Assessing the empirical impact of nuclear, biological, and chemical proliferation on international security

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I. Introduction

According to conventional wisdom in the United States and much of the international community, the proliferation of weapons of mass destruction (WMDs), often considered nuclear, biological, and chemical weapons (NBCs), constitutes an enormous danger to global stability. Nuclear weapons are considered the ultimate weapon, a technology that many nations desire and almost all fear. Many perceive chemical and biological weapons (CBWs) as the "poor man's nuclear weapons", weapons that could potentially deter American involvement in regional contingencies and fundamentally influence the international security environment. However, the actual uses of WMDs in warfare since World War II are scant. The empirical evidence that WMDs deter great powers is very thin. Why, then, do countries care about WMD proliferation? Does the attempted acquisition of and/or possession of weapons of mass destruction really enhance national power in a way that changes crisis bargaining and the initiation and escalation of militarized disputes? Since the impact of WMDs generally does not involve their actual use in warfare, it has to be the derivative of their potential effect on warfare that matters for international security.

Unfortunately, while many excellent case studies of the nuclear age have been conducted (Betts 1987; Jervis 1989) statistical analyses of nuclear weapons are generally limited to binary variables that only code whether or not a country is believed to have nuclear weapons. CBWs have been almost entirely ignored within the mainstream international security literature. Moreover, though scholars now recognize the important function that information about capabilities may play in influencing international conflict

(Blainey 1988; Fearon 1994; Simon 1999; Fischerkeller 1998), the large range of possible WMD capabilities, from research and development to production capabilities to actual possession and types of possession remain unexplored as variables providing the type of information that helps predict the initiation and escalation of international conflict. Given that some now explain the US failure to militarily confront North Korea, in comparison to Iraq, as a result of higher levels of confidence regarding North Korean nuclear capabilities, information clearly matters.[1] This study aims to correct these deficiencies in the literature by attempting to measure the relative empirical impact of specific levels of chemical, biological, and nuclear weapons capabilities on the initiation and escalation of international disputes.

This paper extends existing scholarship on WMDs in two very specific ways. First, using previous analyses of the empirical effect of nuclear weapons as a baseline, competing theories of the way CBWs should influence international conflict are generated. Second, uncertainty about national possession of WMDs may have an independent impact on international conflict. Through a new dataset that incorporates levels of uncertainty regarding the possession of nuclear, biological, and chemical weapons, this paper uses existing theorizing about the impact of certainty on warfare to generate hypotheses concerning the impact of WMDs and then tests them on a dataset of directed dyads from 1898-2002.

Part II describes the baseline theories within the international relations field concerning the relative importance of nuclear weapons, the way biological and chemical weapons may influence international conflict in comparison with nuclear weapons, and

[1] For another view on this, see Stephen Krasner, "Unilateralism, Possibly Unavoidable," Memo Prepared for Conference on Asia in Search of a New World Order, January 2004, http://www.rieti.go.jp/jp/events/04011601/pdf/krasner.pdf <Accessed March 1, 2004>.

the way uncertainty regarding the possession of WMDs may substantially alter their impact. The generation of new data on nuclear, biological, and chemical weapons, and the setup of models for statistical testing are described in part III. Part IV discusses the results of those tests and part V deals with limitations to this project and avenues for future research. Part VI concludes, explaining what the results of this paper may mean for the utility of non and counter proliferation strategies. The results show that nuclear, biological, and chemical weapons have very divergent impacts on the probability of international conflict. While challengers with asymmetrical nuclear advantages make conflict escalation more likely, asymmetrical possession by defenders or joint possession makes escalation less likely. Defenders armed with biological weapons or with probable chemical arsenals are likely to deter conflict, but defenders with known chemical weapons capabilities invite both dispute initiations and escalations. As the United States recalibrates its counter proliferation policy in the aftermath of the war with Iraq, these results can help scholars create a more coherent understanding of the relative threats caused by the proliferation of WMDs and how certain packages of capabilities make deterrence success and failure more likely.

II. Literature Review:

The behaviors this study is specifically interested in include the initiation of disputes, the response by target to the initiation of disputes, and the escalation of a dispute towards war. This project operates at the intersection of a diverse tradition of scholarship that includes the public policy, security studies, and game theoretic

communities. One root of this is Schelling's (1960, 1966) research demonstrating that deterrence credibility is a function of capabilities multiplied by beliefs. High levels of capabilities are unlikely to help states deter or compel others if no one believes they will ever use those capabilities. In contrast, high levels of resolve can lead to success even if the relative balance of capabilities are not necessarily favorable. Given that actual battlefield uses of WMDs have been rare, an approach in this vein, focusing for the most part on events below the level of war, helps get at the way that WMDs may actually influence international conflict. It is beliefs about whether or not countries have certain types of weapons of mass destruction and the probability that such weapons will be used that drive the impact of these weapons on international strategy.

Controversy exists concerning the very definition of weapons of mass destruction. Some (Panovsky 1998) argue that only nuclear weapons should be considered WMDs. Since biological weapons have never really been used and chemical weapons have been used only very rarely, arguably only nuclear weapons can properly be considered massively destructive. Others (Zelicoff 2004) state that while biological weapons, along with nuclear weapons, are WMDs, both are several orders of magnitude in destructiveness above chemical weapons, meaning chemical weapons cannot properly be considered WMDs. Finally, with innovations in the area of cyber warfare and the enormous human destruction caused by economic sanctions, some argue (Clemens and Brown 1999, Lewis 2003, Mueller and Mueller 1999) non-NBC weapons should be considered weapons of mass destruction. For the purposes of this paper, weapons of mass destruction can be defined as nuclear, biological, and chemical (NBC) weapons. This is not meant to imply that all three weapons are equivalent. Indeed, the statistical

tests described below differentiate between the three types of weapons specifically to test their comparative impacts. However, the term WMD is used as short hand, when convenient, to help explain the consequences of these potentially important weapons for the international security environment.

Current empirical research on nuclear deterrence

Throughout the Cold War and afterwards, international relations scholars have evaluated the relative importance of nuclear weapons in deterring the threat of conventional and nuclear war (Betts 1987, Snyder 1961, Schelling 1960, 1966, Jervis 1969). The literature is mostly based in the bipolar competition for international power between the United States and Soviet Union. There are some broad areas of agreement within much of this literature, such as the fact that asymmetrical nuclear capabilities by a challenger will make coercion more successful (Pape 1996, 36-37). Though this facet of nuclear coercion was overshadowed by the Cold War focus on mutually assured destruction, the uneven capacity to cause almost unlimited destruction clearly gives nuclear-armed challengers an edge.

Some disagreements exist, however, concerning the impact of nuclear weapons when both sides have nuclear weapons or when only the defender has nuclear weapons. Jervis (1988, 1989) argues that nuclear weapons have a unique impact on international security for three reasons. First, the magnitude of nuclear weapons is much larger than previous weapons, even fuel-air explosives. Second, no country would be spared the impact of an all-out nuclear war; states could not control the nuclear escalation ladder.

Third, nuclear escalation could occur quickly and potentially as a result of crisis misperceptions (Jervis 1988, 83-84). Despite the overwhelming impact of nuclear weapons, Jervis concludes that states may face circumstances where the relative benefits of going to war outweigh the costs even if utter destruction in war is relatively certain.[2] While war is unlikely in the nuclear age, the risk of nuclear escalation still profoundly influences international politics.

Another perspective comes from rational deterrence theorists, who evaluate the risk of nuclear war from the perspective that nation-states are unitary actors that will rationally weigh costs and benefits.[3] Towards the end of the Cold War scholars began conducting empirical statistical research on the influence of nuclear weapons on deterrence (Bueno de Mesquita and Riker 1982; Kugler 1998; James and Harvey 1989; Vasquez 1991; Jervis 1996). Much of the original empirical work on WMDs comes from analyses of extended deterrence conducted by Huth and Russett (1984, 1988) and Huth (1988, 1990). Their conclusions reflect mainstream rationalist thinking about deterrence. The side with the largest military capabilities is likely to prevail. If the defender has a larger balance of forces, immediate and general deterrence are likely to hold. According to Fearon, "This idea is both highly intuitive and widely accepted by students of international politics" (Fearon 1994, 238). Nuclear weapons serve as a capabilities booster that substantially enhances the deterrent power of countries that possess them.[4]

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[2] Additionally, Jervis thinks disagreements over what constitutes a reasonable balance of forces in the status quo could cause bargaining to break down and conflicts to escalate.

[3] The best debate about rational deterrence theory in the literature can be found in a special issue of *World Politics* in 1989 (Vol. 42, No. 1) and included articles by Achen and Snidal, Downs, George and Smoke, Jervis, and Lebow and Stein.

