treaty does not mention a process or authority of the Executive Council or Secretariat to determine "compliance". Similar to the language of the CWC, the treaty text in Article 2 states the Conference of the States Parties (the collective principal) and the Executive Council (the agent) should "ensure compliance", consider concerns raised by "possible non-compliance", and act to "redress" compliance concerns, but in accordance with Article 5. Article 5, which describes the enforcement powers, authorizes only the Conference to "restrict or suspend the…rights and privileges" of a Party, "recommend to States Parties collective measures", or bring the issue to the attention of the UN. Notably, this is a coercive power of the collective principal only, not of the agent, and lacks the authority of a legal decision regarding noncompliance. Further, even this authority requires the treaty to first enter into force and does not exist under the current ad hoc mandate of the Provisional Technical Secretariat of the CTBT.

Biological and Toxin Weapons Convention (BWC)

The 1972 BWC does not provide for either verification or enforcement of compliance with the treaty but calls for "consultation and cooperation" among to resolve any problems with the treaty among the BWC States Parties. The BWC does mention recourse through the UN Security Council, though no States Party have invoked this right (Smithson 2004b) and this is a complaint process to which all states already have access. BWC enforcement actions to date include primarily the UNGA investigations into suspected violations in a couple of isolated cases in the 1980s.[205] In none of the cases did international or even unilateral sanctions occur. Instead, these cases demonstrate the high

[205] The UN conducted investigations of alleged BW use in Afghanistan and Southeast Asia.

cost of coordinating responses to security issues through the UN system. Investigations were highly constrained when authorized and lacked clear validation of their expertise, precluding an authoritative informational agent. As a further result, it was too costly for any individual interested actor to propose and pursue multilateral sanctions to enforce the norms of the BWC (or its antecedent, the 1925 Geneva Protocol).

Export Control Groups

The two export control groups, the Nuclear Suppliers Group and its CBW counterpart the Australia Group, have had a tremendous effect upon nonproliferation efforts, but not because of their enforcement authorities. Both are maintained by their participating states as nothing more than an informal grouping of states: there is no legalization, decisions are made by consensus, and compliance is voluntary. Enforcement actions have not appeared to be necessary. Of course, the primary reason is that the lowest-common denominator wins to set trade limits and safeguards levels. Even then, states request "waivers" and exceptions for supply deals that go beyond each groups' limits.

Conclusions

The theoretical expectation expressed in most of the IR literature is that international organizations (IOs) have no ability to independently affect enforcement of international agreements. This is because they lack the capacity to act independently of their state masters and, even if they did have autonomy, IOs cannot enforce agreements because they do not trade, cannot tax, and are unable to conscript militaries. IOs enforcement powers, they argue, are purely normative and require voluntary participation by third parties.

However, IOs may also be able to reduce the cost of enforcing a NBCW cartel by absorbing costs of calling for enforcement or by possessing the resources independent of their state principals in which to apply towards directly imposing costs upon violators. First, I argue that IOs can reduce the cost of calling for enforcement because they possess expertise that can be applied towards judgments about compliance and can be punished by their principals for mistakes in judgment (H1). Second, I argue IOs control resources valuable to their state principals and therefore can impose costs upon noncompliant states (H2 and H3). The ability of IOs to themselves suffer costs from failures makes their judgments about compliance credible signals. I argue states will delegate enforcement powers to IOs if this increases the probability that states will be compliant with NBCW nonproliferation bargains because they face greater costs for defecting from agreements.

To generate supportive evidence of my hypotheses, I conduct a quasi-experiment of the effects of IO enforcement powers upon national compliance with the international nuclear nonproliferation regime. Specifically, I examine South Korean and North Korean violations of the nonproliferation regime prior to and after an institutional treatment: ratification of the 1970 NPT and IAEA comprehensive safeguards. I find that the expertise gained by the IAEA as an informational agent and its ability to pay costs from policy failures makes it valuable for setting the agenda on enforcement of nonproliferation norms and rules. I also find that the ability of the IAEA to impose costs upon violators, primarily through denying access to membership benefits, the suspension of nuclear assistance, and referral to the UN Security Council, has a small but important effect upon state behavior.

Some may argue, though, that perhaps the IAEA is unique or was simply lucky in these two cases selected for analysis. While it is difficult to analyze the true universe of possible enforcement events within the IAEA because of observability problems, it is possible to demonstrate that the enforcement advantages of the IAEA are repeated in other elements of NBCW cartels. The Organization for the Prohibition of Chemical Weapons (OPCW) is perhaps the closest comparison case, possessing a formally institutionalized delegation of enforcement authority. Other formal NBCW institutions, in particular the 1972 Biological and Toxin Weapons Convention (BWC) and the 1996 Comprehensive Test Ban Treaty (CTBT) also provide for some enforcement measures. In contrast, the informal export control groupings – the Nuclear Suppliers Group and the Australia Group – rely exclusively upon private enforcement of what is essentially private law among the supplier states.

Enforcement is not a simple matter of the absolute power of the actor seeking to send enforcement to a noncompliant target. Enforcement requires the ability to suffer and impose costs upon the target that are sufficient to affect the target's decision-making processes and facilitate a change in behavior. I have demonstrated that international organizations can, under certain conditions and constructions, suffer and impose costs upon states that violate the norms and rules of the NBCW nonproliferation regime. This work has usefully demonstrated that IOs have the independent power to affect state behavior precisely because of the value states place upon the autonomous provision of informational and other services by these IOs.

Tables

Table 7.1: Summary of Pre-Treatment Observations (Pre-Ratification of NPT and IAEA Safeguards)

Hypotheses↓ Results→	ROK	DPRK,	Summary
If an IO is already an informational agent, then it is likely to be delegated the authority to call for enforcement.	US must expand investment in information. Issue predates existence of NSG.	Same, but USSR/Russia and China rather than US allies, though at least the USSR/Russia was in the NSG.	Major powers' intelligence provides incomplete picture without IAEA access; no reliable informational agent to make judgments
H2: An IO has independent effects upon enforcement if…			
2a: IOs trigger enforcement at inopportune times	US pursues when low international tensions.	Low international tensions with post-Gulf War I cooperation on Iraq facilitates cooperation.	Enforcement occurs at opportune time only.
2b: IOs threats can engage a target in internal reviews of compliance	IAEA has little leverage. Collective action problem to ROK allies and suppliers. Risk of negative externalities from DPRK reactions.	Russia and China have little leverage; the US and IAEA even less leverage.	Security conditions (and economic conditions) restrict set of available sanctions; IAEA has little relationship to interrupt with targets
2c: States are less likely to trigger	The US forced to act as allies are competing to supply reactors and fuel cycle facilities to ROK	Complex to juggle Northeast Asian diplomacy post-Cold War (and global dynamics).	IAEA lacks information to serve as enforcement trigger; without clear agenda setter, state with greatest interest must choose to enforce.
H3: An IO reduces the costs of implementing enforcement if…			
3a: Exclusion from IO participation is costly to targets	IAEA has no basis to act as long as safeguards not violated. ROK is IAEA member but ROK security concerns are not under safeguards	Not clear DPRK is proliferating.	(See 2b)
3b: IO has capacity to impose direct costs	US can impose costs only indirectly; must offer carrots and coerce other allies without emboldening DPRK	USSR offers reactors; US and allies begin talks on targeted rewards but not costs as DPRK is already weak and autarchic	(See 2b)
3c: IO enforcement is less likely to escalate	US threats risk harm to relations with ROK and emboldening DPRK	DPRK uses brinksmanship and destabilizing moves against US efforts.	Any actions sufficient to enforce nonproliferation interests risks worsening regional security problems.

Table 7.2: Summary of Post-Treatment Observation

Hypotheses↓ Results→	DPRK 1993-94	ROK 2004	DPRK 2002-Present*
H1: If the IO is already a valuable informational agent, delegation of the authority to call for enforcement is more likely	Yes: IAEA presses for compliance with safeguards	Yes: IAEA investigates ROK admissions	No: IAEA very constrained
H2: An IO reduces the cost of calling for enforcement if…			
2a: IOs trigger is likely at inopportune times	Yes (incoming US administration) and No (Post-Gulf War cooperation)	Yes – Iran on IAEA agenda; DPRK	No: US chose timing of engagement
2b: IOs threats can force a return to compliance	Yes: Blix strategic behavior to deepen and extend IAEA role	Yes: ROK cooperative in investigation	No: 10/2002 letters on HEU were ignored; 12/2002 IAEA expelled
2c: States are less likely to trigger	Yes: IAEA maintains attention with threat to call for enforcement when UNSC not ready to act	Yes: IAEA makes public when UNSC & IAEA Board are dealing with Iran	No
H3: An IO reduces the costs of implementing enforcement if…			
3a: Has "reciprocal" defection capacity	Yes	Yes	No: No longer an IAEA member
3b: Has capacity to impose direct costs	Yes: IAEA Technical Cooperation projects valuable	Yes (but weak)	No: No longer an IAEA member
3d: Enforcement is less likely to escalate	Yes: IAEA acts do not cause "war" as DPRK threatened for US or UN sanctions	Yes	No

* Note: Third DPRK observation occurs after a second treatment under the 1994 Agreed Framework.

Chapter 8: Conclusion

Summary of the book

Why do states delegate for some nuclear, biological and chemical weapons issues at some points in time but for not other issues or at other times? Why did states choose to delegate deeply to the IAEA in 1957 and through the NPT in 1968 but cooperate superficially for BWs under the 1972 BWC? Why does a ban on chemical weapons (CWs) not emerge until 1995 but delegate substantial authority to an IO? The differences in the level and form of cooperation on security issues as important as NBCWs is made even more puzzling by the conventional conception of these military tools to collectively be "weapons of mass destruction".

One effect the diverse strategies on NBCW issues have in common, however, is to raise the cost to acquiring the materials, technologies, and knowledge necessary to deploy these weapons. I therefore began by describing cooperation through NBCW regimes as being analogous to a trade cartel among states that otherwise could enable proliferation by others. Building upon the trade cartel analogy, I first demonstrated that cooperation to produce security from NBCW threats, like other collective goods, requires states to bargain, monitor, and enforce a bargain that can produce security gains for states on proliferation threats. I then built upon principal-agent theory to derive the basic conditions under which states, facing barriers to cooperation, choose to delegate to IOs rather than forgo cooperation and effective nonproliferation strategies.

More severe threats of NBCW use and converging preferences regarding these threats provide the baseline incentives to cooperate. A greater ability of actors to use or threaten to use NBCWs to gain political advantages should create greater incentives for states to prevent or otherwise obviate this threat. Similarity of preferences among states over NBCW outcomes should transform the interaction from one of inherent conflict to one in which cooperation is possible. Greater similarity or convergence should reduce the distributional effects of cooperation because less compromise is necessary to pursue cooperative outcomes.

However, these two variables alone cannot explain the form of cooperation. I argue states may cooperate to reduce NBCW threats when the baseline conditions hold: significant NBCW threats pose gains to states from cooperation and these states possess similar preferences over outcomes regarding those gains. The decision to delegate to an IO requires that an IO be useful for facilitating cooperation. Delegation to an IO is functionally advantageous if an IO can reduce search costs for NBCW-relevant information, pose lower political risks in the production of that information, and reduce the costs of enforcing compliance with a NBCW bargain.

Summary of Results

There are therefore two necessary factors before states will choose to cooperate on NBCW issues: severe threats from NBCWs and converging preferences over how to best mitigate these threats. Three factors, individually or in combination, explain why states would choose to cooperate through an IO agent: greater economic efficiency in producing information, lower political risks in bargaining and monitoring relevant behavior, and lower costs to enforcing the cooperative bargain. In short, delegation on NBCW issues occurs if IOs offers lower costs to bargaining, monitoring, and enforcing international cooperation on NBCWs. Taken individually, each of the five independent variables is found through qualitative and/or quantitative analysis to be an important cause of delegation.

First, the threat of NBCW use is an important precondition for delegation. Nuclear threats do have a strong causal effect upon nuclear delegation. The empirically low threat from CWs relative to nuclear weapons, both historically and as measured in Chapter 3, makes it unlikely this factor alone will be a significant cause of delegation. In fact, CW threat increases are negatively correlated with increases in CW delegation. This is not surprising given the relatively low level of the CW threat and the availability of unilateral and informal multilateral, but certainly non-delegating, strategies to cope with these CW threats. Irrespective of the variation in BW threats, and the relative severity of these threats falling between that from nuclear weapons and CWs, there has been no delegation for BW threats in 1945-2002 and this complicates inferences. Rather than conclude that the positive results for nuclear delegation are spurious, I argue it is more likely that confounding factors – namely the other four variables – are all that much more important than the threat. Finally, and contrary to the expectation from Realist arguments, I also find US-USSR condominium and US hegemony are negatively correlated with increasing delegation. These effects are large and significant.

Second, state preferences over NBCW issues must converge prior to delegation occurring. The homogeneity of states' revealed preferences on NBCW issues using UN General Assembly votes and ratifications of key NBCW treaties is positively related to the decision to delegate for nuclear and chemical weapons issues. That the results are stronger when weighting the importance of individual states by their NBCW capabilities supports the cartel model being applied: as preferences of states with greater capabilities converge, delegation increases for NBCW issues.

Third, and temporarily putting aside the politics of cooperation, there should be simple economic incentives to collaborate through an international agent on NBCW issues. An informational intermediary is valuable when centralization of monitoring or specialization through the agent's investment in assets specific to the issue produce efficiency gains. New investments in specific assets are necessary when the expertise and technologies required for bargaining and monitoring changes or otherwise grows. Using a case study on nuclear test ban negotiations, I find evidence of this incentive can be inferred from the increasingly limited intelligence the US was able to acquire on the nuclear weapons programs of new nuclear actors despite its continuous innovation in technology and increasing effort. While time-series data on the scope of the information (monitoring) problem for each of the nuclear, biological, and chemical industries – proxied by industry size and the rate of technological change – does not yield strong statistical results, the cross-industry comparisons are more useful. I show that the diffusion of the number and other qualities of potential monitoring targets makes cooperation more efficient (economies of scale) but also can present a large hurdle to entry into the market as an informational agent. The arguments presented in this paper appear supported by the evidence.