[4] Once nuclear weapons are interacted with the conventional balance of forces to determine their comparative impact on cases of deterrence, Huth finds that nuclear weapons substantially increase the probability of deterrence success. The only situation where nuclear weapons do not have a large impact is when the defender/target has larger conventional forces than the attacker (Huth 1990, 285). In this case,

The insight that nuclear weapons play an important role independent of the conventional balance of forces was verified in Fearon's (1994) critique of Huth. Fearon re-examines Huth's findings concluding that the effect of the balance of forces and nuclear weapons is relatively unrelated to the capabilities per se, but to certainty about the use of those capabilities. He argues that when the balance of forces favors the defender or the defender has nuclear weapons, immediate deterrence is likely to hold. Taking into account the relative capabilities of the defender, challengers initiate disputes on issues where they feel the balance of interests favors them and a response by the defender is uncertain. If the defender responds with strength, rather than conceding, the response is likely to deter (Fearon 1994, 254-248).

While Fearon's theory is derived from assumptions of purely rational actors, in contrast to Jervis, they come to very similar conclusions about the way nuclear weapons influence the initiation of international conflicts: while they give states that possess them enormous advantages, highly determined non-nuclear challengers may still initiate conflicts and plausibility probes against nuclear weapons states may occur.[5]

Within the security studies literature on nuclear weapons and proliferation, there are distinct schools of thought involving the initiation and escalation of conflict in general and how nuclear weapons influence the equation. The very prominent debates between Waltz and Sagan (Waltz 1981, Sagan 1993, Sagan and Waltz 1995, Sagan and Waltz 2003) typify these traditions. One work integrating these perspectives on nuclear proliferation is Lavoy's (1995) review of the Waltz/Sagan debate. Lavoy begins by

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nuclear weapons do not serve as an implicit or explicit threat to the challenger because the challenger can be defeated purely with conventional forces. In cases such as the Berlin Airlift Crisis (1948-1949) and the Soviet incursion into Iran (1949), the nuclear capability of the United States compensated for conventional inferiority to produce an effective deterrent.

[5] Fearon does not explicitly discuss the way nuclear weapons may influence conflict escalation

creating a typology of proliferation scholarship, separating scholars and policy makers that study nuclear proliferation into three categories: proliferation optimists, proliferation pessimists, and political relativists. Optimists believe nuclear weapons enhance international security and decrease the probability of war, pessimists believe nuclear weapons in certain global distributions decrease international stability, and relativists believe the relative threat of proliferation depends on whether or not the states that acquire nuclear weapons use them to promote stability or instability (Lavoy 1995, 699-700).

The best representative of the proliferation optimism school is Kenneth Waltz (Waltz 1990). Waltz argues that the proliferation of nuclear weapons will fundamentally stabilize the international security environment. In line with neo-realist theory, he predicts that war is a fundamentally rational decision, based on expected costs and benefits. For Waltz, the sheer magnitude of nuclear war increases the stakes involved in both low-level and higher level disputes involving nuclear powers, inducing restraint. As he writes "Not escalation but de-escalation becomes likely. War remains possible, but victory in war is too dangerous to fight for" (Waltz 1995, 5). While nuclear powers have obvious advantages over non-nuclear powers, if proliferation expands to cover more countries, according to Waltz, it will eliminate the ability of those countries to engage in wars of aggression and escalate crisis situations against other nuclear powers. As a neo-realist, he believes that countries are likely to behave "rationally" with their nuclear arsenals, carefully weighing the costs and benefits and deciding in all cases that the use of nuclear weapons is not worth the cost.

The contrast with Fearon and Jervis should be noted. Fearon thinks that states select into crises with full knowledge of capabilities, meaning some challenges to nuclear defenders should occur when their resolve is uncertain and that escalation will be unrelated to capabilities, since knowledge of capabilities has already been internalized. Jervis thinks that despite the overwhelming consequences of a nuclear attack, states may still decide a war is in their interest. In contrast, Waltz thinks that the threat of nuclear war is so overwhelming that nuclear-armed states should essentially never be challenged, unless it is by other nuclear powers, and that in those cases escalation is still extremely unlikely. Nuclear weapons function to decrease the probability of war at both the initiation and escalation stages.

Unfortunately, while the proliferation pessimism school has interesting insights, its extreme focus on how future proliferation will differ from past proliferation makes it difficult to derive specific arguments for the purposes of understanding the general effects of nuclear weapons in a pre-ultra-proliferated world.[6]

What unifies all of the theorists described above is the belief that nuclear weapons are fundamentally important for international conflict. Whether it is because they are simply more powerful versions of conventional weapons or because the capacity for ultimate destruction they provide fundamentally alters the international security

[6] Sagan's response to Waltz centers on the way organizational routines in new proliferators will influence the probability of international conflict. He thinks that command, control, and safety measures in new proliferant states will be uncertain, risking accidents or the intentional use of nuclear weapons. Sagan also thinks that the biases of military officers towards the use of force risks preventive and preemptive wars by new proliferators, states that have not yet developed stable procedures to handle those weapons (Sagan 1995, 50-51, 55-57, Chapter 2). This is also related to Feaver's arguments about predelegation (Feaver 1992). However, it is difficult to convert Sagan's theorizing into coherent hypotheses for two reasons. First, his argument relies on organizational culture, but he does not provide a method for quantifying and coding organizational culture, meaning those arguments cannot be tested. Second, even more than Waltz, Sagan focuses on the future consequences of proliferation and targets his argument to new proliferant states, differentiating them from new nuclear states prior to the mid-1990s. This makes many of his arguments inapplicable to an empirical study that only includes a limited number of post-Cold War cases.

environment, they clearly matter. Disagreements exist about the mechanisms that will cause coercion or deterrence and about what will occur at lower levels of the escalation ladder. However, as a baseline it is safe to assume a relatively unified consensus (excluding the proliferation pessimists) that

- Asymmetrical nuclear capabilities give states, whether challengers or defenders, a coercive edge in international conflict.
- Due to their massively destructive impacts, conflicts between nuclear powers are generally not likely, though they are more likely at lower stages of the escalation ladder than at higher stages.

A final contrasting perspective on nuclear weapons comes from so-called political relativists, scholars who believe that variables specific to nation-states, such as regime type or relative satisfaction with the international system, are more important than relative capabilities for determining the initiation and escalation of international conflict.

Colin Gray's critique of arms control agreements, laid out in his book *House of Cards: Why Arms Control Must Fail* (1992), revolves around the importance of the domestic-level variables that motivate nation-states for international conflict. Gray states that arms control agreements succeed only when they are unnecessary – when the underlying political conditions have already substantially reduced the risk of war. If hostility increases after an arms control agreement has been implemented, its collapse is inevitable (Gray 1992 222-225). For Gray, capabilities in and of themselves are not critical factors for predicting the initiation and escalation of international conflict. For example, the United States encourages some states, like Australia, to build up their

military forces, but issues statements of concern when the defense budget of the People's Republic of China (PRC) increases. As Gray writes:

> "There is no intention to suggest here that the kind and numbers of weapons are un-important for decisions on war or peace; nor is it implied that accidental war or war through misperception of the meaning of precautionary mobilization procedures is literally impossible. The point rather is that the importance of weapons or military behavior per se typically is swamped in relative significance as a trigger for war by the policy drives of governments" (Gray 1992, 27).

This means that one would expect, when evaluating both the initiation and escalation of international conflict, that the relative importance of any WMD variables, or any conventional balance of forces variables for that matter, will be substantially lower than variables measuring regime type and a state's relative level of satisfaction with the international system. Some scholars, though in a public policy context, have commented on this theory with regards to nuclear proliferation. As Lambakis argues, ". . .it matters not so much that there are nuclear weapons, but rather whether Saddam Hussein or Tony Blair controls them and in what security context" (Lambakis 2001).

While the statistical tests below will to some extent help provide some evidence supporting or contradicting these theories, more important for the purpose of this paper is the relative impact of chemical and biological weapons in contrast with the relative impact of nuclear weapons.[7] But how do biological and chemical weapons fit into this complicated picture? Should they be just like nuclear weapons, only less important? Should they have a larger impact because they are considered more usable? Can

[7] If the tests reveal that nuclear capabilities make initiation more likely or have interesting effects on concessions different than those presented as a general consensus above, it will provide an empirical basis to mediate the small differences between the outcomes predicted by Jervis, Waltz, Fearon, etc.

evaluating chemical and biological weapons help provide evidence that supports or disproves some of the branches of theories about nuclear weapons explained above? The subsequent section will analyze chemical and biological weapons, developing literature-based expectations concerning whether their impact on the initiation and escalation of conflict should be similar to or different from nuclear weapons.

Are CBWs similar to nuclear weapons?

Standard scholarship on chemical and biological weapons emphasizes their unique significance in the modern era.[8] The modern work on CBWs includes extensive public policy analysis (Carus 1991, Smith 2000, Betts 1998, Einhorn 2003, Cirincione 2002, Pringle 2000), but only very limited academic studies. One set of literature focuses on America's calculated ambiguity policy. The calculated ambiguity policy states that the United States will respond with overwhelming force in response to a chemical or biological weapons attack. While the United States does not guarantee the use of nuclear weapons against a CBW strike, it reserves the right to use nuclear weapons in such a circumstance. Sagan (2000) critiques calculated ambiguity, arguing that it may not be credible and that it may create a commitment trap drawing the United States into otherwise avoidable nuclear conflicts.[9] Martin (2001), Murdock and Flournoy (2002), and Gompert (2000) have disagreed with Sagan from multiple perspectives, with Martin

[8] The sole focus on the modern existence and use of CBWs is probably misplaced (see Mayor 2004), but that is beyond the scope of this paper.

[9] The United States has legally foreclosed its biological and chemical warfare options through the Biological Weapons Convention (BWC) and Chemical Weapons Convention (CWC). It is believed that all US offensive biological weapons have been destroyed and that most chemical weapons have been destroyed, with the rest slated for destruction.

arguing that biological and chemical weapons should be de-linked in American strategy, Gompert defending the current policy, arguing that nuclear threats are necessary to deter CBW attacks, and Murdock and Flournoy explaining both sides of the debate but coming down for the most part on the side of guaranteeing a more deadly response than the one currently guaranteed by the calculated ambiguity policy.

Another set of literature on CBW proliferation focuses on the arms control agreements, both explicit and implicit, designed to restrain their use in armed conflict. In one of the best theoretically derived works on the use, or non-use in this particular case, of chemical weapons, Legro examines the use and non-use of specific forms of warfare in World War II, including chemical weapons. He argues that while both Britain and Germany possessed offensive CW capabilities, neither employed them in conflict. Legro concludes that a combination of institutional constraints based on norms, realist considerations based on a fear of retaliation, and organizational culture-related factors decreased the preparedness of all parties for chemical warfare (Legro 1995, 221-225).[10] Interestingly, while for the most part Legro's study repudiates the utility of realism for understanding warfare in World War II, in the chemical weapons case Lego acknowledges that realist motivations probably mattered (Legro 1995, 221). The knowledge that the other side had appropriate defenses and could respond in kind caused restraint by both countries.

Common to existing research are three key assumptions. First, CBWs are an important element of international power that gives countries leverage within the international system. They are symbols of power. Second, many countries now want

[10] Another way to phrase this is that implicit norms of non-use, driven both by perceptions of their illegality in warfare and the knowledge that both sides possessed the defensive capabilities to effectively counter their use, prevented the use of CW in the European theater in World War II.

CBWs because they believe CBWs may help them confront America in future regional contingencies. They give countries an actual edge in bargaining situations or in low-level disputes. Third, the way countries should respond to those that have chemical and biological weapons is different than how countries should respond to those that lack such weapons. America needs an independent doctrine to plan its response to a CBW attack because the potential consequences are enormous.

Unfortunately, no work has tested these assumptions, but the existing literature on the actual utility of CBWs can be used to generate comparative hypotheses for statistical analysis. One way to think about the empirical impact of chemical and biological weapons is that they should be far lower than those of nuclear weapons. The blast radius, the area effected by the delivery of a single weapon, and the number of people likely killed would be much higher for an average nuclear attack in comparison to an average biological or chemical attack (Cordesman 2001).[11] Zelicoff (2004) argues that the magnitude of destruction possible from chemical weapons means they are not WMDs.[12] The historical record provides some support for this view. While the Germans achieved an important tactical breakthrough at the battle at Second Ypres in 1915, once both sides in World War I developed their own chemical arsenals and chemical defenses, the weapons ceased to be decisive. Weather conditions such as sunlight and wind influence the relative effectiveness of chemical weapons (Hammond Jr. 1999, 65). This makes them relatively unreliable in many cases. The difficulty of mating chemical weapons

[11] Those interested in more on the actual impact of a nuclear war should see British Medical Association Board of Science and Education, *The Long-term environmental and medical effects of nuclear war* (London: British Medical Association, 1986); United Nations Department for Disarmament Affairs, *Study on the climatic and other global effects of nuclear war* (New York: United Nations, 1989).

[12] For the purposes of this paper, chemical weapons can be defined as they are by the United Nations, as "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).

onto missiles also complicates perceptions of their relative effectiveness (Karp 1996). Even in the case of the United States in World War I, when 26.8 percent of US casualties were due to chemical weapons, only 2 percent of those casualties died (Spiers 1994, 4). The very fact that the United States and the rest of the world have essentially been willing to forgo their use and move towards destroying their weapons stockpiles speaks to their general irrelevance. The international perception that the use of chemical weapons is "immoral" may militate against their use, reducing their usefulness. Finally, recent uses of chemical weapons may illustrate the difficulties involved in their delivery. The Aum Shinrikyo cult distributed sarin gas in the Japanese subway system in 1995. However, while thousands were sent to the hospital, only twelve people eventually died (Tucker 2001).

Biological weapons, though offering a possibility for massive destruction unmatched by chemical weapons, also face a multiplicity of technical complications that reduces their relative utility.[13] First, biological agents are unlikely to survive for a long time in the open atmosphere, meaning they have to be delivered rapidly. Second, as with chemical weapons, changing weather conditions could undermine the effectiveness of a BW attack (Panofsky 1998). Third, biological weapons would either have to be directly placed in a position to cause destruction, such as the poisoning of a water supply, or sprayed in the air above a city. This is harder to do than many realize and reduces the probability of a successful BW attack (Tucker 2001; Karp 1996). Fourth, if proper warning and containment occur, passive defense measures can substantially cut into the impact of a biological weapons attack (OTA 1993, 52). Fifth, the empirical record shows

[13] For the purpose of this paper, biological weapons can be defined as "any infectious agent such as a bacteria or virus used intentionally to inflict harm upon others. This definition is often expanded to include biologically-derived toxins and poisons" (ABC News 2001).

the perceived effectiveness of biological weapons is questionable. Believing biological weapons did not provide a relative edge in combat, the United States gave up its offensive biological weapons program in the early 1970s. Biological weapons, to the best of our knowledge, have not been used in warfare in the modern era. As with chemical weapons, perceptions that their use is immoral date back to the 1899 Hague Conventions in formal arms control treaties. Whether it is because an existent international taboo has altered national preferences or because the fear of retribution deters the use, there is a clear international consensus that the use of biological weapons is simply wrong. This means threats to use CBWs are generally not credible, meaning they are unlikely to influence international behavior. Hypothesis 1 attempts to test this perspective on the utility of biological and chemical weapons.

Hypothesis 1: Biological and chemical weapons should have very little impact on the initiation and escalation of international conflict. This will not be because all weapons of mass destruction do not matter for international conflict, but because biological and chemical weapons are uniquely unimportant in comparison with nuclear weapons.

However, there are also some reasons to expect that CBWs should have a decisive impact on warfare. While the use of chemical weapons in World War I was not decisive, their non-use in World War II was not due to perceptions of irrelevance. Rather, since both sides had chemical weapons, general deterrence held. As the Egyptian use against Yemen, the Japanese use against China, and the Italian use against Ethiopia demonstrate, one-sided uses of chemical weapons have been especially effective in warfare (SIPRI

1971, 87). Especially in cases of asymmetric capabilities, when a country cannot respond in kind with chemical weapons and/or lacks the proper defenses, the threat of a or actual chemical weapons attack could be effective. In particular, Iraq's use of chemical weapons against Iran highlights the dangers of chemical warfare. While only 45,000 of the estimated one million deaths in the Iraq-Iran war were due to Iraq's use of nerve and blood agents, they induced widespread fear in Iranian lines. By combining chemical attacks, which disoriented Iranian forces and created panic, with follow-up conventional assaults, Iraq was able to triumph over an adversary that might have otherwise emerged victorious (Mauroni 2003, 152-153). While that is true that mustard and blood gases are unlikely to cause mass destruction, more modern nerve gases such as sarin or VX, if disseminated on a wide scale, could actually lead to massive casualties (SIPRI 1971, 84-85). Most importantly for the purposes of this paper, it is the international *perception* that chemical weapons are effective, not their actual effectiveness, that determines their impact on international conflict. Even though weather and technology-related factors may make effective utilization difficult, they are perceived internationally as a powerful weapon that can be a difference maker in times of conflict. It is their status as the "poor man's nuclear bomb" that drives the international proliferation of chemical weapons (Hammond Jr. 1999, X-XI; Burck and Flowerree 1991, XI; Mauroni 2003, XIII).