Fourth, returning to the politics of information, I find that IOs are not just efficient fora for bargaining or for producing information. IOs in the area of NBCW issues are delegated authority from their state principals because they can produce less biased information and produce it more safely. This finding is evident in statistical analysis of state preferences and in an analysis of the reported intelligence on Iraqi NBCW activities from 1970-2003 available to the US and UK compared to the international community (IAEA, UNSCOM and UNMOVIC): the unbiasedness of IOs made their reports more trusted and more accurate. Also important is the fact that that *US* preferences are diverging from others that also increases the relative utility of NBCW IOs. The US is a major supplier of information about the NBCW activities of others but is less trusted as its preferences over outcomes become more extreme. An analysis of the sovereignty costs of participating in a mutual monitoring regime demonstrates that the economic risks of participation are also considered by states. The absence of BW delegation again complicates inference, but the data suggest there are boundary conditions to these incentives: When the risk of sovereignty costs is extremely high because information is particularly valuable, states may not perceive delegation to an agent to sufficiently offset the risks required to cooperate on BW issues.

Fifth, I demonstrate that IOs can suffer international audience costs and impose economic costs upon states that violate the norms and rules of the NBCW nonproliferation regime. Specifically, I show that the expertise of the IAEA and its ability to suffer costs from policy failures makes it valuable as an agenda setter for proposing enforcement to the international community. Also, the ability of the IAEA to impose costs upon violators, though limited, has a small but important effect upon state behavior. Therefore, and again contrary to most IR theorists' expectations, IOs under specific conditions can possess the autonomous and independent capacity to affect the decision-making processes of targets and coerce a change in their behavior: enforcement of NBCW norms and rules.

Explaining NBCW Delegation

Does the application of cartel theory and PA models lend traction to a security issue such as NBCW proliferation? Does this project explain when and why we observe delegation to NBCW issues in the international system? In short, yes. In this section, I briefly review the evidence for the ability of threats, preferences, costs of information and costs of enforcement to explain delegation to the individual regimes.

Nuclear weapons

There has been significant historical variation in nuclear threats and NBCW preferences and these two variables to account for much of the variation in nuclear delegation. Historical analysis is useful to interpret the causal relationship between the costs of information and delegation because the first major expansion of the nuclear industry was caused by (or the anticipated effect of) the first nuclear delegation event: the creation of the IAEA. Therefore, monitoring of the nuclear industry for nonproliferation purposes began when the industry was very small and it became increasingly clear with the industry's growth that multiple, overlapping monitoring systems were more costly, inefficient, and subject to gaps in coverage relative to a centralized system. The expansion of the nuclear industry over time has required the continuous renegotiation amongst the principals over provision of the IAEA's resources for monitoring. Also required has been regular reinterpretation within the IAEA of its mandate as the original approach for the safeguards process has become less and less adequate for verifying the production of the nonproliferation goals of its principals.

As delegation for monitoring has evolved, so has delegation for enforcement. Obviously, the entry into force of the NPT was important for building consensus amongst states about the nuclear proliferation problem and the agreement upon the need for nonproliferation to be enforced not only by the UN but also by private actors. However, the NPT became important only because the original enforcement mechanism – IAEA termination of nuclear assistance and other sanctions – failed to be a useful lever because of changes in the nuclear industry. Instead, the IAEA has acquired greater power as an enforcement trigger, though it still retains some capacity to impose costly sanctions on states receiving IAEA technical assistance. While delegation has also occurred for monitoring nuclear testing, many other aspects of nuclear cooperation have occurred without delegation. Not only has the CTBT yet to enter into force, but the NSG remains a major tool for limiting proliferation.

Chemical weapons

Delegation for CW threats does not occur until the mid-1990s even though states began discussing the terms and processes for cooperation in the late 1960s. The failure to negotiate a CW treaty alongside or shortly after the BWC may have been because of the minor perceived threat. However, the threat remains relatively constant and low throughout the period of analysis, giving the variation in the threat little traction in explaining delegation that occurs under the CWC. There are therefore three reasons why delegation does not occur until the 1990s.

First, there was significant disagreement (preference heterogeneity) over what should be included and how the agreement could be verified. Second, most states believed only the most powerful states could effectively use CWs in warfare against others while protecting their own troops, and that these states generally already had nuclear weapons for deterrence and/or war-fighting. Third, the chemical industry was large, economically valuable, and (technologically-speaking) rapidly evolving through to the 1980s.

The diminishing economic importance of the chemical industry reduced the costs of cooperating while the increasing threat of CW use, primarily by those states and NSAs that are not nuclear weapons states, led to the decision to finally cooperate on CW threats in the mid-1990s. The ability of IOs to produce this cooperation more efficiently and with less unbiased information can explain the decision to delegate. The future possible power of the OPCW to impose costs upon violators when it moves beyond the disarmament stage, by denying access to the international chemical trade, could prove even more powerful for enforcement of an international obligation by an IO than the IAEA with nuclear weapons issues.

Biological weapons

The absence of delegation throughout the period of analysis is not as puzzling as it might appear, even though the threat from BW proliferation was, as I argue, greater than that for CWs. The BWC, which entered into force in 1975, was clearly an attempt to deal with the biological weapons threat that was ascendant in the late 1960s and early 1970s, but in most cases, as for CWs, the most capable BW states were already NWS or met their security needs in other ways. And, the serious negotiations over a verification protocol that began in the mid-1990s was a response to the perceived increase in the seriousness of the threat as the world learned more about state (Soviet and Iraqi) and non-state actor (Aum Shinrikyo) BW activities. However, like the chemical industry, the biotechnology and various other biological industries were already very valuable and very large, and only becoming increasingly diversified, when states identified an interest in cooperating (e.g., their preferences converged). However, the necessary scale of investment to even begin monitoring, combined with the immense risk of compromising valuable commercial and national security information, has posed an incredible barrier to investing in assets useful to differentiating BW activities from peaceful activities.[206] Therefore, delegation of any significance has not occurred.

Policy recommendations and prediction

I have presented both argument and evidence that delegation for NBCW issues has occurred when cooperation is desired by states but they encounter problems in negotiating, monitoring, or enforcing a specific bargain. Specifically, delegation occurs when states seek to cooperate and an IO agent can reduce the costs of information production, make information revelation safer and more reliable, and can reduce the cost to cooperating states of enforcing their bargain. Under what conditions are we likely to see delegation increase in the future? Or see delegation decrease?

Delegation for nuclear issues is already quite strong, significant, and broad. While the resources of the IAEA and CTBT Provisional Technical Secretariat could be expanded, there are also several current proposals for expanding the authority of IOs over nuclear issues to reduce the future threat from these weapons. One, making ratification of an IAEA Additional Protocol a mandatory requirement for compliance with the NPT, would expand leverage over a select group of states but such agreements are already in force with most others. Two, creating a role for the IAEA in nuclear fuel supply and fuel cycle facility management by internationalizing these activities will expand the ability of

[206] The US has expressed concern that such transparency would allow potential adversaries to learn about and exploit weaknesses in US defensive efforts.

the IAEA to directly impose costs upon those who violate their safeguards agreements. Internationalization of fuel cycle services, such as enrichment and reprocessing, are elements of current proposals under negotiation, including the US Global Nuclear Energy Partnership (GNEP) and others. Internationalization could occur selectively and voluntarily (non-universally) to effect this expanded monitoring and enforcement capacity. Three, a CTBT has been negotiated but has not yet entered into force. The monitoring capabilities of the CTBT PTS are currently quite a substantial improvement upon information otherwise accessible to the participating states and the creation of an on-site inspection capability would further expand its informational utility to its membership. Its entry into force would create the obligation by ratifying states to forbear from testing and to accept on-site inspections when testing activities are suspected. However, the CTBT Preparatory Committee (the membership body serving as an executive body over the PTS) could create the OSI mechanism without entry into force and expand the informational signal provided by the CTBT PTS monitoring and verification capabilities without such an obligation.

Delegation for chemical weapons issues is significant but also quite recent and therefore not fully tested for its efficacy. The OPCW is currently limited primarily to the continuous monitoring of disarmament efforts of acknowledged CW possessors in order to verify destruction is complete and total. The OPCW lacks the resources to perform this mission and simultaneously conduct the intensive inspection regime necessary to verify the compliance of other states. As a result, the expansive regular and special inspection authorities of the OPCW have yet to be fully tested. The CWC also already provides for international export controls and national implementing legislation, both of which exceed delegation to IOs for nuclear issues. Therefore, formal expansion of delegation is unlikely to occur until the OPCW's existing authorities are tested and proven. Failures could certainly lead to a retraction of this delegation.

Delegation for biological weapons issues could be predicted because the growing apparent threat and converging preferences about those threats are confronting a stabilized sovereignty cost of transparency from monitoring. However, it is already occurring with the formal launch in August 2007 of the BWC Implementation Support Unit. Staffed by three (3) people working within the UN Department for Disarmament Affairs, the ISU lacks the resources or authority to accomplish little beyond maintaining a web presence and serving as a clearinghouse for informational exchange among the treaty states. The BWC Review Conferences continue to be plagued by differences among the parties, quite similar to those which have confronted the IAEA: developing states seek promotion of peaceful uses of biotechnology that developed states (especially the US) resist, and there are debates among developed states over the best strategies reducing the BW threat. An expansion of delegation towards monitoring, as sought by many in negotiations on a verification protocol that ended in 2001, is unlikely because of strong US opposition. While delegation may expand to aid centralization of national informational activities, a deepening of national obligation through extending the treaties provisions to require national legislation (though this is not delegation) is more likely.

Explaining Delegation in IR

This dissertation examines the power of IOs as agents of their state principals. This power comes primarily from the information they wield but also from their ability to translate informational agency into enforcement power. The enforcement power of IOs today follows from the expertise and investment in monitoring behavior that is the basis for credible reporting on compliance and noncompliance. The enforcement power of IOs can be expanded, but this would require the collective decision by their principals to expand their role in trade and assistance or to provide them with the coercive capability to punish either individuals (such as the authority to apprehend and remand for trial and incarceration) or states (such as authorizing their direct access to military forces). Delegating such coercive authority in this respect is unlikely, but not impossible.

While they have real power to affect state behavior, IOs remain agents of and subject to the constraints maintained by their state principals. That IOs are agents of states, employed to further a collective purpose, does not demean them. IOs are agents of states just as states are agents of their citizens, one further link in the chain of delegation between the interests of individual people and the outcomes we observe. This dissertation should therefore not be read as only an analysis of international organizations and the reasons states use them.

This dissertation also is about nuclear, biological and chemical weapons, the threats they pose to states, from states and NSAs, and how states work together to cope. By drawing on technical knowledge of these weapons, including their research, design and use, this project illuminates how these threats have changed over time and what strategies might be useful for reducing these threats. Unfortunately, the NBCW threat is one that is unlikely to ever disappear.

Finally, this dissertation is also a study of the nature of sovereignty and of political organization more broadly conceived. This project confirms that, even in the high politics of security, states do delegate to other actors at least partial responsibility for their security. This implies the need for additional research on the relationship among states in security institutions and between states and other global actors. While the threat from NBCWs is unlikely to disappear, actors can improve their cooperation with better understanding of the feasible forms of cooperation and the conditions under which particular forms may be most useful.

This dissertation helps theoretically connect known cases of security and non-security cooperation amongst states and other actors to each other. This is useful to demonstrate the full range along which any individual or collective actor can cooperate with others to increase their security, which is a necessary step before explaining these phenomena. By identifying key causal variables and beginning tests of not only the empirical power to cause delegation, but understanding something about the empirically observed range of values of these variables, we can begin to imagine counterfactual worlds in which we push the values of the variables to further extremes.

The ultimate goal is not to develop abstract theory. The goal is to inform policy and decision-making by individuals and their political agents. The goal is to enable improvements in the responsiveness of existing institutions to the demands of their principals and to enable the creation of new institutions when the interests of the principals demand them.

References

1969. Vienna Convention on the Law of Treaties.

1970. Treaty on the Non-Proliferation of Nuclear Weapons. London, Moscow, and Washington, DC (Opened 1 July 1968, Entered into force 5 March 1970).

2003. Decommissioning status of shutdown nuclear installations. European Union: European Commission - Energy.

2005. World Development Indicators: World Bank.

2008. *National Economies Encyclopedia: Iran International Trade* Encyclopedia of the Nations, 2007 [cited 28 January 2008]. Available from http://www.nationsencyclopedia.com/economies/Asia-and-the-Pacific/Iran-INTERNATIONAL-TRADE.html.

(Canada), CSIS. 2000. Perspectives: Biological Weapons Proliferation: Canadian Security Intelligence Service.

Abbot, Kenneth W., and Duncan Snidal. 1998. Why States Act through Formal Institutions. *Journal of Conflict Resolution* 42 (1):3-32.

Abbott, Kenneth W., Robert O. Keohane, Andrew Moravcsik, Anne-Marie Slaughter, and Duncan Snidal. 2001. The Concept of Legalization. In *Legalization and World Politics*, edited by J. Goldstein, M. Kahler, R. O. Keohane and A.-M. Slaughter. Cambridge, MA: MIT Press.

Ackerman, Gary A., and Kevin S. Moran. 2005. Bioterrorism and Threat Assessment. Stockholm, Sweden: Weapons of Mass Destruction Commission (WMDC).

Adler, Emanuel. 1992. The Emergence of Cooperation: National Epistemic Communities and the International Evolution of the Idea of Nuclear Arms Control. *International Organization* 46 (1):101-145.

Aggarwal, Vinod K., and Cédric Dupont. 2003. Comment on 'Common Goods, Matrix Games and Institutional Response'. *European Journal of International Relations* 9 (3):475-478.

Akiyama, Ichiro. 2005. Interview, edited by R. Brown. The Hague, The Netherlands.

Albright, David. 2007. Phased International Cooperation with North Korea’s Civil Nuclear Programs. Washington, DC: Institute for Science and International Security.

Albright, David, and Mark Hibbs. 1992. Pakistan's Bomb: Out of the closet. *Bulletin of the Atomic Scientists* 48 (6):38-43.

Albright, David, and Corey Hinderstein. 2004. Uncovering the Nuclear Black Market: Working toward closing gaps in the international nonproliferation regime. Paper read at Institute for Nuclear Materials Management 45th Annual Meeting, 2 July 2004, at Orlando, FL.

Albright, Madeline Korbel. 1999. Article-by-Article Analysis of The Comprehensive Nuclear Test-Ban Treaty. Washington, DC: US Department of State.

Allan, Susan. 2007. Interview, edited by R. Brown. La Jolla, CA.