Though biological weapons are difficult to deliver, Steinbrunner (1997) argues the consequences of their use are almost unlimited. Given the new possibilities for genetic manipulations made possible by modern science, biological weapons could threaten the future of human civilization. The Office of Technology Assessment, while cautioning that the probability of effective use is much lower than for nuclear weapons,

concluded in 1993 that, pound for pound, biological weapons might be more devastating for human populations than nuclear weapons (OTA 1993, 52). Even though the probability of effective use is low, the enormous magnitude may instantly make the use of biological weapons a credible threat. United States policy makers certainly take the threat seriously. In an oft-repeated statement on the risk of biological warfare, the Office of Technology Assessment also noted that the distribution of 100kg of anthrax in the air over a city could kill up to three million people (BBC 1998). As with chemical weapons, while defensive measures can mitigate the terminal impact of use, in cases of asymmetric capabilities, the threat to use biological weapons could be especially credible. Also similarly to chemical weapons, it is the fear of the impact of biological weapons, even more than a rational cost-benefit analysis, that makes them important for international politics. The possibility of mass disease in the homeland or among troops deployed abroad, is frightening (Mauroni 2003, XV). This alternative view of chemical and biological weapons leads to the following hypothesis.

Hypothesis 2: Biological and chemical weapons should each have an independent impact on the probability of the initiation and escalation of warfare that is similar to, but smaller than, nuclear weapons.

By framing the hypothesis in this way, it will let us test the relative independent effect of each type of weapon. Thus, if scholars such as Zelicoff are correct, the results will show that nuclear and biological weapons have a substantial impact on warfare but that chemical weapons are relatively useless.

A final perspective on biological and chemical weapons is that they are even more useful for the purposes of international bargaining, especially at lower levels of hostility, than nuclear weapons. The nuclear taboo is powerful. No nation has used nuclear weapons since 1945 and the consequences for the international system if such use occurred would be substantial (Schelling 1980, 264-265).[14] Geller (1990) finds that nuclear weapons do not deter escalation by non-nuclear states precisely because the use of nuclear weapons is not considered credible.[15] Pape (Pape 1996, 36) even argues that despite giving states an enormous advantage in general, the use of nuclear weapons would be carefully scrutinized by the international community due to the likelihood of their use inflicting disproportionate impacts on an enemy.[16] Despite their perception as inhumane, chemical weapons have been used in warfare several times in the last fifty years. Though biological weapons have not been used, relative international perceptions of their importance have always been high. The United States and Soviet Union maintained active offensive BW research programs until the 1970s. Revelations about Iraq's biological weapons program after 1991 and about the former Soviet biological weapons program exposed the possibility of biological warfare to a broad international audience (Moodie 2001). Combined with widespread policy analysis of the risks of biological warfare (Tucker 2001, Mauroni 2003, Danzig 2003, Barnaby 2002), the credibility of biological weapons threats may be uniquely high due to the perception that

[14] For a good introduction to the construction of the nuclear and chemical weapons taboo, see Richard Price and Nina Tannenwald, "Norms and Deterrence: The Nuclear and Chemical Weapons Taboo," Peter Katzenstein, ed., *The Culture of National Security* (New York: Columbia University Press, 1996), 114-152.
[15] This contrasts the conclusion of Huth (1990), who states that nuclear weapons are especially useful for immediate deterrence due to psychological perceptions of their utility in the minds of national leaders (272-273).
[16] Pape references Brodie as well, which is instructive in this area. Bernard Brodie, *Escalation and the Nuclear Option* (Princeton, N.J.: Princeton University Press, 1966).

nations are unlikely to use nuclear weapons. If the credibility of CBW threat were larger than the credibility of nuclear threats, one would expect to see the following

Hypothesis 3:

A. Biological and chemical weapons, due to perceptions of their usability in warfare, should have a larger effect on the initiation and escalation of international conflict than nuclear weapons.
B. Due to perceptions that they are not usable, escalation by non-WMD states against nuclear-armed defenders should be more likely than escalation against CBW-armed defenders.

Information, Certainty, and International Strategy

Just as important as actual WMD capabilities may be the perception of capabilities, at least in terms of how states respond to those they believe have WMD. Mercer (1996) argues that international perceptions of power can be as important as actual capabilities and that perceptions vary depending on whether a state is interacting with allies or adversaries. Even states that lack WMD capabilities may behave as if they possess those weapons if they are believed to have them by their key adversaries and allies. The belief that the global pursuit of WMDs constitutes a threat to national security has been a cornerstone of American grand strategy since President Clinton declared a national emergency with regards to WMD proliferation in 1994. The Bush Doctrine

(2002) relies in large part on the assumption that countries seeking to acquire WMDs constitute a threat to American national security.[17] As the aftermath of the invasion of Iraq highlighted, international common knowledge of the WMD capabilities of other countries is a mixed bag, at best. There are varying levels of certainty about the WMD programs of other countries.

Fearon's theory of conflict also includes concrete predictions about how the certainty of weapons possession should influence state behavior. Fearon fundamentally believes war is about incomplete information (1995).[18] As information is diffused throughout the international system, bargaining stakes become clearer, making agreements easier to conclude. In cases where there is a lack of information, such as minor powers thinking about challenging major powers in areas where the resolve of the major power is not certain, challenges should be more likely. When there is more certainty, challenges are less likely but will only occur when the challenger is especially determined, making escalation more likely.

While most of the literature on the importance of information focuses on beliefs about national will, it can be extended to capabilities as well. With regards to the possession of weapons of mass destruction, information may play an important role. When challengers are uncertain about the WMD capabilities of the defender, they may exercise less restraint in initiating challenges. However, since the process of initiating a conflict involves the revelation of information, that should increase transparency about

[17] For some insight into the intellectual foundations of that strategy, see Keith B. Payne (study director) et al., *Rationale and Requirements for U.S. Nuclear Forces, Vol. 1, Executive Report*, January 2001, http://www.nipp.org/Adobe/volume%201%20complete.pdf <Accessed March 1, 2004>.

[18] Another path to war, according to Fearon (1995) is the failure to make credible commitments. The credible commitments problem, when nations want to make deals but cannot trust that the other side will live up to their side of the bargain, also results from information. If each side has information about the intent of the other side and the domestic pressures faced by the other side, it would be much easier to make credible commitments.

capabilities, decreasing the probability of escalation. If countries make WMD threats deemed credible, deterrence holds; if not, deterrence is more likely to fail. In contrast, as certainty about WMD possession by both the challenger and the defender increases, initiations should be less likely but, because of selection effects, escalation will become more likely.

Hypothesis 4: As levels of uncertainty about WMD possession by the challenger or defender increase, the probability of conflict initiation should increase but the probability of conflict escalation should decrease. As levels of certainty about WMD possession by the challenger or defender increase, the probability of conflict initiation should decrease but the probability of conflict escalation should increase.

However, another way to look at the interaction of certainty and WMDs comes from Kenneth Waltz. Waltz argues that the escalatory possibility of nuclear war provides uniquely important information to both sides about the costs of conflict (Waltz 1995, 5). When states are more certain about the potential consequences of conflict, they are less likely to escalate. In a world of uncertainty, countries will initiate more probes and limited uses of force because they do not fear the ultimate consequences of escalation. The risk analysis involved when one of the states involved possesses nuclear weapons eliminates uncertainty about the ultimate consequence of war. Instead of war involving gains at best and limited destruction at worst, nuclear war involves gains at best but ultimate annihilation at worst. This certainty will induce restraint (Waltz 1995, 6-7). As Waltz writes “In a conventional world, deterrent threats are ineffective because the

damage threatened is distant, limited, and problematic. Nuclear weapons make military miscalculation difficult and politically pertinent prediction easy" (Waltz 1995, 8). The contrast to Fearon is that the signaling model posits that variations in the level of information matter. It makes a difference whether a country is sure an adversary has nuclear weapons or whether it just suspects that the possibility exists. Waltz disagrees, arguing that the threat of nuclear war is so large that it swamps the possibility of uncertainty. Waltz uses the example of the Crimean War to prove his point. Given the uncertain but relatively low expected costs of conflict, Britain and France were quite willing to send troops to the Crimean. However, in a world of potential nuclear escalation, British and French intervention would have been unlikely (Waltz 1995, 5).

To some extent, an application of Schelling's (1980) threat that leaves something to chance helps bolster Waltz's argument. While the logic concerns a loss of control over the mechanisms of escalation, it can also be applied to uncertainty about capabilities. Schelling states that holding out the possibility of uncontrolled escalation can be more effective in inducing concessions than outright threats. Convincing a state that you may lose control of the situation generates a fear of escalation larger than if a state thinks de-escalation can be assured by the rational belief that nuclear war is unthinkable. Applied purely to capabilities, since the costs of escalation are beyond measurement and states are assumed to be risk averse, even the uncertain possession of WMD capabilities should deter the initiation of conflict (Schelling 1980, 187-189).

Hypothesis 5: At any level of certainty about WMD possession by the defender, initiation should be unlikely. At any level of certainty about WMD possession by both sides,

escalation should be unlikely. Variations in certainty should not influence initiation and escalation.

III. Research Design

The baseline model and control variables

The base research design used for this paper is a set of over 140,000 observations drawn from the EUGene dataset (Bennett and Stam 2000). The data was set up in a directed-dyads approach. Given that many of the hypotheses are directed, depending on the specific capabilities of the challenger or the defender, a directed dyads approach is necessary to capture the specific effect of WMDs on international conflict. For all interactions described in the paper, state A refers to the state that originally initiated the dispute, the challenger, while state B refers to the defender. Given the relative infrequency of conflict in the international system, the rare events correction suggested by King and Zheng was also utilized (2001).[19]

Several different dependent variables are suggested by the hypotheses described above. Each data run in the results section will explicitly describe the dependent variable, model, and reason for selection. The main dependent variable is a special 1-5 scale created for this study measuring relative levels of hostility employed by both sides. The measures of hostility are drawn from the hostility levels reported for side A and side

[19] The initiation and escalation of international disputes happens very infrequently in the international system. King and Zeng report that only .034% of all dyads after World War II are embroiled in wars (King and Zeng 2001, 137).[19] This can skew the signs of coefficients and make variables look significant whose substantive impact is actually very small. To correct for rare events bias, King and Zeng created a relogit model that uses a different probability equation from a basic logic model to solve the bias resulting from the rare nature of the dependent variable (King and Zeng 2001, 703-705). I employ their suggested solution of sampling all dispute dyads and ten percent of non-dispute dyads.

B in version 3.0 of the Militarized Interstate Dispute dataset (Ghosen and Bennett 2003). A one represents the initiation of a dispute (by side A in a directed dyads setup). Two and three signify escalation to the use of force by side A when side B backs down and by side B when side A backs down, respectively. Four represents the use of force by both sides and five represents escalation to full-scale war, meaning more than 1000 battle deaths.

The baseline model used for this study is multinomial logistic regression. Multinomial logit models allow for the independent estimation of the relationship between the independent variables and the dependent variable at each level of the dependent variable. Use of a multinomial logit model is justified for two reasons. First, the levels of the dependent variables, especially those levels involving the terminal outcome of the dispute, are not ordered. Second, even within the variations in the hostility level, there is no reason to expect that movement from a challenge to the status quo to a display of force is exactly proportional to movement from a display of force to the use of force by one state. Given that the dependent variable is categorical but unordered, this justifies the use of a multinomial logit model (Long 1997, chapter 6; Bennett and Stam, 2000: 460-461).

Several control variables were added to the model to test the relative importance of WMDs. Given that one school of thought about WMDs, the political relativism school, predicts that the acquisition of WMDs has very little to do with the initiation and escalation of disputes and that regime-specific variables will have a larger impact, including appropriate control variables is necessary to fully test the hypotheses. The control variables include measures for regime type from the Polity IV dataset, satisfaction

with the international system, participation in specific types of alliances (defense, entente, neutrality), the conventional balance of forces, and contiguity on land. Most of these come from Bennett and Stam's (2003) very extensive book on the variables and were generated using their EUGene dataset (Bennett and Stam 2000). Interested readers should consult their book (chapter 3) for more information on the creation of the control variables.[20] The possibility of fixed time effects was corrected with the creation of time-based controls (Beck, Katz, and Tucker 1998). All models were run with robust standard errors, to avoid potential heteroscedasticity.

Generation of new variables of interest

On the recommendation of several scholars, many of whose arguments are explained above, unique sets of variables were created for both chemical and biological weapons. Since existing data was not available for this purpose, the data was generated using a combination of secondary sources recommended by experts in the field and US government sources when available.[21] The availability of US government data, considered more reliable since it is presumably based on classified intelligence sources, was privileged when secondary sources disagreed with US government data.

[20] The relevant citations for the datasets used by EUGene in this instance are Bennett, D. Scott, and Allan Stam. 2000. "*EUGene*: A Conceptual Manual." *International Interactions* 26:179-204. Website: http://eugenesoftware.org; Ghosn, Faten, and Glenn Palmer. 2003. "Codebook for the Militarized Interstate Dispute Data, Version 3.0." Online: http://cow2.la.psu.edu; Ghosn, Faten, and Scott Bennett. 2003. Codebook for the Dyadic Militarized Interstate Incident Data, Version 3.0. Online: http://cow2.la.psu.edu; Singer, J. David. (1987). "Reconstructing the Correlates of War Dataset on Material Capabilities of States, 1816-1985" *International Interactions*, 14: 115-32.

[21] The scholars consulted to help assemble this dataset included Michael Moodie of the Chemical and Biological Arms Control Institute, Dr. Alan Zelicoff, formerly of Sandia National Laboratories, Paul Kerr of Arms Control Today, Jeff Lewis of the University of Maryland, John Hart of the Stockholm International Peace Research Institute, Nate Krisoff of the Stimson Center, and Jon Wolfsthal of the Carnegie Endowment for International Peace. The specific sources/pages that led to the coding of particular data points are available upon request. If you have a question about a specific data point, please email the author.

Unfortunately, US government data is only really available for the post-Cold War period. Given that all the sources used to generate the data were specifically recommended by experts in the field, the data was coded to reflect what the balance of those sources believed was true at a given point in time.[22]

Several different binary independent variables were created. Each variable described below was generated for both biological and chemical weapons. For comprehension purposes, the following description is only for chemical weapons. Countries were coded as having chemical weapons programs that were either known, probable, in production, possible, or in research and development. Due to data problems, the possible and research and development variables were combined for some of the data runs. Each was coded a one if the state was judged to possess those capabilities at time t and a zero if they did not.[23]

To test the possibility that countries treat chemical weapons capabilities alike regardless of perceptions of certainty, an additional variable was created for both biological and chemical weapons. The variable is coded a one if a country is believed to have any level of interest in biological (chemical) weapons and a zero it if has no interest. Finally, similarly to the joint possession of nuclear weapons variables created by previous research, binary dummy variables were created to measure the impact of joint possession of biological and chemical weapons.

[22] For the actual coding of capabilities for countries during specific years, please contact the author.
[23] While it was unused in the data analysis described below, there was also a linear variable created on a one through five scale, with a five representing known weapons capabilities, a four probable weapons capabilities, a three the ability to produce capabilities, a two possible capabilities, and a one capabilities in research and development. Again, due to data problems, a one through four scale was also created, with a one representing both possible capabilities and research and development. These variables allow for the testing of the hypotheses concerning uncertainty.

The baseline binary nuclear weapons variable comes from the Bennett-Stam (2003) dataset. In contrast to previous studies that have viewed nuclear weapons as a yes or no question—either states have nuclear weapons or they do not—this paper expands the data on nuclear weapons to cover a broader range of capabilities and attempted capabilities. First, similar to the work described above to outline a relative levels of CBW capabilities, a similar effort was undertaken for nuclear weapons, coding for research, suspicion of possession, production capabilities, probable possession, and actual possession.[24] Interestingly, there is some deviation between the Bennett-Stam coding of nuclear states and the dataset of known nuclear states constructed in this paper.[25] Robustness tests demonstrate no difference in statistical outcomes when the Bennett-Stam variable was used, and while the Bennett-Stam coding scheme for nuclear weapons relied on a single website that is currently unavailable, the creation of the nuclear variables for this project, described in footnote 24, was more detailed.

The nuclear, chemical, and biological weapons variables are also interacted with a concentration of capabilities measure generated from the Correlates of War Project (the variables are multiplied together). The concentration of capabilities variable combines military, economic, and demographic variables into a single measure of power. By

[24] Data from Gartzke and Jo (2003), the Natural Resources Defense Council, the Federation of American Scientists, and Bennett and Stam (2003), was used to construct the nuclear capabilities data.