Allison, Graham. 2004. *Nuclear Terrorism: the ultimate preventable catastrophe*. New York: Times Books.

Alter, Karen J. 2006. Delegation to International Courts and the Limits of Re-Contracting Political Power. In *Delegation and Agency in International Organizations*, edited by D. Hawkins, D. A. Lake, D. Nielson and M. J. Tierney. Cambridge: Cambridge University Press.

Alter, Karen J. 2008. Delegating Sovereignty to International Courts. *Law & Contemporary Problems* Forthcoming.

Aoki, Masahiko. 2001. *Toward a Comparative Institutional Analysis*. Cambridge, MA: MIT Press.

Aoyagi, Masaki. 2002. Collusion in Dynamic Bertrand Oligopoly with Correlated Private Signals and Communication. *Journal of Economic Theory* 102 (1):229-248.

Aoyagi, Masaki, and Guilaume Frechette. 2005. Collusion as Public Monitoring Becomes Noisy: Experimental Evidence: Osaka University and New York University.

Army, US Department of the. 1993. *Field Manual: Health Service Support in a Nuclear, Biological, and Chemical Environment, Chapter 2: Nuclear, Biological and Chemical Weapons Effects*. Washington, DC.

Arthur, W. Brian. 1994. *Increasing Returns and Path Dependence in the Economy*. Ann Arbor: University of Michigan Press.

Asada, Masahiko. 2002. CTBT: Legal Questions Arising from its Non-Entry-Into-Force. *Journal of Conflict and Security Law* 7 (1):85-122.

ASN. 2001. Annual Report: Nuclear safety and radiation protection in France in 2001. Paris: Autorite de surete nucleaire.

Axelrod, Robert, and Robert O. Keohane. 1986. Achieving Cooperation under Anarchy: Strategies and Institutions. In *Cooperation Under Anarchy*, edited by K. Oye. Princeton, NJ: Princeton University Press.

Baldwin, David A. 1985. *Economic Statecraft*. Princeton, NJ: Princeton University Press.

Baliga, Sandeep. 1999. Monitoring and Collusion with 'Soft' Information. *Journal of Law, Economics and Organization* 15 (2):434-440.

Ballance, Robert, Janos Pogany, and Helmut Forstner. 1992. *The World's Pharmaceutical Industries*. Vermont: Edward Elgar Publishing Co.

Ballon de Amezaga, Liliam. 2005. Interview, edited by R. Brown. Vienna, Austria.

Banks, Arthur S. 2002. Cross-National Time-Series Data Archive (1945-2002): Databanks International.

Barkin, J. Samuel. 2004. Time Horizons and Multilateral Enforcement in International Cooperation. *International Studies Quarterly* 48:363-382.

Barletta, Michael, Amy Sands, and Jonathan B. Tucker. 2002. Keeping track of anthrax: the case for a biosecurity convention. *Bulletin of the Atomic Scientists* 58 (3):57-62.

Barnaby, C. Frank. 1969. Nonproliferation Negotiations, 1961-1968. In *1st Pugwash Symposium: Preventing the Spread of Nuclear Weapons*, edited by C. F. Barnaby. London: Souvenir Press.

Barnaby, Frank. 1993. *How Nuclear Weapons Spread: Nuclear-weapon proliferation in the 1990s*. London: Routledge.

Barzel, Yoram. 1997. *Economic Analysis of Property Rights*. New York: Cambridge University Press.

Beardsley, Kyle, and Victor Asal. 2007. Winning with the Bomb: The Advantages of Being a Nuclear Power: Harvard University.

Beaulieu, Eugene, and Christopher Magee. 2004. Four Simple Tests of Campaign Contributions and Trade Policy Preferences. *Economics & Politics* 16 (2):163-187.

Bechhoefler, Bernhard G. 1973. Historical Evolution of International Safeguards. In *International Safeguards and Nuclear Industry*, edited by M. Willrich. Baltimore, MD: Johns Hopkins University Press.

Beck, Michael E. 2004. The Promise and Limits of the PSI. *The Monitor* 10 (1):16-17.

Bennett, D. Scott, and Matthew C. Rupert. 2003. Comparing Measures of Political Similarity. *Journal of Conflict Resolution* 47 (3):367-393.

Bennett, D. Scott, and Allan Stam. 2000. EUGene: A Conceptual Manual. *International Interactions* 26:179-204.

Bensaude-Vincent, Bernadette, and Isabelle Stengers. 1996. *A History of Chemistry*. Translated by D. van Dam. Cambridge, MA: Harvard University Press.

Berman, Eli, and David D. Laitin. 2006. Hard Targets: Theory and Evidence on Suicide Attacks: UC San Diego Department of Economics and Stanford University Deparment of Political Science.

Bernauer, Thomas. 1990. *The Projected Chemical Weapons Convention: a guide to the negotiations in the Conference on Disarmament*. Edited by U. N. I. f. D. Research. New York, NY: UN.

Bertsch, Gary K., Richard T. Cuppitt, and Steven Elliott-Grower, eds. 1994. *International Cooperation on Nonproliferation Export Controls*. Ann Arbor, MI: University of Michigan Press.

Black, Stephen. 2002. UNSCOM and the Iraqi Biological Weapons Program. In *Biological Warfare and Disarmament: New Problems/New Perspectives*, edited by S. Wright. Lanham, MD: Rowan & Littlefield Publishers.

Bonham, G. Matthew, Victor M. Sergeev, and Pavel B. Parshin. 1997. The Limited Test-Ban Agreement: Emergence of new knowledge structures in international negotiation. *International Studies Quarterly* 41 (2):215-240.

Boutwell, Jeffrey. 1983. Politics and the Peace Movement in West Germany. *International Security* 7 (4):72-92.

Bowie, Robert R. 1961. Basic Requirements of Arms Control. In *Arms Control, Disarmament, and National Security*, edited by D. P. Brennan. New York, NY: George Braziller, Inc.

Braddick, Michael J. 2000. *State Formation in Early Modern England c.1550-1700*. New York: Cambridge University Press.

Bradley, Curtis A., and Judith G. Kelley. 2006. The Concept of International Delegation. Paper read at Delegating Sovereignty: Constitutional and Political Perspectives, 3-4 March 2006, at Duke University

Braun, Chaim, and Christopher F. Chyba. 2004. Proliferation Rings: challenges to the nuclear nonproliferation regime. *International Security* 29 (2):5-49.

Brennan, Donald G. 1976. A Comprehensive Test Ban: Everybody or Nobody. *International Security* 1 (1):92-117.

Brennan, Donald P., and Morton H. Halperin. 1961. Policy Considerations of a Nuclear-Test Ban. In *Arms Control, Disarmament, and National Security*, edited by D. P. Brennan. New York, NY: George Braziller, Inc.

Broad, William J., and David E. Sanger. 2004. As Nuclear Secrets Emerge in Khan Inquiry, More Are Suspected. *New York Times*, 26 December 2004.

Brock, William H. 2000. *The Chemical Tree: a history of chemistry*. Reissued ed. New York: W.W. Norton & Co.

Brown, Harold. 2007. U.S. Nonproliferation Policy. In *Public Policy & Nuclear Threats Summer Program 2007* La Jolla, CA: Institute for Global Conflict and Cooperation.

Brown, Robert L. 2005. 21st Century Deterrence: Punishment, Denial, and the Future Demand for Nuclear Weapons. In *The Future Security Environment and the Role of U.S. Nuclear Weapons in the 21st Century*. Washington, DC: Center for Strategic and International Studies.

Brown, Robert L., and Sonal R. Desai. 2005. International Nonproliferation Institutions, Domestic Lock-In, and Germany. Paper read at Annual Meeting of the American Political Science Association, 1-4 September 2005, at Washington, DC.

Brown, Walton Lyonnaise. 1982. Assessing the Impact of American Nuclear Proliferation Policy, 1970-1980: An Analysis of Six Cases. PhD Dissertation, Political Science, University of Michigan, Ann Arbor.

Browning, Edgar K., and Mark A. Zupan. 1996. *Microeconomic Theory and Applications*. Fifth ed. New York, NY: HarperCollins.

Buchanan, Ewen. 2005. Interview, edited by R. Brown. New York, NY.

Bud, Robert. 1991. Biotechnology in the Twentieth Century. *Social Studies of Science* 21 (3):415-457.

Bueno de Mesquita, Bruce. 1975. Measuring Systemic Polarity. *Journal of Conflict Resolution* 19 (2):187-216.

Bueno de Mesquita, Bruce. 2000. Popes, Kings, and Endogenous Institutions: The Concordat of Worms and the Origins of Sovereignty. *International Studies Review*.

Bunn, George. 1992. *Arms Control By Committee: managing negotiations with the Russians*. Stanford, CA: Stanford University Press.

Bunn, George. 2004. Interview, edited by R. Brown. Palo Alto, CA.

Burns, E.L.M. 1969. The Nonproliferation Treaty: Its Negotiation and Prospects. *International Organization* 23 (4):788-807.

Burr, William. 2005. National Intelligence Estimates of the Nuclear Proliferation Problem: the first ten years, 1957-1967. Washington, D.C.: National Security Archive.

Burr, William, and Jeffrey T. Richelson. 2000. Whether to 'Strangle the Baby in the Cradle': The United States and the Chinese Nuclear Program, 1960-64. *International Security* 25 (3):54-99.

Bush, George H.W. 2003. State of the Union.

Butler, Robin, Peter Inge, John Chilcot, Michael Mates, and Ann Taylor. 2004. Review of Intelligence on Weapons of Mass Destruction (The Butler Report). London, UK: House of Commons.

Buzan, Barry, and Richard Little. 2000. *International Systems in World History: Remaking the Study of International Relations*: Oxford University Press.

C&EN. various. Various (i.e., 'Facts and Figures', 'Finances', etc.). *Chemical and Engineering News*.

Callen, Bruce W. 1990. CORRTEX and Limits on Nuclear Testing. *Swords and Ploughshares* 4 (4):5-8.

Calvert, Randall. 1985. The Value of Biased Information: A Rational Choice Model of Political Advice. *Journal of Politics* 42 (2):530-55.

Capps, Oral. 2006. *Applied Econometric Methods in Agriculture*. College Station, TX: Texas A&M University Department o Agricultural Economics.

Carlton, Dennis W., and Jeffrey M. Perloff. 1994. *Modern Industrial Organization*. 2nd ed. Reading, MA: Addison-Wesley.

Carothers, James. 1995. Caging the Dragon: The Containment of Underground Explosions. Livermore, CA: Lawerence Livermore National Laboratory and US Department of Energy.

Carpenter, Jeffrey, Samuel Bowles, and Herbert Gintis. 2006. Mutual Monitoring in Teams: Theory and Experimental Evidence on the Importance of Reciprocity. Middlebury, VT.

Chang, Laurence, and Peter Kornbluh. 1999. The Cuban Missile Crisis, 1962: A National Security Archive Documents Reader.

Chayes, Abram, and Antonia Handler Chayes. 1993. On Compliance. *International Organization* 47 (2):175-205.

CIA. 1987. North Korea's Nuclear Efforts. In *Wampler, Robert A. 2003. North Korea and Nuclear Weapons: The Declassified U.S. Record (Electronic Briefing Book No. 87). Washington, D.C.: The National Security Archive.* Washington, DC: CIA.

CIA. 2005. Managing Nuclear Proliferation: The Politics of Limited Choice (25X1A9a, December 1975). In *National Intelligence Estimates of the Nuclear Proliferation Problem: the first ten years, 1957-1967*, edited by W. Burr. Washington, D.C.: National Security Archive.

Cleminson, Frank Ronald. 2003. What Happened to Saddam's Weapons of Mass Destruction? *Arms Control Today* 33 (7):3-6.

CNS. 2005. *Inventory of International Nonproliferation Organizations and Regimes: Convention on the Physical Protection of Nuclear Materials* [pdf file]. Center for Nonproliferation Studies, 22 April 2005 2004 [cited 29 September 2005 2005]. Available from http://cns.miis.edu/pubs/inven/pdfs/cppnm.pdf.

Cohen, Avner. 2001. Israel and Chemical/Biological Weapons: History, Deterrence and Arms Control. *The Nonproliferation Review* 8 (3):27-53.

Cohen, Avner, and Thomas Graham Jr. 2004. An NPT for non-members. *Bulletin of the Atomic Scientists* 60 (3):40-44.

Compte, Olivier. 2002a. On Failing to Cooperate When Monitoring is Private. *Journal of Economic Theory* 102 (1):151-188.

Compte, Olivier. 2002b. On Sustaining Cooperation without Public Observations. *Journal of Economic Theory* 102 (1):106-150.

Cooper, Scott, Darren Hawkins, Wade Jacoby, and Daniel Nielson. 2005. Yielding Sovereignty to International Institutions: Bringing System Structure Back In. Paper read at International Studies Association Annual Meeting, 1-5 March 2005, at Honolulu, Hawaii.

Cooter, Robert D. 2000. *The Strategic Constitution*. Princeton: Princeton University Press.

Corden, Pierce. 2004. Interview, edited by R. Brown. Washington, DC.

Corden, Pierce. 2005. Personal Communication, edited by R. Brown. Vienna, Austria.

Cortell, Andrew P., and Susan Peterson. 2006. Dutiful Agents, Rogue Actors, or Both? Staffing, Voting Rules, and Slack in the WHO and WTO. In *Delegation and Agency in International Organizations*, edited by D. Hawkins, D. A. Lake, D. Nielson and M. J. Tierney. Cambridge: Cambridge University Press.

Crone, Hugh D. 1992. *Banning Chemical Weapons*. Cambridge, MA: Cambridge University Press.

Cronin, Audrey Kurth. 2003. Behind the Curve: globalization and international terrorism. *International Security* 27 (3):30-58.

CSIS, Canada. 2000. Perspectives: Biological Weapons Proliferation: Canadian Security Intelligence Service.

Dahl, Road. 1964. *Charlie and the Chocolate Factory*: Alfred A. Knopf.

Dai, Xinyuan. 2007. *International Institutions and National Policies*: Cambridge University Press.

Dando, Malcolm. 1999. The Impact of the Development of Modern Biology and Medicine on the Evolution of Offensive Biological Warfare Programs in the Twentieth Century. *Defense Analysis* 15 (1):43.

Davison, Neil. 2005. The Role of Scientific Discovery in the Establishment of the First Biological Weapons Programmes. In *Bradford Science and Technology Report*: University of Bradford Department of Peace Studies.

Dembinski, Matthias. 1995. North Korea, IAEA Special Inspections, and the Future of the Nonproliferation Regime. *The Nonproliferation Review* 2 (2):31-40.

Devroy, Ann. 1994. U.S. to Seek Sanctions on N. Korea; Nuclear Inspectors Cite 'Lost' Change to Monitor Reactor *Washington Post*, 3 June 1994.

Diab, M. Zuhair. 1997. Syria's Chemical and Biological Weapons: Assessing Capabilities and Motivations. *The Nonproliferation Review* 5 (1):104-111.

Donnelly, Charles H. 1960. Chemical-Biological-Radiological (CBR) Warfare and its Disarmament Aspects. Washington, DC: Subcommittee on Disarmament, Committee on Foreign Relations, United States Senate 86th Congress 2nd Session.

DOS. 1986. Verifying Nuclear Testing Limitations: Possible US-Soviet Cooperation. Washington, DC: US Department of State.

Downing, Brian M. 1992. *The Military Revolution and Political Change: the origins of democracy and autocracy in early modern Europe*. Princeton, NJ: Princeton University Press.

Downs, George, and David M. Rocke. 1995. *Optimal Imperfection? Domestic uncertainty and institutions in International Relations*. Princeton, NJ: Princeton University Press.

Downs, George W. 2000. Constructing Effective Environmental Regimes. *Annual Review of Political Science* 3:25-42.

DPRK. 1994. LETTER DATED 5 MAY 1994 FROM THE PERMANENT REPRESENTATIVE OF THE DEMOCRATIC PEOPLE’S REPUBLIC OF KOREA TO THE UNITED NATIONS ADDRESSED TO THE PRESIDENT OF THE SECURITY COUNCIL (S/1994/540), edited by U. N. S. Council.

du Preez, Jean, and María Lorenzo Sobrado. 2004. *IAEA Board Gives Iran Yet Another Chance* [website]. CNS (Center for Nonproliferation Studies) Research Story, 27 September 2004 [cited 27 September 2004]. Available from http://cns.miis.edu/pubs/week/040927.htm.

Duelfer, Charles A. 2004. Comprehensive Revised Report with Addendums on Iraq's Weapons of Mass Destruction (Duelfer Report). Washington, D.C.: Iraq Survey Group (ISG) and Special Advisor to the Director of Central Intelligence on Iraq's Weapons of Mass Destruction.

Dunn, Lewis A. 1985. The Emerging Nuclear Suppliers: some dimensions of the problem. In *The Nuclear Suppliers and Nonproliferation*, edited by R. W. Jones, C. Merlini, J. F. Pilat and W. C. Potter. Lexington, MA: Lexington Books.

Eden, Lynn. 2004. *Whole World On Fire: Organizations, Knowledge, and Nuclear Weapons Devastation*. Ithaca, NY: Cornell University Press.

Einhorn, Robert. 2004. Interview, edited by R. Brown. Washington, DC.

ElBaradei, Mohamed. 2004a. Introductory Statement to the Board of Governors (13 September 2004). Vienna, Austria: International Atomic Energy Agency.

ElBaradei, Mohamed. 2004b. Introductory Statement to the Board of Governors (25 November 2004). Vienna, Austria: International Atomic Energy Agency.

Elliot, Kimberly Ann, Gary Clyde Hufbauer, and Jeffrey J. Schott. 2008. *Economic Sanctions Reconsidered*. 3rd ed. Washington, DC: Institute for International Economics

Epstein, David, and Sharyn O'Halloran. 1999. *Delegating Powers*. Cambridge: Cambridge University Press.

Esteban, Joan, and Debraj Ray. 2001. Collective Action and the Group Size Paradox. *American Political Science Review* 95 (3):663-672.

EY. Various. Various. In *Biotechnology Industry Report*: Ernst & Young LLP.

Faiola, Anthony, and Dafna Linzer. 2004. S. Korea Admits Extracting Plutonium. *Washington Post*, 10 September 2004, A01.

Falk, Richard. 2002. The Challenges of Biological Weaponry: A 21st Century Assessment. In *Biological Warfare and Disarmament: New Problems/New Perspectives*, edited by S. Wright. Lanham, MD: Rowan & Littlefield Publishers.

Fängmark, Ingrid, and Lena Norlander. 2005. Indicators of State and Non-State Offensive Chemical and Biological Programmes. Stockholm, Sweden: Weapons of Mass Destruction Commission (WMDC).

Fearon, James D. 1995. Rationalist Explanations for War. *International Organization* 49 (3):379-414.

Fearon, James D. 1998. Bargaining, Enforcement, and International Cooperation. *International Organization* 52 (2):269-305.

Fearon, James D., and David D. Laitin. 2003. Ethnicity, Insurgency, and Civil War. *American Political Science Review* 97 (1):75-91.

Fields, Jeffrey, Joe Sepulveda, Marian Wang, and Tomoko Yasaka. 2007. *Iraq Profile: Nuclear Overview* [web site]. Nuclear Threat Initiative, February 2006 2006 [cited 1 June 2007]. Available from http://www.nti.org/e_research/profiles/Iraq/Nuclear/index.html.

Findlay, Trevor, ed. 1991. *Chemical Weapons & Missile Proliferation (with implications for the Asia/Pacific region)*. Boulder, CO: Lynne Rienner Publishers.

Findlay, Trevor. 2003. The lessons of UNSCOM and UNMOVIC. In *Verification Yearbook 2004*, edited by T. Findlay. London.

Finer, Samuel. 1975. State- and Nation-Building in Europe: Role of the Military. In *The Formation of Nation States in Western Europe*, edited by C. Tilly. Princeton, NJ: Princeton University Press.

Firmage, Edwin Brown. 1969. The Treaty on the Non-Proliferation of Nuclear Weapons. *American Journal of International Law* 63 (4):711-746.

Fischer, David A.V. 1997. *History of the International Atomic Energy Agency: the first forty years*. Vienna: International Atomic Energy Agency.

Forsberg, Randall, William Driscoll, Gregory Webb, and Jonathan Dean. 1995. *Nonproliferation Primer: preventing the spread of nuclear, chemical, and biological weapons.* Cambridge, MA: The MIT Press.

Frantz, Douglas. 2005. A High-Risk Nuclear Stakeout. *Los Angeles Times*, 27 February 2005.

Fraser, Claire, and Malcolm Dando. 2001. Genomics and Future Biological Weapons: The need for preventative action by the biomedical community. *Nature Genetics*:253-265.

Frieden, Jeffrey A. 1999. Actors and Preferences in International Relations. In *Strategic Choice and International Relations*, edited by D. A. Lake and R. Powell. Princeton: Princeton University Press.

Frost, Robin M. 2005. *Nuclear Terrorism After 9/11*, *Adelphi Papers #378*. New York, NY: Routledge for the International Institute for Strategic Studies.

Gallini, Linda. 2004. Interview, edited by R. Brown. Washington, DC.

Garoupa, Nuno. 1997. The Theory of Optimal Law Enforcement. *Journal of Economic Surveys* 11 (3):267-295.

Gartzke, Erik. 1998. Kant we all just get along? Opportunity, Willingness, and the Origins of the Democratic Peace. *American Journal of Political Science* 42 (1):1-27.

Gartzke, Erik. 2000. Preferences and the Democratic Peace. *International Studies Quarterly* 44:191-212.

Gartzke, Erik, and Dong-Joon Jo. 2007. Bargaining, Nuclear Proliferation, and Interstate Disputes: Harvard University.

Gleditsch, Kristian Skrede. 2002. *All International Politics is Local: The Diffusion of Conflict, Integration and Democratization*. Ann Arbor, MI: University of Michigan Press.

Gleditsch, Kristian Skrede, and Michael D. Ward. 1999. Interstate System Membership: A Revised List of the Independent States since 1816 *International Interactions* 25:393-413.

Gleditsch, Nils Petter, Peter Wallensteen, Margareta Sollenberg Ericksson, and Harvard Strand. 2002. Armed Conflict 1946-2001: A New Dataset. *Journal of Peace Research* 39 (5):615-637.

Goldblat, Jozef. 1971. *The Problem of Chemical and Biological Warfare, Volume 4: CB Disarmament Negotiations, 1920-1970*. Stockholm: SIPRI.

Goldschmidt, Bertrand. 1977. A Historical Survey of Nonproliferation Policies. *International Security* 2 (1):69-87.

Goldschmidt, Bertrand. 1985. From Nuclear Middle Ages to Nuclear Renaissance. In *Atoms for Peace: An Analysis After Thirty Years*, edited by J. F. Pilat, R. E. Pendley and C. K. Ebinger. Boulder, CO: Westview Press.

Goldstein, Judith, Miles Kahler, Robert O. Keohane, and Anne-Marie Slaughter. 2001. Introduction: Legalization and World Politics. In *Legalization and World Politics*, edited by J. Goldstein, M. Kahler, R. O. Keohane and A.-M. Slaughter. Cambridge, MA: MIT Press.

Goodby, James E. 2005. The Limited Test Ban Negotiations, 1954-63: How a negotiator viewed the precedings. *International Negotiation* 10:381-404.

Gould, Chandré, and Peter I. Folb. 2000. The South African Chemical and Biological Warfare Program: An Overview. *The Nonproliferation Review* 7 (3):10-23.

Gould, Erica R. 2003. Money Talks: Supplementary Financiers and International Monetary Fund Conditionality. *International Organization* 57 (3):551-586.

Gould, Erica R. 2006. Delegating Conditionality: Understanding Variations in Control and Conformity. In *Delegation and Agency in International Organizations*, edited by D. Hawkins, D. A. Lake, D. Nielson and M. J. Tierney. Cambridge: Cambridge University Press.

Green, Edward J., and Robert H. Porter. 1984. Noncooperative Collusion under Imperfect Price Information. *Econometrica* 52 (1):87-100.

Greenwood, Ted, and Robert Jr. Haffa. 1981. Supply-Side Non-Proliferation. *Foreign Policy* 42:125-140.

Grossi, Rafael Mariano. 2005. Interview, edited by R. Brown. The Hague, The Netherlands.

Gummett, Philip. 1981. From NPT to INFCE: Development in Thinking about Nuclear Non-Proliferation. *International Affairs (Royal Institute of International Affairs)* 57 (4):549-567.

Haftel, Yoram Z., and Alexander Thompson. 2006. The Independence of International Organizations: Concept and Applications. *Journal of Conflict Resolution* 50 (2):253-275.

Haftendorn, Helga. 2005. Germany's Accession to NATO: 50 years on. *NATO Review* Summer 2005.

Haftendorn, Helga, Robert O. Keohane, and Celeste A. Wallander. 1999. *Imperfect Unions: security institutions over time and space*. Oxford: Oxford University Press.

Haggard, Stephan, and Beth A. Simmons. 1987. Theories of International Regimes. *International Organization* 41 (3):491-517.

Hall, Bronwyn H., Adam B. Jaffe, and Manuel Trajtenberg. 2001. The NBER Patent Citations Data File: Lessons, Insights and Methodological Tools (NBER Working Paper 8498). Cambridge, MA: National Bureau of Economic Research (NBER).

Hammes, Thomas X. 2005. Insurgency: Modern Warfare Evolves into a Fourth Generation. In *Strategic Forum #214*. Washington, DC: National Defense University.

Hanchen, Thomas, and Thomas von Ungern-Sternberg. 1985. Information Costs, Intermediation and Equilibrium Price. *Economica* 52:407-419.

Hancock, Kathleen J. 2001. Surrendering Sovereignty: Hierarchy in the International System and the Former Soviet Union. Dissertation, Political Science, University of California at San Diego, La Jolla.

Hart, John, Frida Kuhlau, Ronald Sutherland, and Jean Pascal Zanders. 2002. Maintaining the Effectiveness of the Chemical Weapons Convention. Stockholm: Stockholm International Peace Research Institute.

Hawkins, Darren, and Wade Jacoby. 2003. How Agents Matter. Paper read at Delegation to International Organizations, August 23, 2003, at San Diego, CA.

Hawkins, Darren, David A. Lake, Daniel Nielson, and Michael J. Tierney. 2006. States, International Organizations, and Principal-Agent Theory. In *Delegation and Agency in International Organizations*, edited by D. Hawkins, D. A. Lake, D. Nielson and M. J. Tierney: Cambridge University Press.

Hildenbrand, Gunter. 1978. A German Reaction to U.S. Nonproliferation Policy. *International Security* 3 (2):51-56.

Hirdman, Sven, ed. 1972. *The Near-Nuclear Countries and the NPT*. Stokholm: Stockholm International Peace Research Institute.

Hirschleifer, Jack. 1987. *Economic Behavior in Adversity*. Chicago, IL: University of Chicago Press.

Hogendoorn, E.J. 1997. A chemical weapons atlas. *Bulletin of the Atomic Scientists* 53 (5):35-39.

Holzinger, Katharina. 2003. Common Goods, Matrix Games and Institutional Response. *European Journal of International Relations* 9 (2):173-212.

Horowitz, Michael. 2004. Assessing the Empirical Impact of Nuclear, Biological and Chemical Weapons Proliferation. Paper read at International Studies Association Annual Meeting, March 2004, at Honolulu, HI.

Horowitz, Michael. 2007. The Diffusion of Nuclear Weapons: Is Nuclear Deterrence an Emerging Property: Harvard University.

Huber, John D., and Charles R. Shipan. 2002. *Deliberate Discretion? The institutional foundations of bureaucratic autonomy.* New York, NY: Cambridge University Press.

Hufbauer, Gary Clyde, Jeffrey J. Schott, and Kimberly Ann Elliot. 1990. *Economic Sanctions Reconsidered: supplemental case histories*. 2nd ed. Washington, DC: Institute for International Economics

Hughs, Sally Smith. 2001. Making Dollars out of DNA: The First Major Patent in Biotechnology and the Commercialization of Molecular Biology, 1974-1980. *Isis* 92 (3):541-575.

IAEA. 1957. Statute of the IAEA. Vienna: The International Atomic Energy Agency.

IAEA. 1982. The Annual Report for 1981. Vienna: The International Atomic Energy Agency.

IAEA. 1984. The Annual Report for 1983. Vienna: The International Atomic Energy Agency.

IAEA. 1994. IMPLEMENTATION OF THE AGREEMENT BETWEEN THE AGENCY AND THE DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA FOR THE APPLICATION OF SAFEGUARDS IN CONNECTION WITH THE TREATY ON THE NON-PROLIFERATION OF NUCLEAR WEAPONS (INFCIRC/4O3). Vienna: International Atomic Energy Agency.