[25] Additional estimations revealed no statistical differences between the Bennett-Stam estimations and those created with the newer coding scheme. These differences are as follows. Bennett and Stam code Israel as having nuclear weapons in 1973, but on the basis of research by Cohen, I follow Gartze and Jo in coding Israel as having nuclear weapons in 1964. They code Pakistan as having nuclear weapons in 1986 and India as having nuclear weapons in 1974. Given the more nuanced coding scheme made possible by the new variables described above, I code Pakistan as a probable nuclear power beginning in 1987 but not as a known nuclear power until 1998. India is coded as probable from its peaceful nuclear explosion in 1974 until its full-blown nuclear test in 1998. Bennett and Stam code South Africa as a known nuclear power from 1980 through 1991, but I code South Africa as a probable nuclear power from 1979 through 1991. They also code Kazakhstan as giving up its nuclear weapons two years before I reach the same conclusion. In all cases, deviations from Bennett and Stam were based on either the more recent data from Gartzke and Jo or the Federation of American Scientists. Attempts to track down the web page used by Bennett and Stam to generate their nuclear weapons possession data were unsuccessful.

interacting the NBC variables with traditional power variables, it controls for the way that the conventional balance of forces may influence a particular dyad. Since if a country does not have a particular NBC capability, the interacted variable will be zero, comparing the interacted variable to results with just the conventional capabilities variables will show if specific WMDs really have a unique impact on international conflict.

One problem in the data is that to some extent these programs were secret at various points in time. This raises the question of how states process information and make decisions about relative capabilities. For those states with secret programs, the existence of those secret programs may have altered the way a state negotiated, since it could perceived itself as having different options in terms of future capabilities than those that other states knew they had. However, for the country negotiating with a state that had a secret program, there would be no way to tell. The data collected for this project reflects international conventional wisdom, drawn from a multiplicity of private and public sources, not just US government sources. The new variables generated for this project can be seen in Appendix A.[26]

IV. Results

The Initiation of International Conflict

To establish a baseline through which the relative importance of CBWs and relative certainty of possession of all WMDs could be assessed, some summary statistics

[26] Not all of the variables in Appendix A were utilized in the study. Additional data measuring nuclear arsenal size, the possession of tactical and strategic nuclear weapons, interactions between NBC weapons possession, and the signature/ratification of WMD-based arms control agreements was also collected and will be utilized in future research.

were collected concerning the risk of war. Interestingly, states without nuclear weapons got involved in major wars with states that had nuclear weapons on twelve occasions, while the converse only occurred in ten situations.[27] However, this summary statistic should not be taken too seriously because the data cannot show the state that originally escalated the conflict. The initial regression results, presented in Appendix B, confirm the results of Bennett and Stam's (2003) earlier research. This first regression was done as a logit, with robust standard errors. The dependent variable, as recommended by Bennett and Stam (2003) when solely looking at this question of initiation, is the initiation of a militarized dispute as coded by the Correlates of War 2 project (Ghosn and Palmer 2003). This means the logit model is the most appropriate because it accurately measures coefficients and significance for binary dependent variables.

The results confirm the conventional wisdom of Jervis, Fearon, and Waltz regarding nuclear weapons (the table is not presented here to save space but can be viewed in Appendix B). Having nuclear weapons, once interacted with the relative conventional balance of forces, both makes states less likely to initiate disputes and seems to shield them from initiations by others.[28] The R2 of the model is extremely high, at .7988, meaning the model captures most of the variance in the dependent variable. This means we can be confident the variables being estimated are actually the ones that matter for the initiation of conflict. However, while the nuclear weapons variable is

[27] The cases of non-nuclear states escalating against nuclear powers are Egypt and Syria escalating against Israel, Vietnam against the United States, Argentina against the United Kingdom, and China against both the United States and the United Kingdom. Nuclear states escalating against non-nuclear states include the converse of the above, the Soviet Union against Hungary. Given that these are essentially the same conflicts, minus the Soviet Union and Hungary on one side and Argentina and the United Kingdom on the other, these results should not be viewed as very significant.

[28] In line with the methodological suggestion of Braumoeller (2003), the individual coefficients for the nuclear weapons and conventional balance of forces variables are disregarded in favor of the interaction term. The presence of the interactive term skews the signs and significance levels of the baseline variables.

significant in the direction predicted by Fearon and Waltz, the regime variables are also significant. The size and significance of the joint democracy and satisfaction with the status quo variables provides some limited support for Gray's argument that the intentions of nation-states, not their capabilities, best explains the initiation of international conflict.

Table 1: Probability of conflict initiation with WMD and WMD interaction variables included

	Coefficient	*Robust Standard Error*
Joint Democracy	-0.457**	0.181
Side A Revisionist	9.364**	0.291
Side B Revisionist	6.657**	0.354
Contiguity	3.094**	0.148
Defense Pact	-0.459**	0.200
Neutrality Pact	0.153	0.438
Entente Pact	-0.321	0.399
Side A Relative Democracy	-0.007**	0.003
Side B Relative Democracy	-0.012**	0.002
Balance of Forces	-0.886*	0.511
Side A Major Power	1.823**	0.221
Side B Major Power	1.609**	0.194
Peace Years	-0.015**	0.004
Side A Known Nuclear Weapons	2.153*	1.132
Side B Known Nuclear Weapons	4.519**	1.294
Side A NW * Balance of Forces	-3.445**	1.257
Side B NW * Balance of Forces	-6.313**	1.419
Both Possess Nuclear Weapons	0.409	0.590
Side A Known Biological Weapons	0.680	1.263
Side B Known Biological Weapons	1.019	1.348

Side A BW * Balance of Forces	0.384	1.426
Side B BW * Balance of Forces	0.263	1.526
Both Possess Biological Weapons	-0.237	0.663
Side A Known Chemical Weapons	0.179	1.071
Side B Known Chemical Weapons	-3.157**	1.166
Side A CW * Balance of Forces	0.442	1.237
Side B CW * Balance of Forces	4.413**	1.302
Both Possess Chemical Weapons	-0.710	0.448
_cons	-5.856	0.434
Number of obs =	85731.000	
Wald chi2(28)	2837.010	
Prob > chi2	0.000	
Pseudo R2	0.807	
Log pseudo-likelihood	-1596.485	

* Represents significance at the .1 level, ** significance at the .05 level. The model was estimated with robust standard errors and measures the effect of each independent variable on the initiation of conflict.

The second data run, table 1 above, includes variables for known possession of biological and chemical weapons. This tests the relative impact of biological and chemical weapons in the same way that nuclear weapons are normally tested. As with the first test, the WMD variables are interacted with the conventional balance of forces. Once that interaction term is introduced, the importance of the non-interacted WMD and balance of forces variables no longer become relevant, meaning the key results for interpretation are the interacted WMD variables.[29] The results show that the impact of nuclear weapons in the tests above was not masking a more important effect resulting

[29] For more detailed analysis of the theoretical insights behind this argument, see Braumoeller (2003).

from the possession of chemical and biological weapons. Both of the nuclear weapons variables of interest are negative and significant, highlighting an important role decreasing the probability of dispute initiation. Possession of chemical weapons by the defender, however, makes challenges significantly more likely. Biological weapons have no effect.

Table 2: Conflict Initiation -- All WMD uncertainty variables and interaction terms

	Coefficient	*Robust Standard Errors*
Both Possess Nuclear Weapons	0.096	0.657
Both Possess Biological Weapons	-0.269	0.674
Both Possess Chemical Weapons	-0.552	0.443
Side A NW * Balance of Forces	-1.407	1.681
Side A Probable NW * Balance of Forces	4.938**	2.063
Side A NW Production * Balance of Forces	-2.521	1.805
Side A NW Suspicion * Balance of Forces	0.997	2.068
Side A BW * Balance of Forces	-0.51	1.789
Side A Probable BW * Balance of Forces	0.272	2.94
Side A BW Production * Balance of Forces	7.459**	2.359
Side A BW Suspicion * Balance of Forces	1.378	1.593
Side A CW * Balance of Forces	-0.959	1.63
Side A Probable CW * Balance of Forces	-6.930**	2.597
Side A CW Production * Balance of Forces	-2.173	3.123
Side A CW Suspicion * Balance of Forces	0.721	2.006
Side B NW * Balance of Forces	-5.459**	1.666
Side B Probable NW * Balance of Forces	1.411	2.395
Side B NW Production * Balance of Forces	-7.943**	2.532
Side B NW Suspicion * Balance of Forces	2.597	1.873
Side B BW * Balance of Forces	-1.101	1.706
Side B Probable BW * Balance of Forces	-4.088	2.617
Side B BW Production * Balance of Forces	-1.986	3.415
Side B BW Suspicion * Balance of Forces	-4.066	2.147
Side B CW * Balance of Forces	5.138**	1.629
Side B Probable CW * Balance of Forces	0.3	1.91

Side B CW Production * Balance of Forces	6.206	4.407
Side B CW Suspicion * Balance of Forces	-1.239	2.772
Number of obs	85731	
Wald chi2(67)	2847.95	
Prob > chi2	0	
Log Pseudo-likelihood	-1530.6746	
Pseudo R2	0.8147	

* Represents significance at the .1 level, ** significance at the .05 level. The model was estimated with robust standard errors and measures the effect of each independent variable on the initiation of conflict.