IAEA. 1997. The IAEA Turns 40: Key Dates and Historical Developments. Vienna, Austria: The International Atomic Energy Agency.

IAEA. 1998. The Evolution of IAEA Safeguards. Vienna, Austria: The International Atomic Energy Agency.

IAEA. 2002. Annual Report of the International Atomic Energy Agency (IAEA): United Nations.

IAEA. 2003. Technical Co-operation Report for 2002. Vienna: IAEA.

IAEA. 2004. Implementation of the NPT Safeguards Agreement in the Islamic Republic of Iran. Vienna, Austria: International Atomic Energy Agency.

IAEA. 2006. Nuclear Power Reactors in the World. In *Reference Data Series No.2*. Vienna: IAEA.

IAEA. 2008. *Fact sheet on DPRK nuclear safeguards* International Atomic Energy Agency, 2007a [cited 11 January 2008]. Available from http://www.iaea.org/NewsCenter/Focus/IaeaDprk/fact_sheet_may2003.shtml.

IAEA. 2007b. IAEA-TC (Technical Cooperation) Projects By Country. Vienna: IAEA.

IAEA. 2007c. iNFCIS (Integrated Nuclear Fuel Cycle Information System): IAEA.

IAEA. 2007d. Nuclear Research Reactors in the World: IAEA.

IAEA. 2007e. Power Reactor Information System: IAEA.

Intriligator, Michael, and Abdullah Toukan. 2006. Terrorism and Weapons of Mass Destruction. In *Creating a global counter-terrorism network*, edited by P. Katona, J. Sullivan and M. Intriligator. London: Taylor & Francis.

Jensen, Lloyd. 1974. *Return from the Nuclear Brink*. Lexington, MA: Lexington Books.

Jervis, Robert. 1978. Cooperation under the security dilemma. *World Politics* 30 (2):167-214.

Jervis, Robert. 1982. Security Regimes. *International Organization* 36 (2):173-194.

Jo, Dong-Joon, and Erik Gartzke. 2007. Determinants of Nuclear Weapons Proliferation. *Journal of Conflict Resolution* 51 (1):167-194.

Jo, Dong-Joon, and Erik Gartzke. ND. Determinants of Nuclear Weapons Proliferation: a quantitative model.

Jones, Brian. 2003. Intelligence, verification and Iraq's WMDs. In *Verification Yearbook 2004*, edited by T. Findlay. London: VERTIC.

Jones, Rodney W., Cesare Merlini, Joseph F. Pilat, and William C. Potter, eds. 1985. *The Nuclear Suppliers and Nonproliferation*. Lexington, MA: Lexington Books.

Kadlec, Robert P., Allan P. Zelicoff, and Ann M. Vritis. 1997. Biological Weapons Control: Prospects and Implications for the Future. *Journal of the American Medical Association* 278 (5):351-356.

Kahler, Miles. 2000. The state of the state in world politics. Paper read at State of the Discipline, 1-2 December 2000, at Washington, DC.

Kahler, Miles. 2001. Conclusion: The Causes and Consequences of Legalization. In *Legalization and World Politics*, edited by J. Goldstein, M. Kahler, R. O. Keohane and A.-M. Slaughter. Cambridge, MA: MIT Press.

Kandori, Michihiro. 2002. Introduction to Repeated Games with Private Monitoring. *Journal of Economic Theory* 102 (1):1-15.

Kang, Jungmin, Peter Hayes, Li Bin, Tastujiro Suzuki, and Richard Tanter. 2005. South Korea's Nuclear Surprise. *Bulletin of the Atomic Scientists* 61 (1):40-49.

Karon, Tony. 2007. Spinning the NIE Iran Report. *Time Magazine*, 5 December 2007.

Keohane, Robert O. 1982. The demand for international regimes. *International Organization* 36 (2).

Keohane, Robert O. 1984. *After Hegemony: Cooperation and Discord in the World Political Economy*. Princeton, NJ: Princeton University Press.

Keohane, Robert O., and Lisa L. Martin. 1999. Institutional Theory, Endogeneity, and Delegation. Paper read at Progress in International Relations Theory: A Collaborative Assessment and Application of Imre Lakatos's Methodology of Scientific Research Programs, January 15-16, 1999, at Scottsdale, AZ.

Kiewiet, D. Roderick, and Mathew D. McCubbins. 1991. *The Logic of Delegation*. Chicago, IL: University of Chicago Press.

Koblentz, Gregory. 2004. Pathogens as Weapons: the international security implications of biological warfare. *International Security* 28 (3).

Koremenos, Barbara. ND. Bringing More ‘Precision’ to the Three Dimensions of Legalization.

Koremenos, Barbara, Charles Lipson, and Duncan Snidal. 2001. The Rational Design of International Institutions. *International Organization* 55 (4):761-799.

Krasner, Stephen D. 1983. Structural causes and regime consequences: regimes as intervening variables. *International Organization* 36 (2).

Krasner, Stephen D. 1991. Global Communications and National Power. *World Politics* 43:336-66.

Krasner, Stephen D. 1999. *Sovereignty: organized hypocrisy*. Princeton, NJ: Princeton University Press.

Kroenig, Matthew. 2007. Importing the Bomb: Sensitive Nuclear Assistance and Nuclear Proliferation: Harvard University.

Kvok, Boris. 2005. Interview, edited by R. Brown. Vienna, Austria.

Lake, David A. 1999. *Entangling Relations*. Princeton, NJ: Princeton University Press.

Lake, David A. 2001. Beyond Anarchy: The Importance of Security Institutions. *International Security* 26 (1):129-160.

Lake, David A. 2005. Hierarchy in International Relations: Authority, Sovereignty, and the New Structure of World Politics. Paper read at Annual Meeting of the International Studies Association, 1-5 March 2005, at Honolulu, Hawaii.

Lake, David A. 2007. Escape from the State-of-Nature: Authority and Hierarchy in World Politics. *International Security* 32 (1):47-49.

Lake, David A., and Mathew D. McCubbins. 2006. The Logic of Delegation to International Organizations. In *Delegation and Agency in International Organizations*, edited by D. Hawkins, D. A. Lake, D. Nielson and M. J. Tierney. Cambridge: Cambridge University Press.

Lake, David A., and Robert Powell. 1999. International Relations: A Strategic-Choice Approach. In *Strategic Choice and International Relations*, edited by D. A. Lake and R. Powell. Princeton: Princeton University Press.

Le Guelte, Georges. 1999. A Commentary on Further Cooperation. Paper read at 2nd NSG International Seminar on the Role of Export Controls in Nuclear Non-Proliferation, 8-9 April 1999, at New York, NY.

Lehman, Ronald. 2004. Interview, edited by R. Brown. Livermore, CA.

Leitenberg, Milton. 2000. An Assessment of the Biological Weapons Threat to the United States. Paper read at Emerging Threats Assessment: Biological Terrorism, 7-9 July 2000, at Dartmouth College Institute for Security Technology Studies.

Leitenberg, Milton. 2005. Assessing the Biological Weapons and Bioterrorism Threat. Carlisle, PA: US Army War College Strategic Studies Institute.

Letterie, Wilko, and Otto H. Swank. 1997. Learning and signaling by advisor selection. *Public Choice* 92:353-367.

Levi, Margaret. 1988. *Of Rule and Revenue*. Berkeley, CA: University of California Press.

Levi, Michael. 2007. *On nuclear terrorism*. Cambridge, MA: Harvard University Press.

Levite, Ariel E. 2003. Never Say Never Again: nuclear reversal revisited. *International Security* 27 (3):59-88.

Liberman, Peter. 2001. The Rise and Fall of the South African Bomb. *International Security* 26 (2):43-86.

Lind, William S., Keith Nightengale, John F. Schmitt, Joseph W. Sutton, and Gary I. Wilson. 1989. The Changing Face of War: Into the fourth generation. *Marine Corps Gazette* October 1989:22-26.

Lindgren, David T. 2000. *Trust but verify: imagery analysis in the Cold War*. Annapolis, MD: Naval Institute Press.

Linzer, Dafna. 2004a. Nuclear capabilities may elude terrorists, experts say. *Washington Post*, 29 December 2004, A01.

Linzer, Dafna. 2004b. S. Korea Nuclear Project Detailed. *Washington Post*, 12 September 2004, A24.

Livingstone, Neil C., and Joseph D. Douglass, Jr. 1984. *CBW: The Poor Man's Atomic Bomb*. Vol. 1, *National Security Paper*. Cambridge, MA: Institute for Foreign Policy Analysis.

Loeb, Benjamin S. 1991. The Limited Test Ban Treaty. In *The Politics of Arms Control Treaty Ratification*, edited by M. Krepon and D. Caldwell. New York, NY: St. Martins Press.

Lowrance, William W. 1976. Nuclear Futures For Sale: To Brazil from West Germany, 1975. *International Security* 1 (2):147-166.

Lupia, Arthur, and Mathew D. McCubbins. 1994. Designing Bureaucratic Accountability. *Law and Contemporary Problems* 57 (1):91-126.

Lyne, Mona, Daniel Nielson, and Michael J. Tierney. 2006a. A Problem of Principals: Common agency and social lending at the multilateral development banks: University of South Carolina, Brigham Young University, College of William and Mary.

Lyne, Mona, Daniel Nielson, and Michael J. Tierney. 2006b. Getting the model right: single, multiple, and collective principals in development aid. In *Delegation and Agency in International Organizations*, edited by D. Hawkins, D. A. Lake, D. Nielson and M. J. Tierney: Cambridge University Press.

Manyin, Mark E. 2001. North Korea-Japan Relations: The normalization talks and the compensation/reparations issue. In *CRS Report for Congress*. Washington, DC: Congressional Research Service.

Martin, Lisa L. 1992a. *Coercive Cooperation*. Princeton, NJ: Princeton University Press.

Martin, Lisa L. 1992b. Interests, Power, and Multilateralism. *International Organization* 46 (4):765-792.

Martin, Lisa L. 2000. *Democratic Commitments: Legislatures and International Cooperation*. Princeton: Princeton University Press.

Martin, Lisa L. 2002a. Distribution, Information, and Delegation to International Organizations: The case of IMF conditionality. Harvard University.

Martin, Lisa L. 2006. Distribution, Information, and Delegation to International Organizations: The case of IMF conditionality. In *Delegation and Agency in International Organizations*, edited by D. Hawkins, D. A. Lake, D. Nielson and M. J. Tierney. Cambridge: Cambridge University Press.

Martin, Lisa L., and Beth A. Simmons. 1999. Theories and Empirical Studies of International Institutions. In *Exploration and Contestation in the Study of World Politics*, edited by P. J. Katzenstein, R. O. Keohane and S. D. Krasner. Cambridge, MA: MIT Press.

Martin, Susan B. 2002b. The Role of Biological Weapons in International Politics: The Real Military Revolution. *Journal of Strategic Studies* 25 (1):63-98.

Massarani, Luisa. 2004. Brazil denies refusing to allow nuclear inspections. In *SciDevNet: Science and Development Network*.

May, Michael (chair). 2008. Nuclear Forensics: role, state of the art, and program needs. Washington, D.C.: Joint Working Group of the American Physical Society (APS) and the American Association for the Advancement of Science (AAAS).

Mazarr, Michael J. 1995. Going Just a Little Nuclear: nonproliferation lessons from North Korea. *International Security* 20 (2):92-122.

McBride, James Hubert. 1967. *The Test Ban Treaty: military, technological, and political implications*. Chicago, IL: Henry Regnery Company.

McCarthy, Timothy, Jeffrey Fields, Jennifer Arbaugh, Jack Boureston, Junko Horibe, Joe Sepulveda, and Marian Wang. 2007. *Iraq Profile: Biological Weapons Overview* [web site]. Nuclear Threat Initiative, February 2006 2006a [cited 1 June 2007]. Available from http://www.nti.org/e_research/profiles/Iraq/Biological/index.html.

McCarthy, Timothy, Jeffrey Fields, Markus K. Binder, and Sarah Wickre. 2007. *Iraq Profile: Chemical Weapons Overview* [web site]. Nuclear Threat Initiative, February 2006 2006b [cited 1 June 2007]. Available from http://www.nti.org/e_research/profiles/Iraq/Chemical/index.html.

McCubbins, Mathew D., and Daniel B. Rodriguez. 2006. When Does Deliberating Improve Decisionmaking? *Journal of Contemporary Legal Issues* 15 (9):9-51.

McCubbins, Mathew D., and Thomas Schwartz. 1984. Congressional Oversight Overlooked: Police Patrols versus Fire Alarms. *American Journal of Political Science* 28 (1):165-179.

McCubbins, Mathew, Roger Noll, and Barry Weingast. 1987. Administrative Procedures as Instruments of Political Control. *Journal of Law, Economics and Organization* 3 (2):243-277.

McCubbins, Mathew, Roger Noll, and Barry Weingast. 1989. Structure and Process, Politics and Policy: Administrative Arrangements of Political Control. *Virginia Law Review* 75 (2):431-482.

McElroy, Rodney J. 1991. The Geneva Protocol of 1925. In *The Politics of Arms Control Treaty Ratification*, edited by M. Krepon and D. Caldwell. New York, NY: St. Martins Press.

McKenzie, Kenneth F. 2000. The Revenge of the Melians: Asymmetric Threats and the Next QDR. In *McNair Paper*. Washington, DC: National Defense University.

McKnight, Allan. 1970. Nuclear Non-Proliferation: IAEA and EURATOM. New York, NY: Carnegie Endowment for International Peace.

McKnight, Allan. 1971. *Atomic Safeguards: a study in international verification*, *UNITAR Study*. New York: United Nations.

Mearsheimer, John J. 1994. The False Promise of International Institutions. *International Security* 19 (3):5-49.

Mearsheimer, John J. 2001. *The Tragedy of Great Power Politics*. New York: Norton.

Medalia, Jonathan. 1998. Nuclear Weapons: Comprehensive Test Ban Treaty and Nuclear Testing (CRS Issue Brief IB92099). Washington, DC: Congressional Research Service.

Meselson, Matthew, and Julian Perry Robinson. 1980. Chemical Warfare and Chemical Disarmament. *Scientific American* 242 (4).

Mickolus, Edward F., Todd Sandler, Jean M. Murdock, and Peter A. Flemming. 2003. International Terrorism: Attributes of Terrorist Events, 1968-2002 (ITERATE). Dunn Loring, VA: Vinyard Software.

Miller, Judith, Stephen Engelberg, and William Broad. 2001. *Germs: biological weapons and America's secret war*. New York: Simon & Schuster.

Milner, Helen V. 1997. *Interests, institutions and information: domestic politics and international relations*. Princeton: Princeton University Press.

Milner, Helen V. 2006. Why Multilateralism? Foreign aid and domestic principal-agent problems. In *Delegation and Agency in International Organizations*, edited by D. Hawkins, D. A. Lake, D. Nielson and M. J. Tierney. Cambridge: Cambridge University Press.

Milton, Brooke, and Guarav Kampani. 2007. *North Korean Nuclear Developments: an updated chronology* Center for Nonproliferation Studies, 2007 [cited 10 December 2007].

Mintz, John. 2004. Technical hurdles separate terrorists from biowarfare. *Washington Post*, 30 December 2004, A01.

Moodie, Michael. 1999. The Chemical Weapons Threat. In *The New Terror: Facing the Threat of Biological and Chemical Weapons*, edited by S. D. Drell, A. D. Sofaer and G. D. Wilson. Stanford, CA: Stanford University Press.

Moodie, Michael. 2003. CBACI Special Report #5: Reducing the Biological Threat: New Thinking, New Approaches. Washington, D.C.: Chemical and Biological Arms Control Institute (CBACI).

Moodie, Michael L. 2004. Interview, edited by R. Brown. Washington, DC.

Moore, Matthew, and Adrian Blomfield. 2007. Bush warns Putin over 'World War Three'. *The Telegraph (U.K.)*, 17 October 2007.

Moore, Thomas. 2004. Interview, edited by R. Brown. Washington, DC.

Morgan, Patrick M. 2003. *Deterrence Now*. Cambridge: Cambridge University Press.

Morgenthau, Hans J. 1985. *Politics Among Nations*. Edited by K. W. Thompson. 6th (Brief) ed. Boston, MA: McGraw-Hill.

Morrow, James D. 1994. Modeling the Forms of International Cooperation: Distribution Versus Information. *International Organization* 48 (3):387-423.

Muller, Harald, David A.V. Fischer, and Wolfgang Kotter. 1994. *Nuclear Non-Proliferation and Global Order*, *SIPRI*. New York, NY: Oxford University Press.

Mundell, Ian. 2005. Interview, edited by R. Brown. The Hague, The Netherlands.

Nacht, Michael. 1981. The Future Unlike The Past: Nuclear Proliferation and American Security Policy. *International Organization* 35 (1):193-212.

NDU. 2002. Chemical, Biological, Radiological, and Nuclear Terrorism: The Threat According the Current Unclassified Literature. Washington, D.C.: Center for Nonproliferation Research at National Defense University.

NIC. 2007. Iran: Nuclear Intentions and Capabilities (November 2007). In *National Intelligence Estimate*. Washington, DC: National Intelligence Council, Office of the Director of National Intelligence.

Nielson, Daniel, and Michael J. Tierney. 2003. Delegation to International Organizations: Agency Theory and World Bank Environmental Reform. *International Organization* 57 (2):241-276.

NSG. 1997. International Seminar on the Role of Export Controls In Nuclear Non-proliferation, 7-8 October 1997, at Vienna, Austria.

NTI. 2008. *North Korea Profile, Nuclear: Biological Weapons Overview* Nuclear Threat Initiative, January 2008 2004a [cited 1 May 2008]. Available from http://www.nti.org/e_research/profiles/NK/Biological/index.html.

NTI. 2008. *North Korea Profile, Nuclear: Chemical Chronology, 1947-1996* Nuclear Threat Initiative, 2004 2004b [cited 1 May 2008]. Available from http://www.nti.org/e_research/profiles/NK/Chemical/52.html.

NTI. 2007. *South Korea Profile, Nuclear: Nuclear Chronology, 1950-1979* Nuclear Threat Initiative, 2004c [cited 26 November 2007 2007]. Available from http://www.nti.org/e_research/profiles/SKorea/Nuclear/3045_3046.html.

NTI. 2007. *Iraq Profile: Nuclear, Biological and Chemical Weapons and Missiles* [web site]. February 2006 2007 [cited January 2007 2007]. Available from http://www.nti.org/e_research/profiles/Iraq/index.html.

Official, CTBTO-PTS. 2005a. CTBTO-PTS Interview, edited by R. Brown. Vienna, Austria.

Official, I.A.E.A. 2005b. IAEA Interview 01, edited by R. Brown. Vienna, Austria.

Official, I.A.E.A. 2005c. IAEA Interview 02, edited by R. Brown. Vienna, Austria.

Official, I.A.E.A. 2005d. IAEA Interview 03, edited by R. Brown. Vienna, Austria.

Official, I.A.E.A. 2005e. IAEA Interview 04, edited by R. Brown. Vienna, Austria.

Official, I.A.E.A. 2005f. IAEA Interview 05, edited by R. Brown. Vienna, Austria.

Official, U.K. Ministry of Defense. 2006. Presentation, edited by R. Brown. Annapolis, MD.

Official, U.S. State Department. 2004a. Interview 04, edited by R. Brown. Washington, DC.

Official, U.S. State Department. 2004b. Interview 05, edited by R. Brown. Washington, DC.

Official, U.S. State Department. 2005g. Personal Communication 13, edited by R. Brown. Washington, DC.

Olson, Mancur, and Richard Zeckhauser. 1966. An Economic Theory of Alliances. *Review of Economic and Statistics* (48):266-279.

Ondrejka, Ronald J. 1986. Imaging Technologies. In *Arms Control Verification: The Technologies That Make It Possble*, edited by K. Tsipis, D. W. Hafemeister and P. Janeway. Washington, DC: Pergamon-Brassey's International Defense Publishers.

OPCW. 1993. Chemical Weapons Convention (Convention on the prohibition of the development, production, stockpiling and use of chemical weapons and their destruction). Paris.

Orberdorfer, Don. 1979. Pakistan: The Quest for Atomic Bomb; Problem Discussed by West, Moscow, Peking. *The Washington Post*, 27 August 1979, A1.

OSD. 1996. Proliferation: Threat and Response. Washington, D.C.: Office of the Secretary of Defense, U.S. Department of Defense.

OSD. 2006. *Fact Sheet on Exposure Limits for Sarin (GB)* [http://www.gulflink.osd.mil/dugway/low_lv_chem_fact.htm]. Office of the Special Assistant for Gulf War Illnesses, 1997 [cited 18 January 2006]. Available from http://www.gulflink.osd.mil/dugway/low_lv_chem_fact.htm.

Osiander, Andreas. 2001. Sovereignty, International Relations, and the Westphalian Myth. *International Organization* 55 (2):251-288.

Ostrom, Elinor. 1990. *Governing the Commons: the evolution of institutions for collective action*. New York: Cambridge University Press.

OTA. 1993a. Proliferation of Weapons of Mass Destruction: Assessing the Risks. Washington, D.C.: U.S. Congress, Office of Technology Assessment.

OTA. 1993b. Technologies Underlying Weapons of Mass Destruction. Washington, D.C.: U.S. Congress, Office of Technology Assessment.

Oudraat, Chantal de Jonge. 2002. UNSCOM: Between Iraq and a Hard Place. *European Journal of International Law* 13 (1):139-152.

Ølgaard, P.L. 1969. The Soviet-American Draft Non-proliferation Treaty: Will it Work? In *1st Pugwash Symposium: Preventing the Spread of Nuclear Weapons*, edited by C. F. Barnaby. London: Souvenir Press.

Pearson, Graham S. 2004. 21 Years of CBW Protection: A Changing World. Paper read at 8th International Symposium on Protection Against Chemical and Biological Warfare Agents, 2-6 June 2004, at Gothenburg, Sweden.

Pearson, Graham S. 2006. The Iraqi Biological Weapons Program. In *Deadly Cultures: Biological Weapons Since 1945*, edited by M. Wheelis, L. Rozsa and M. Dando. Cambridge, MA: Harvard University Press.

PhRMA. 1991. PMA Statistical Factbook. Washington, DC: Pharmaceutical Research and Manufacturers of America (PhRMA).

PhRMA. 2007. Pharmaceutical Industry Profile 2007. Washington, DC: Pharmaceutical Research and Manufacturers of America (PhRMA).

Pilat, Joseph F. 2005. Reassessing Security Assurances in a Unipolar World. *Washington Quarterly* 28 (2):159-170.

Pilat, Joseph F., Robert E. Pendley, and Charles K. Ebinger, eds. 1985. *Atoms for Peace: An Analysis After Thirty Years*. Boulder, CO: Westview Press.

Pinkston, Daniel A. 2007. *South Korea's Nuclear Experiments* Center for Nonproliferation Studies, 9 November 2004 [cited 12 December 2007]. Available from http://cns.miis.edu/pubs/week/041109.htm.

Polinsky, A. Mitchell. 1980. Private versus Public Enforcement of Fines. *Journal of Legal Studies* 9 (1):105-127.

Polinsky, A. Mitchell, and Steven Shavell. 2006. The Theory of Public Enforcement of Law. In *Handbook of Law and Economics, Volume 1*, edited by A. M. Polinsky and S. Shavell.

Pollack, Jonathan D., and Mitchell B. Reiss. 2004. South Korea: The Tyranny of Geography and the Vexations of History. In *The Nuclear Tipping Point: why states reconsider their nuclear choices*, edited by K. M. Campbell, R. J. Einhorn and M. B. Reiss. Washington, DC: Brookings Institution Press.

Pollack, Kenneth M. 2002. *Arabs at War: Military Effectiveness, 1948-1991*. Lawrence, NE: University of Nebraska Press.

Pollack, Kenneth M. 2006a. Principal-Agent Analysis and International Delegation: Red Herrings, Theoretical Clarifications, and Empirical Disputes. Paper read at Delegating Sovereignty: Constitutional and Political Perspectives, 3-4 March 2006, at Duke University

Pollack, Mark A. 1997. Delegation, agency, and agenda setting in the European Community. *International Organization* 51 (1):99-134.

Pollack, Mark A. 2003. The Delegation of Powers to the European Commission. Paper read at Delegation to International Organizations, August 23, 2003, at San Diego, CA.

Pollack, Mark A. 2005. Theorizing the European Union: International Organization, Domestic Polity, or Experiment in New Governance. *Annual Review of Political Science* 8:357-398.

Pollack, Mark A. 2006b. The Delegation of Powers to the European Commission. In *Delegation and Agency in International Organizations*, edited by D. Hawkins, D. A. Lake, D. Nielson and M. J. Tierney. Cambridge: Cambridge University Press.

Powell, Robert. 1999. *In the Shadow of Power: states and strategies in international politics*. Princeton: Princeton University Press.

Powell, Robert. 2002. Bargaining Theory and International Conflict. *Annual Review of Political Science* 5:1-30.

Powell, Robert. 2006. War as a Commitment Problem. *International Organization* 60 (1):169-203.

Power, Paul F. 1986. The Mixed State of Non-Proliferation: The NPT Review Conference and Beyond. *International Affairs (Royal Institute of International Affairs)* 62 (3):477-491.

Pritchard, Charles L. 2007. *Failed Diplomacy: the tragic story of how North Korea got the bomb*. Washington, D.C.: Brookings Institution.

Purver, Ron. 1995. Chemical and Biological Terrorism: The threat according to the open literature: Canadian Security Intelligence Service.

Quester, George H. 1970. The Nuclear Nonproliferation Treaty and the International Atomic Energy Agency. *International Organization* 24 (2):163-182.

Quester, George H. 1973. *The Politics of Nuclear Proliferation*. Baltimore, MD: Johns Hopkins University Press.

Ramzy, Ramzy Ezzeldin (Egyptian Ambassador to International Organizations in Vienna). 2005. Interview, edited by R. Brown. Vienna, Austria.

RAND. 2007. RAND California Statistics: RAND Corporation.

Rathjens, George. 1995. Rethinking Nuclear Proliferation. In *Weapons Proliferation in the 1990s*, edited by B. Roberts. Cambridge, MA: Center for Strategic and International Studies (CSIS) and MIT Press.

Rauchhaus, Robert W. 2007. Evaluating Nuclear Proliferation and the Nuclear Peace: A Quantitative Approach: Harvard University.

Raustiala, Kal. 2004. Police Patrols and Fire Alarms in the NAAEC. *Loyola of Los Angeles International & Comparative Law Review* 26.

Reeps, Horst. 2005. Interview, edited by R. Brown. The Hague, The Netherlands.

Reichart, John F. 2001. Adversary Use of NBC Weapons: A Neglected Challenge. In *Strategic Forum*. Washington, DC: National Defense University.

Reicke, Henning. 1999. US Non-Proliferation Campaigns and their Impact on Institutional Change. In *Imperfect Unions: security institutions over time and space*, edited by H. Haftendorn, R. O. Keohane and C. A. Wallander. Oxford: Oxford University Press.

Reiss, Mitchell. 1995. *Bridled Ambition*. Washington DC: Woodrow Wilson Center Press.

Representatives, Professional Staff Member for US House of. 2004. Interview 10, edited by R. Brown. Washington, DC.

RERF. 2008. *Frequently Asked Questions: How many persons perished in or survived the atomic bombings?* [web site]. Radiation Effects Research Foundation, 2007 2007 [cited 15 March 2008]. Available from http://www.rerf.or.jp/general/qa_e/qa1.html.

Rich, Robert F., and Cheol H. Oh. 2000. Rationality and Use of Information in Policy Decisions. *Science Communication* 22 (2):173-211.

Richelson, Jeffrey T. 13. *U.S. Satellite Imagery, 1969-1999* [electronic briefing book]. National Security Archive, 5 October 2006 1999 [cited 13]. Available from http://www.gwu.edu/~nsarchiv/NSAEBB/NSAEBB13/.

Richelson, Jeffrey T. 2006a. Eyes on the Bomb: U-2, CORONA, and KH-7 Imagery of Foreign Nuclear Installations: National Security Archive.

Richelson, Jeffrey T. 2006b. *Spying on the bomb*. New York, NY: W.W. Norton & Company.

Richelson, Jeffrey T. 2006c. The VELA Incident: nuclear test or meteoriod?: National Security Archive.

Roberts, Brad, and Michael Moodie. 2002. Biological Weapon: Toward a Threat Reduction Strategy. *Defense Horizons* (15):1-8.