Table 2, above, tests the likelihood of conflict initiation against the control variables and the full set of WMD variables, including variations in international certainty about the possession of WMDs. The results reported here are just the coefficients and significance scores for the variables of interest, the WMD interaction variables. The complete results are of this regression are available in Appendix B. The results are interesting and help unpack the unique impacts caused by the possession and suspected possession of chemical and biological weapons. For nuclear weapons, the results show that known possession of nuclear weapons by challengers does not make initiation significantly more likely, while possession by defenders makes initiation significantly less likely. Besides continuing to validate previous research on the subject, even when probability of acquisition is included, it provides theoretical support to Waltz and Fearon. However, those states deemed on the verge of acquiring nuclear weapons are substantially more likely to initiate militarized disputes. This provides some evidence in support of power transition theory. Given that states on the verge of acquiring nuclear weapons are generally likely to be rising powers, they theoretically should be more

aggressive. Joint possession of nuclear weapons does not significantly influence the probability of initiation.

Controlling for conventional capabilities, possessing biological weapons production capabilities makes a state significantly more likely to initiate conflict. However, a closer look at the data reveals that many of the relevant cases come from Germany before World War II, whose primary threat to the world did not arise from biological weapons, and from West Germany after World War II, whose biological weapons production capabilities, though existent, are not generally considered critical to international security. None of the other BW variables are significant in any direction. Given that there is not really a strong theoretical reason to believe that possessing BW production facilities makes states more aggressive, it appears the significant impact of BW on the initiation of conflict is defensive. Working towards a biological weapons capability makes it less likely a state will be challenged, showing the importance of uncertainty in deterring other states. Joint possession of biological weapons does not significantly influence the probability of initiation.

Chemical weapons produce similarly differential impacts on the probability of dispute initiation. States possessing likely chemical weapons arsenals are significantly less likely to initiate conflicts, but no other level of potential chemical weapons capabilities, from known possession to production capabilities or suspicion of interest, has a significant impact on the behavior of State A. However, perhaps the most intriguing result, one entirely consistent with the behavior of America in Iraq, is that states with known chemical weapons capabilities are significantly more likely to be challenged. However, given that states such as Egypt and Iraq were known chemical

weapons possessors but were the subject of attacks unrelated to their chemical weapons capabilities (Egypt by Israel in 1967 and Iraq by Israel in 1981), further evidence from the full escalation model is necessary to determine if possessing chemical weapons capabilities increases the risk of being challenged in a militarized dispute. Joint possession of chemical weapons does not significantly influence the probability of initiation.

This evidence demonstrates that chemical weapons, and to a lesser extent biological weapons, seem to have a significant impact on international conflict, validating hypothesis two and contradicting hypothesis one. However, given the widely varying levels of significance for variables that have only limited theoretical support, drawing causal conclusions from these initial results would be hasty.

The Escalation of International Conflict

The test to measure the escalation of international conflict used a multinomial logit model. The dependent variable was the five-stage measure of militarized disputes described above. The control variables were relatively constant. Joint democracies are less likely to escalate disputes, escalation is less likely when the balance of forces is very unequal, major powers and revisionist states are more likely to escalate conflicts, and while defensive alliances generally preclude escalation, neutrality pacts are correlated with a greater number of escalations. The full results can be seen in Appendix B. For clarity purposes, the full results are not presented here. Rather, they are described in a way that will make it easy to assess their impact for the hypotheses. Unfortunately, due

to convergence problems, it was not possible to include the joint nuclear, biological, and chemical weapons capabilities variables into the model. However, independent estimations of those revealed that joint nuclear weapons possession makes escalation extremely unlikely and that joint chemical weapons possession makes initiation extremely unlikely. In other cases, joint nuclear and chemical possession did not have a statistically significant impact, while in all cases joint biological weapons possession did not have a statistically significant impact. The model had an R squared value of .685, signifying that the model does a good job predicting the variance in the dependent variable. The high degrees of freedom revealed by the Wald test (320) also prove that, despite the large number of independent variables, the modular setup is appropriate.

Table 3: Multinomial Logit Model at DV = 1, dispute initiation, including all WMD uncertainty variables and interaction terms

	Coefficient	*Robust Standard Error*
DV = 1 -- Conflict initiation by State A		
Side A NW * Balance of Forces	-1.304	1.856
Side A Probable NW * Balance of Forces	1.81	2.811
Side A NW Production * Balance of Forces	835.772**	180.981
Side A NW Suspicion * Balance of Forces	0.595	2.309
Side A BW * Balance of Forces	-0.512	2.055
Side A Probable BW * Balance of Forces	-1.118	3.134
Side A BW Production * Balance of Forces	4.021	2.508
Side A BW Suspicion * Balance of Forces	0.045	1.876
Side A CW * Balance of Forces	0.23	1.746
Side A Probable CW * Balance of Forces	-8.524**	2.736
Side A CW Production * Balance of Forces	1.843	3.823
Side A CW Suspicion * Balance of Forces	-1.557	3.525
Side B NW * Balance of Forces	-2.42	2.096
Side B Probable NW * Balance of Forces	8.130**	3.706
Side B NW Production * Balance of Forces	2.303	7.607
Side B NW Suspicion * Balance of Forces	0.847	2.35
Side B BW * Balance of Forces	0.794	2.263

Side B Probable BW * Balance of Forces	-8.454**	3.043
Side B BW Production * Balance of Forces	1.962	5.483
Side B BW Suspicion * Balance of Forces	-1.789	2.497
Side B CW * Balance of Forces	1.88	1.938
Side B Probable CW * Balance of Forces	2.342	2.638
Side B CW Production * Balance of Forces	4.769	4.986
Side B CW Suspicion * Balance of Forces	-0.784	3.266

* Represents significance at the .1 level, ** significance at the .05 level. The model was estimated with robust standard errors and measures the effect of each independent variable on the initiation of conflict.

For the initial stage of conflict, table 3 above, the results for the WMD variables differ somewhat from the full initiation stage model run above. This is because since many of those initiations end up escalating, they are not coded as initiations by the more detailed model. Nuclear production capabilities are positively associated with the initiation of conflict. This could be because those states that are thought capable of producing nuclear weapons but have not actually produced weapons, such as India in the early 1970s, are especially likely to initiate disputes, hoping to use the perception of their nuclear arsenals to intimidate others. Once states acquire nuclear weapons, however, they become more risk averse, validating part of Waltz's understanding of nuclear weapons. Interestingly, in converse to when the full set of conflict initiations is evaluated, defending states on the verge of acquiring nuclear weapons are especially likely to be challenged.

As with the initiation model, challengers possessing biological weapons are not especially likely to initiate disputes. However, when the defender is perceived to have biological weapons, but possession has not been verified, challenges to the status quo become less likely. Chemical weapons also have very little effect on initiation in this

model. Probable possession of chemical weapons appears correlated with not initiating militarized disputes, but it is unclear, theoretically, why that would be the case (no reason to presume that probable chemical weapons possession causes risk aversion).