Robinson, Julian Perry. 1971. *The Problem of Chemical and Biological Warfare, Volume 1: The Rise of CB Weapons*. Stockholm: SIPRI.

Robinson, Julian Perry. 1973. *The Problem of Chemical and Biological Warfare, Volume 2: CB Weapons Today*. Stockholm: SIPRI.

Rockwood, Laura. 2002. The IAEA's Strengthened Safeguards System. *Journal of Conflict and Security Law* 7 (1):123-136.

Rodrik, Dani. 1995. Why is there multilateral lending? Paper read at Annual World Bank Conference on Development Economics 1995, at Washington, D.C.

Rosen, Steven. 1967. Proliferation Treaty Controls and the IAEA. *Journal of Conflict Resolution* 11 (2):168-175.

Rosenberg, Barbara Hatch. 2004. The Cupboard Was Bare. *The Los Angeles Times*, 1 February 2004.

Rosendorf, B. Peter, and Helen V. Milner. 2001. The optimal design of international trade institutions: uncertainty and escape. *International Organization* 55 (4):829-857.

Rozgonova, Daniela. 2005. Interview, edited by R. Brown. Vienna, Austria.

Russell, Richard L. 2005. Iraq's Chemical Weapons Legacy: What Others Might Learn From Saddam. *Middle East Journal* 59 (2):187-209.

Sagan, Scott D. 1995. More Will Be Worse. In *The Spread of Nuclear Weapons: A Debate*, edited by K. N. Waltz and S. D. Sagan. New York: Norton.

Sagan, Scott D. 1997. Why do states build nuclear weapons? *International Security* 21 (3):54-86.

Sagan, Scott D. 2002. More Will Be Worse. In *The Spread of Nuclear Weapons: A Debate Renewed*, edited by K. N. Waltz and S. D. Sagan. New York: Norton.

Saikal, Amin. 2002. The Coercive Disarmament of Iraq. In *Biological Warfare and Disarmament: New Problems/New Perspectives*, edited by S. Wright. Lanham, MD: Rowan & Littlefield Publishers.

Samore, Gary. 1994. Iraq. In *Nuclear Proliferation After the Cold War*, edited by M. Reiss and R. S. Litwak. Washington, D.C.: Woodrow Wilson Center Press.

Sanger, David E. 1993. Atom Agency Said to Issue Demand to North Korea. *New York Times*, 11 February 1993, A6.

SAROV. 2004. Problems of On-Site Access and Inspections in the Context of Nuclear Weapons Reductions and Nuclear Security Cooperation. Sarov, Russia: Sarov Analytical Center for Nonproliferation.

Sasikumar, Karthika, and Christopher R. Way. ND. Testing Theories of Proliferation: Lessons From South Asia. Ithaca, NY: University of British Colombia and Cornell University.

Scheinman, Lawrence. 1985. *The Nonproliferation Role of the International Atomic Energy Agency*. Washington, DC: Resources for the Future.

Scheinman, Lawrence. 2004. Interview, edited by R. Brown. Washington, D.C.

Scheinman, Lawrence. 2005. Interview, edited by R. Brown. Washington, D.C.

Schelling, Thomas C. 1960. *The Strategy of Conflict*. Cambridge, MA: Harvard University Press.

Schelling, Thomas C. 1961. Reciprocal Measures for Arms Stabilization. In *Arms Control, Disarmament, and National Security*, edited by D. P. Brennan. New York, NY: George Braziller, Inc.

Scheve, Kenneth F., and Matthew J. Slaughter. 2001. What determines Individual Trade-Policy Preferences? *Journal of International Economics* 54 (3):267-92.

Schmidt, Fritz. 1997. The Role of the IAEA in Nuclear Export Controls. Paper read at International Seminar on the Role of Export Controls In Nuclear Non-proliferation, 7-8 October 1997, at Vienna, Austria.

Schmidt, Fritz. 1999. Zangger Committee. Paper read at 2nd NSG International Seminar on the Role of Export Controls in Nuclear Non-Proliferation, 8-9 April 1999, at New York, NY.

Schultz, Kenneth A. 1999. Do Democratic Institutions Constrain or Inform? Constrasting two institutional perspectives on democracy and war. *International Organization* 53 (2):233-266.

Selvage, Douglas. 2001. The Warsaw Pact and Nuclear Nonproliferation, 1963-1965. Washington, DC: Woodrow Wilson International Center for Scholars Cold War International History Project.

Senate, Professional Staff Member for US. 2004. Interview 11, edited by R. Brown. Washington, DC.

Shea, Dana A. 2004. Terrorism: Background on Chemical, Biological, and Toxin Weapons and Options for Lessening their Impact. Washington, DC: Congressional Research Service.

Shea, Dana A., and Frank Gottron. 2004. Small-scale Terrorist Attacks Using Chemical and Biological Agents: a assessment framework and preliminary comparisons. Washington, DC: Congressional Research Service.

Shoham, Dany. 1998. Chemical and Biological Weapons in Egypt. *The Nonproliferation Review* 5 (3):48-58.

Shuey, Robert. 2001. Nuclear, Biological, and Chemical Weapons and Missiles: The Current Situation and Trends. Washington, DC: Congressional Research Service.

Shy, Oz. 1995. *Industrial Organization: Theory and Applications*. Boston, MA: MIT Press.

Signorino, Curtis S., and Jeffrey M. Ritter. 1999. Tau-b or Not Tau-b: Measuring the Similarity of Foreign policy Positions. *International Studies Quarterly* 43 (1):115-144.

Simon, Jeffrey D. 1989. Terrorists and the Potential Use of Biological Weapons. Santa Monica, CA: RAND.

Sims, Jennifer E. 1990. *Icarus Restrained: an intellectual history of nuclear arms control, 1945-1960*. Boulder: Westview Press.

Sims, Nicholas A. 1987. *International Organization for Chemical Disarmament*. Vol. 8, *SIPRI Chemical & Biological Warfare Studies*. New York, NY: Oxford University Press.

Singer, J. David. 1987. Reconstructing the Correlates of War Dataset on Military Capabilities of States, 1816-1985. *International Interactions* 14:115-132.

Singh, Sonali, and Christopher R. Way. 2004. The Correlates of Nuclear Proliferation. *Journal of Conflict Resolution* 48 (6):859-885.

SIPRI, Stockholm International Peace Research Institute -, ed. 1969-2004. *SIPRI Yearbook: Armaments, Disarmament and International Security*. Oxford: Oxford University Press.

SIPRI, Stockholm International Peace Research Institute -, ed. 1982. *World Armaments and Disarmament: SIPRI Yearbook 1982*. Oxford: Oxford University Press.

SIPRI, Stockholm International Peace Research Institute -, ed. 1983. *World Armaments and Disarmament: SIPRI Yearbook 1983*. Oxford: Oxford University Press.

SIPRI, Stockholm International Peace Research Institute -, ed. 1985. *World Armaments and Disarmament: SIPRI Yearbook 1985*. Oxford: Oxford University Press.

SIPRI, Stockholm International Peace Research Institute -, ed. 1986. *World Armaments and Disarmament: SIPRI Yearbook 1986*. Oxford: Oxford University Press.

SIPRI, Stockholm International Peace Research Institute -, ed. 1987. *SIPRI Yearbook 1987: Armaments, Disarmament and International Security*. Oxford: Oxford University Press.

SIPRI, Stockholm International Peace Research Institute -, ed. 1988. *SIPRI Yearbook 1988: Armaments, Disarmament and International Security*. Oxford: Oxford University Press.

SIPRI, Stockholm International Peace Research Institute -, ed. 1989. *SIPRI Yearbook 1989: Armaments, Disarmament and International Security*. Oxford: Oxford University Press.

SIPRI, Stockholm International Peace Research Institute -, ed. 1990. *SIPRI Yearbook 1990: Armaments, Disarmament and International Security*. Oxford: Oxford University Press.

SIPRI, Stockholm International Peace Research Institute -, ed. 1992. *SIPRI Yearbook 1992: Armaments, Disarmament and International Security*. Oxford: Oxford University Press.

SIPRI, Stockholm International Peace Research Institute -, ed. 1994. *SIPRI Yearbook 1994: Armaments, Disarmament and International Security*. Oxford: Oxford University Press.

SIPRI, Stockholm International Peace Research Institute -, ed. 1995. *SIPRI Yearbook 1995: Armaments, Disarmament and International Security*. Oxford: Oxford University Press.

SIPRI, Stockholm International Peace Research Institute -, ed. 1996. *SIPRI Yearbook 1996: Armaments, Disarmament and International Security*. Oxford: Oxford University Press.

SIPRI, Stockholm International Peace Research Institute -, ed. 1998. *SIPRI Yearbook 1998: Armaments, Disarmament and International Security*. Oxford: Oxford University Press.

SIPRI, Stockholm International Peace Research Institute -, ed. 1999. *SIPRI Yearbook 1999: Armaments, Disarmament and International Security*. Oxford: Oxford University Press.

Smithson, Amy. 2004a. Interview, edited by R. Brown. Washington, DC.

Smithson, Amy E. 1993. The Chemical Weapons Convention Handbook. Washington, DC: The Henry L. Stimson Center.

Smithson, Amy E. 2004b. Biological Weapons: Can Fear Overwhelm Inaction. *Washington Quarterly* 28 (1):165-178.

Smithson, Amy E., and Leslie-Anne Levy. 2000. Ataxia: The Chemical and Biological Terrorism Threat and the US Response. Washington, D.C.: Henry L. Stimson Center.

Snidal, Duncan. 1985. Coordination versus the Prisoners' Dilemma: Implications for International Cooperation and Regimes. *American Political Science Review* 79 (4):923-942.

Snyder, Scott. 1997. North Korea's Nuclear Program: The role of incentives in preventing deadly conflict. In *The Price of Peace: incentives and international conflict prevention*, edited by D. Cortright: Rowan & Littlefield.

Sokolski, Henry D. 2004. Iran: Nuclear rights and wrongs. *NRO: nationalreviewONLINE*, 23 September 2004.

Solingen, Etel. 1994. The Political Economy of Nuclear Restraint. *International Security* 19 (2):126-169.

Solingen, Etel. 2007. *Nuclear Logics: contrasting paths in East Asia and the Middle East*. Princeton: Princeton University Press.

Spar, Debora L. 1994. *The Cooperative Edge: the internal politics of international cartels*. Ithaca, NY: Cornell University Press.

Spiers, Edward M. 1986. *Chemical Warfare*. London: MacMillan Press.

Spiers, Edward M. 1994. *Chemical and Biological Weapons: A study of proliferation*. New York, NY: St. Martin's Press.

Spruyt, Hendrik. 1994. *The Sovereign State and its Competitors*. Princeton: Princeton University Press.

Spruyt, Hendrik. 2002. The Origins, Development, and Possible Decline of the Modern State. *Annual Review of Political Science* 2002 (5):127-149.

Squassoni, Sharon A. 2005. Nuclear, Biological, and Chemical Weapons and Missiles: Status and Trends. Washington, DC: Congressional Research Service.

Stein, Arthur A. 1983. Coordination and collaboration: regimes in an anarchic world. In *International Regimes*, edited by S. D. Krasner: Cornell.

Stern, Jessica. 2002/03. Dreaded Risks and the Control of Biological Weapons. *International Security* 27 (3):89-123.

Stoll, Richard J. 2005. *Latent Nuclear Capability States Data Set* (1996) [web site]. 2005 [cited 9 June 2005 2005]. Available from http://es.rice.edu/projects/Poli378/Nuclear/Proliferation/model.html.

Strange, Susan. 1983. *Cave! hic dragones*: a critique of regime analysis. In *International Regimes*, edited by S. D. Krasner. Ithaca: Cornell University Press.

Stratford, Richard J. K. 1999. The Practice of Export Controls: Effect on Trade and Peaceful Nuclear Activities. Paper read at 2nd NSG International Seminar on the Role of Export Controls in Nuclear Non-Proliferation, 8-9 April 1999, at New York, NY.

Strom, Kaare. 2000. Delegation and accountability in parliamentary democracies. *European Journal of Political Research* 37:261-289.

Strom, Kaare. 2001. Agency and Parliamentary Democracy, edited by K. Strøm and e. al.

Sweeney, Kevin, and Omar M.G. Keshk. 2005. The Similarity of States: On the Use of *S* to Compute Dyadic Interest Similarity. Working paper, Department of Political Science, Ohio State University, Columbus, OH.

Szasz, Paul. 1973. International Atomic Energy Agency Safeguards. In *International Safeguards and Nuclear Industry*, edited by M. Willrich. Baltimore, MD: Johns Hopkins University Press.

Tate, Trevor McMorris. 1990. Regime-Building in the Non-Proliferation System. *Journal of Peace Research* 27 (4):399-414.

Tenet, George J. 2002. Worldwide Threat - Converging Dangers in a Post 9/11 World. In *Select Committee on Intelligence*. Washington, D.C.

ter Haar, Barend. 1991. *The Future of Biological Weapons*. New York, NY: Praeger Press.

Terrill, Andrew. 1991. The Chemical Warfare Legacy of the Yemen War. *Comparative Strategy* 10.

Thee, Marck. 1988. The Pursuit of a Comprehensive Nuclear Test Ban. *Journal of Peace Research* 25 (1):5-15.

Thompson, Alexander. 2006a. Coercion through IOs: The Security Council and the Logic of Information Transmission. *International Organization* 60 (1):1-34.

Thompson, Alexander. 2006b. Principal Problems: The Rise and Fall of UN Weapons Inspections in Iraq. Paper read at Annual Convention of the International Studies Association, 22-25 March 2006, at San Diego, CA.

Thompson, William R. 2001. Identifying Rivals and Rivalries in World Politics. *International Studies Quarterly* 45 (4):557-586.

Thorne, Carleton E. 1997. Multilateral Nuclear Export Controls: Past, Present and Future. Paper read at International Seminar on the Role of Export Controls In Nuclear Non-proliferation, 7-8 October 1997, at Vienna, Austria.

Tierney, Michael J. 2006. Delegation of Authority in International Relations: The Promise and Limits of Agency Theory. Paper read at Delegating Sovereignty: Constitutional and Political Perspectives, 3-4 March 2006, at Duke University

Tilly, Charles. 1975. Reflections on the History of European State-Making. In *The Formation of Nation States in Western Europe*, edited by C. Tilly. Princeton, NJ: Princeton University Press.

Tilly, Charles. 1990. *Coercion, capital, and European states, AD 990-1990*. Cambridge, MA: Basil Blackwell.

Timerbaev, Roland, and Susan Welsh. 1994. The IAEA's Role in Nuclear Arms Control: Its Evolution and Future Prospects. *The Nonproliferation Review* 1 (3):18-31.

Trachtenberg, Marc. 1999. *A constructed peace : the making of the European settlement, 1945-1963*. Princeton, NJ: Princeton University Press.

Trapp, Ralf. 2005. Interview, edited by R. Brown. The Hague, The Netherlands.

Traub, James. 2004. The Netherworld of Nonproliferation. *The New York Times Magazine*, 13 June 2004, 49-53,70,77-78.

Tsebelis, George. 2002. *Veto Players: How Political Institutions Work*. New York: Princeton University Press.

Tucker, Jonathan B. 2002. A Farewell to Germs: the U.S. renunciation of biological and toxin warfare, 1969-70. *International Security* 27 (1):107-148.

Tucker, Jonathan B. 2008. The body's own bioweapons. *Bulletin of the Atomic Scientists* 64 (1):16-22.

UN. 2005. *United Nations Special Commission (UNSCOM): Basic Facts* [web site]. United Nations, unknown [cited 2 October 2005]. Available from http://www.un.org/Depts/unscom/basicfacts.html.

UN. 1945. *Charter of the United Nations*. San Francisco, CA.

UN. 2004. Energy Statistics Database: United Nations Statistics Division.

UN. 2005. United Nations Common Database (UNCDB): United Nations Statistics Division.

UN. various. Reports of Executive Chairman of the Special Commission and Reports by the Secretary General on the activities of the Special Commission: S/23165 (25 October 1991), S/23268 (4 December 1991), S/24108 (16 June 1992), S/24984 (17 December 1992), S/25977 (21 June 1993), S/26910 (21 December 1993), S/1994/750 (24 June 1994), S/1994/1422/Add.1 (15 December 1994), S/1995/494 (20 June 1995), S/1995/1017 Annex I (7 December 1995), S/1995/1038 (17 December 1995), S/1996/258 (11 April 1996), S/1996/848 (11 October 1996), S/1997/301 (11 April 1997). New York, NY: United Nations.

US House of Representatives, Committee on Armed Services. 1984. Full Committee Briefing on the Recently Proposed Chemical Arms Treaty before the US House of Representatives Committee on Armed Services 98th Congress 2nd Session (10 May 1984). In *US House of Representatives Committee on Armed Services*. Washington, DC: US Government Printing Office.

US House of Representatives, Committee on Foreign Affairs and its Subcommittee on Arms Control, International Security and Science. 1990. Proliferation and Arms Control. Hearings before the United States House of Representatives Committee on Foreign Affairs and its Subcommittee on Arms Control, International Security and Science 101st Congress 2nd Session (17 May and 11 July 1990). In *Committee on Foreign Affairs and its Subcommittee on Arms Control, International Security and Science*. Washington, DC: US Government Printing Office.

US House of Representatives, Committee on Foreign Relations. 1994. Implementation of the Chemical Weapons Convention. Hearing before the United States House of Representatives Committee on Foreign Relations 103rd Congress 2nd Session (3 August 1994). In *Committee on Foreign Relations*. Washington, DC: US Government Printing Office.

US House of Representatives, Subcommittees on International Security and Scientific Affairs and on Asian and Pacific Affairs of the Committee on Foreign Relations. 1980. Strategic Implications of Chemical and Biological Warfare. Hearing before the US House of Representatives, Subcommittees on International Security and Scientific Affairs and on Asian and Pacific Affairs of the Committee on Foreign Relations 96th Congress 2nd Session (24 April 1980). In *US House of Representatives, Subcommittee on Asian and*

Pacific Affairs of the Committee on Foreign Relations 96th Congress 2nd Session. Washington, DC: US Government Printing Office.

US Senate, Committee on Appropriations. 1982. Binary Chemical Weapons. Hearings on before The Committee on Appropriations 97th Congress 2nd Session (5-6 May 1982). In *Committee on Appropriations 97th Congress 2nd Session*. Washington, DC: US Government Printing Office.

US Senate, Committee on Foreign Relations. 1969a. The Treaty on the Nonproliferation of Nuclear Weapons (Executive H), Part 2. Hearings before the Committee on Foreign Relations 90th Congress 2nd Session (Part 2; February 18 and 20, 1969). In *Committee on Foreign Relations on Executive H, 90th Congress, Second Session*. Washington, DC: US Government Printing Office.

US Senate, Committee on Foreign Relations. 1969b. *Underground Weapons Testing. Hearing on S.J. Res. 155 To Provide for a Study and Evaluation of the International and Other Foreign Policy Aspects of the Underground Weapons Testing Before the United States Senate Committee on Foreign Relations, 91st Congress 1st session (29 September 1969)*, *Committee on Foreign Relations, 91st Congress 1st session*. Washington, DC: US Government Printing Office.

US Senate, Committee on Foreign Relations. 1974. *Prohibition of Chemical and Biological Weapons. Hearings before the Committee on Foreign Relations, United States Senate, 93rd Congress 2nd session, on Ex. J, 91-2 (Protocol for the prohibition of the use in war of asphyxiating, poisonous, or other gases, and of bacteriological methods of warfare), Ex. Q, 92-2 (Convention on the prohibition of the development, production, and stockpiling of bacteriological (biological) and toxin weapons, and on their destruction), and on S.Res. 48 (Relating to a comprehensive interpretation of the Geneva Protocol) (10 December 1974)*, *Committee on Foreign Relations, 93rd Congress 2nd Session*. Washington, DC: US Government Printing Office.

US Senate, Committee on Foreign Relations. 1978. Ex. 1, Additional Protocol I to the Treaty for the Prohibition of Nuclear Weapons in Latin America (Treaty of Tlatelolco). Hearing Before The Committee on Foreign Relations 95th Congress 2nd Session (August 15, 1978). In *Committee on Foreign Relations 95th Congress 2nd Session*. Washington, DC: US Government Printing Office.

US Senate, Committee on Foreign Relations. 1984. Chemical Warfare: Arms Control and Nonproliferation. Hearing Before The Committee on Foreign Relations and the Subcommittee on Energy, Nuclear Proliferation and Government Processes of the Committee on Governmental Affairs 98th Congress 2nd Session (28 June 1984). In *Committee on Foreign Relations and Committee on Governmental Affairs 98th Congress 2nd Session*. Washington, DC: US Government Printing Office.

US Senate, Committee on Foreign Relations. 1987. The Threshold Test Ban Treaty and Peaceful Nuclear Explosion Treaty. Hearings on before The Committee on Foreign

Relations 100th Congress 1st Session (January 13 and 15, 1987). In *Committee on Foreign Relations 100th Congress 1st Session*. Washington, DC: US Government Printing Office.

US Senate, Committee on Foreign Relations. 1989a. The Chemical and Biological Weapons Threat: The Urgent Need for Remedies. Hearings Before The Committee on Foreign Relations 101st Congress 1st Session (January 24, March 1, and May 9, 1989). In *Committee on Foreign Relations 101st Congress 1st Session*. Washington, DC: US Government Printing Office.

US Senate, Committee on Foreign Relations. 1996. Current and Projected National Security Threats to the United States and Its Interests Abroad. Hearings Before The Select Committee on Intelligence 104th Congress 2nd Session (22 February 1996). In *Select Committee on Intelligence*. Washington, DC: US Government Printing Office.

US Senate, Committee on Foreign Relations. 2002. Reducing the Threat of Chemical and Biological Weapons. Hearing Before The US Senate Committee on Foreign Relations 107th Congress 2nd Session (19 March 2002). In *US Senate Committee on Foreign Relations 107th Congress 2nd Session*. Washington, DC: US Government Printing Office.

US Senate, Committee on Foreign Relations Subcommittee on Arms Control, Oceans, International Operations and the Environment. 1983. *Yellow Rain (Chemical and Toxin Weapons Use): The Arms Control Implications. Hearing before US Senate Subcommittee on Arms Control, Oceans, International Operations and the Environment of the Committee on Foreign Relations 98th Congress 1st Session (24 February 1983)*. 98th Congress 1st Session ed, *Committee on Foreign Relations 100th Congress 1st Session*. Washington, DC: US Government Printing Office.

US Senate, Committee on Governmental Affairs and its Permanent Subcommittee on Investigations. 1989b. The Global Spread of Chemical and Biological Weapons: Assessing Challenges and Responses. Hearings Before the US Senate Committee on Governmental Affairs and its Permanent Subcommittee on Investigations 101st Congress 1st Session (9-10 February 1989). In *Committee on Governmental Affairs and its Permanent Subcommittee on Investigations 101st Congress 1st Session*. Washington, DC: US Government Printing Office.

US Senate, Subcommittee on Arms Control, International Law and Organization of the Committee on Foreign Relations. 1973. S. Res. 67, Calling on the President to promote negotiations for a comprehensive test ban treaty. Hearing before the Subcommittee on Arms Control, International Law and Organization of the Committee on Foreign Relations 93rd Congress 1st Session (1 May 1973). In *Subcommittee on Arms Control, International Law and Organization of the Committee on Foreign Relations 93rd Congress First Session*. Washington, DC: US Government Printing Office.

US Senate, Subcommittee on Arms Control, International Law and Organization of the Committee on Foreign Relations. 1977a. Nonproliferation Issues. Hearings Before The Subcommittee on Arms Control, International Law and Organization of the Committee on Foreign Relations 94th Congress 1st and 2nd Sessions (19 March, 16 and 28 April, 18 and 22 July 21 and 24 October, 1975; 23 and 24 February, 15 March, 22 September, and 8 November, 1976). In *Subcommittee on Arms Control, International Law and Organization of the Committee on Foreign Relations 94th Congress First and Second Sessions*. Washington, DC: US Government Printing Office.

US Senate, Subcommittee on Arms Control, Oceans and International Environment of the Committee on Foreign Relations. 1977b. Hearings on Executive N, Two Treaties Between the US and Soviet Union on (1) The Limitation of Underground Weapons Tests and the Protocol Thereto, Signed in Moscow on July 23, 1974; and (2) Underground Nuclear Explosions for Peaceful Purposes, and the Protocol Thereto, Signed in Washington and Moscow on May 28, 1976 Before The Subcommittee on Arms Control, Oceans and International Environment of the Committee on Foreign Relations 95th Congress 1st Session (28 July, 3 August and 8 and 15 September, 1977). In *Subcommittee on Arms Control, Oceans and International Environment of the Committee on Foreign Relations 95th Congress 1st Session*. Washington, DC: US Government Printing Office.

US Senate, Subcommittee on Technology, Terrorism, and Government Information of the Committee on the Judiciary. 1998. Biological Weapons: The Threat Posed By Terrorists. Hearings Before The US Senate Subcommittee on Technology, Terrorism, and Government Information of the Committee on the Judiciary 105th Congress 2nd Session (4 March and 22 & 23 April, 1998). In *US Senate Subcommittee on Technology, Terrorism, and Government Information of the Committee on the Judiciary 105th Congress 2nd Session*. Washington, DC: US Government Printing Office.

Voeten, Erik. 2004. Resisting the Lonely Superpower: responses of states in the UN to US dominance. *Journal of Politics* 66 (3):729-754.

Wallander, Celeste A. 2000. Institutional Assets and Adaptability: NATO after the Cold War. *International Organization* 54 (4):705-735.

Walt, Stephen M. 1985. Alliance Formation and the Balance of Power. *International Security* 9 (4):3-43.

Waltz, Kenneth N. 1979. *Theory of International Politics*. 1st ed. New York: McGraw-Hill.

Waltz, Kenneth N., and Scott D. Sagan, eds. 2002. *The Spread of Nuclear Weapons: A Debate Renewed*. 2nd ed. New York: Norton.

Wampler, Robert A. 2003. North Korea and Nuclear Weapons: The Declassified U.S. Record (Electronic Briefing Book No. 87). Washington, D.C.: The National Security Archive.

Wendt, Alexander. 1999. *Social Theory of International Politics*. Cambridge: Cambridge University Press.

Wilkening, Dean. 1999. BCW Attack Scenarios. In *The New Terror: Facing the Threat of Biological and Chemical Weapons*, edited by S. D. Drell, A. D. Sofaer and G. D. Wilson. Stanford, CA: Stanford University Press.

Wit, Joel S., Daniel B. Poneman, and Robert L. Gallucci. 2004. *Going Critical: the first North Korean nuclear crisis*. Washington, DC: Brookings Institution Press.

Wit, Joel S., Jon Wolfsthal, and Choong-suk Oh. 2005. The Six Party Talks and Beyond: Cooperative Threat Reduction and North Korea. Washington, D.C.: CSIS.

Wittner, Lawrence S. 1993. *One World Or None: A History of the World Nuclear Disarmament Movement Through 1953*. 3 vols. Vol. 1, *The Struggle Against The Bomb*. Stanford: Stanford University Press.

Wittner, Lawrence S. 1997. *Resisting the Bomb: 1954-1970*. 3 vols. Vol. 2, *The Struggle Against The Bomb*. Stanford: Stanford University Press.

Wolf, John Stern. 2004. Interview, edited by R. Brown. Washington, D.C.

Woolridge, Jeffrey M. 2000. *Introductory Econometrics: a modern approach*. 1st ed: Sout-Western College Publishing.

Wright, Robert. 1995. Nukes, Nerve Gas and Anthrax Spores -- Be Very Afraid. *New Republic*, 1 May 1995.

Wright, Susan. 1986. Recombinant DNA Technology and its Social Transformation, 1972-1982. *Osiris* 2 (2):303-360.

Wright, Susan. 2002. Introduction: In Search of a New Paradigm of Biological Disarmament. In *Biological Warfare and Disarmament: New Problems/New Perspectives*, edited by S. Wright. Lanham, MD: Rowan & Littlefield Publishers.

York, Herbert F. 1987. *Making Weapons, Talking Peace: A physicist's odyssey from Hiroshima to Geneva*, *Alfred P. Sloan Foundation*. New York NY: Basic Books, Inc.

Zanders, Jean Pascal. 2000. Chemical and Biological Weapon Terrorism: Assessing the challenges from sub-state proliferation. Paper read at Emerging Threats Assessment: Biological Terrorism, 7-9 July 2000, at Dartmouth College Institute for Security Technology Studies.