Table 4: Multinomial Logit Model at DV = 2 and 3, successful coercion by Side A (2) or Side B (3), including all WMD uncertainty variables and interaction terms

	Coefficient	*Robust Standard Error*
DV = 2 -- Conflict escalation by State A and State B does not reciprocate		
Side A NW * Balance of Forces	-3.802**	1.945
Side A Probable NW * Balance of Forces	6.597**	3.223
Side A NW Production * Balance of Forces	15.053**	4.304
Side A NW Suspicion * Balance of Forces	-0.651	2.167
Side A BW * Balance of Forces	-1.653	2.025
Side A Probable BW * Balance of Forces	-0.81	3.232
Side A BW Production * Balance of Forces	-3.865	3.154
Side A BW Suspicion * Balance of Forces	1.662	2.238
Side A CW * Balance of Forces	-0.945	1.949
Side A Probable CW * Balance of Forces	-5.433**	3.053
Side A CW Production * Balance of Forces	-6.513	4.406
Side A CW Suspicion * Balance of Forces	1.993	2.342
Side B NW * Balance of Forces	-6.038**	1.844
Side B Probable NW * Balance of Forces	0.55	3.503
Side B NW Production * Balance of Forces	-8.245**	3.225
Side B NW Suspicion * Balance of Forces	2.621	1.909
Side B BW * Balance of Forces	0.058	2.027
Side B Probable BW * Balance of Forces	-6.132**	3.611
Side B BW Production * Balance of Forces	-1.572	3.774
Side B BW Suspicion * Balance of Forces	-4.365	2.73
Side B CW * Balance of Forces	6.598**	1.824
Side B Probable CW * Balance of Forces	3.331	3.064
Side B CW Production * Balance of Forces	3.559	4.101
Side B CW Suspicion * Balance of Forces	-1.898	2.83
DV = 3 -- Conflict escalation by State B and State A does not reciprocate		
Side A NW * Balance of Forces	5.52	5.06
Side A Probable NW * Balance of Forces	3.357	6.421
Side A NW Production * Balance of Forces	-0.459	3.005
Side A NW Suspicion * Balance of Forces	5.307	6.166
Side A BW * Balance of Forces	4.376	3.758
Side A Probable BW * Balance of Forces	4.122	5.628
Side A BW Production * Balance of Forces	-2.748	4.609
Side A BW Suspicion * Balance of Forces	8.727	5.597

Side A CW * Balance of Forces	-7.141**	3.457
Side A Probable CW * Balance of Forces	4.865	3.311
Side A CW Production * Balance of Forces	-1.842	6.12
Side A CW Suspicion * Balance of Forces	-15.216**	6.066
Side B NW * Balance of Forces	-4.923	3.394
Side B Probable NW * Balance of Forces	4.257	4.739
Side B NW Production * Balance of Forces	-4.733	3.541
Side B NW Suspicion * Balance of Forces	8.023	9.217
Side B BW * Balance of Forces	-3.105	5.289
Side B Probable BW * Balance of Forces	13.303**	5.172
Side B BW Production * Balance of Forces	-3.705	8.883
Side B BW Suspicion * Balance of Forces	-1.785	3.715
Side B CW * Balance of Forces	-1.265	4.663
Side B Probable CW * Balance of Forces	-16.741**	3.503
Side B CW Production * Balance of Forces	3.42	7.674
Side B CW Suspicion * Balance of Forces	-0.02	3.981

* Represents significance at the .1 level, ** significance at the .05 level. The model was estimated with robust standard errors and measures the effect of each independent variable on the initiation of conflict.

Levels two and three of the dependent variable, table 4 above, measure when one side escalates to the use of force and the other backs down**.** The possession of nuclear weapons by State A makes it significantly more unlikely that B will back down. This provides some evidence for the Geller (1990) findings that nuclear weapons threats may not be credible because of the nuclear weapons taboo. However, possessing either nuclear weapons production capabilities or suspected nuclear arsenals makes side A significantly more likely to triumph over side B. This may provide some evidence for Sagan (1997) and Feaver's (1997) beliefs about the way initial nuclear arsenals may be more usable. Perhaps when faced with a state that may have nuclear weapons but whose possession is not certain, defenders believe that the probability of use in state A is higher because state A will fear preemption against its nuclear installations. This, paradoxically, increases the relative capabilities of state A, representing the threat that leaves something

to chance, as described by Schelling. As we would expect, the defending state is significantly unlikely to back down from the challenger when it either has nuclear weapons or nuclear weapons production capabilities. Interestingly, no level of nuclear capabilities by state A or state B make state A significantly more likely to back down when confronted by state B. This could be a demonstration of Fearon's proposed selection effects. Since challengers select into a conflict with knowledge of the nuclear weapons capabilities of their adversaries, even nuclear threats by those adversaries cannot cause them to back down. Deterrence operates at the initiation of conflict stage, not escalation.

As with conflict initiation, biological weapons do not significantly influence the probability that state A will escalate and state B will back down. The exception is that probable possession of BWs by the defender makes it less likely state B will back down when faced with a use of force by state A. On the flip side, probable possession of BWs by state B not only makes state B less likely to back down to state A, it also makes state B more likely to successfully coerce state A. This is important evidence of the coercive impact of BW threats. The impacts for chemical weapons are even more striking. Probable possession of chemical weapons by state A makes them less likely to successfully coerce state B short of war, but the possession of chemical weapons by state B makes successful coercion by state A significantly more likely. Possession or suspected possession (as distinguished from probable possession) of chemical weapons by state A makes it significantly less likely that state A will be successfully coerced, while probable possession of chemical weapons by state B makes successful coercion of state A less likely. This potentially highlights the generally defensive nature of chemical

weapons. While they can help nations avoid coercion, they are generally not useful for conquest.

Table 5: Multinomial Logit Model at DV = 4, both sides using force short of war, including all WMD uncertainty variables and interaction terms

	Coefficient	*Robust Standard Error*
DV = 4 -- Conflict escalation by both sides short of war		
Side A NW * Balance of Forces	-1.191	2.305
Side A Probable NW * Balance of Forces	8.395*	4.747
Side A NW Production * Balance of Forces	-13.085**	2.755
Side A NW Suspicion * Balance of Forces	2.183	2.765
Side A BW * Balance of Forces	-0.114	2.315
Side A Probable BW * Balance of Forces	-0.15	3.999
Side A BW Production * Balance of Forces	-0.768	4.225
Side A BW Suspicion * Balance of Forces	3.379	2.34
Side A CW * Balance of Forces	0.391	2.109
Side A Probable CW * Balance of Forces	-6.217*	3.361
Side A CW Production * Balance of Forces	-7.316*	3.983
Side A CW Suspicion * Balance of Forces	1.085	2.421
Side B NW * Balance of Forces	-6.606**	2.158
Side B Probable NW * Balance of Forces	-0.516	3.037
Side B NW Production * Balance of Forces	-6.360**	2.864
Side B NW Suspicion * Balance of Forces	1.937	2.094
Side B BW * Balance of Forces	-4.416**	2.027
Side B Probable BW * Balance of Forces	-6.407**	3.208
Side B BW Production * Balance of Forces	-10.803**	1.957
Side B BW Suspicion * Balance of Forces	-3.939	2.543
Side B CW * Balance of Forces	8.258**	1.931
Side B Probable CW * Balance of Forces	2.153	2.584
Side B CW Production * Balance of Forces	231.832**	45.337
Side B CW Suspicion * Balance of Forces	-1.898	2.94

* Represents significance at the .1 level, ** significance at the .05 level. The model was estimated with robust standard errors and measures the effect of each independent variable on the initiation of conflict.

At the higher levels of conflict, where both sides use force short of war, the results are striking. For the use of force short of war, seen above in table 5, both sides are significantly more likely to escalate when state A is believed to have nuclear weapons, but both sides are significantly less likely to escalate when state B is known to have nuclear weapons or when state B has nuclear weapons production capabilities. This is consistent with Waltz's understanding of nuclear weapons. States are especially unlikely to escalate against nuclear-armed defenders for fear of sure destruction. This provides some evidence for hypothesis five. The biological weapons capabilities of state A are totally unrelated to escalation. However, when state B possesses biological weapons capabilities, it has a significant impact. This is a reversal from the very inconsistent effects of biological weapons at lower levels of conflict. Perhaps, due to the international taboo against biological weapons, states do not even implicitly threaten the use of biological weapons until serious escalation has already occurred. If state B possesses biological weapons, is believed to possess biological weapons, or has biological weapons production facilities, escalation short of full-scale war becomes significantly less likely. The effect for chemical weapons is similarly interesting. Both sides are unlikely to use force if state A is believed to have a chemical weapons arsenal or if it has chemical weapons production facilities. However, escalation by both sides is especially likely if state B has chemical weapons. This once again provides some support for the idea the acquisition of chemical weapons invites challengers, perhaps due to fear that states with chemical weapons will acquire more dangerous weapons in the future.[30]

[30] This is one area when developing a WMD interaction term, to account for the way different WMD capabilities influence each other, could substantially aid future research.

Table 6: Multinomial Logit Model at DV = 5, interstate war, including all WMD uncertainty variables and interaction terms

	Coefficient	*Robust Standard Error*
DV = 5 -- Conflict escalation by both sides to full scale war		
Side A NW * Balance of Forces	9.175*	4.749
Side A Probable NW * Balance of Forces	1.291	6.962
Side A NW Production * Balance of Forces	-13.764**	3.864
Side A NW Suspicion * Balance of Forces	7.936	5.748
Side A BW * Balance of Forces	-0.223	2.818
Side A Probable BW * Balance of Forces	5.022	4.223
Side A BW Production * Balance of Forces	-1.904	6.623
Side A BW Suspicion * Balance of Forces	2.972	5.823
Side A CW * Balance of Forces	1.234	2.309
Side A Probable CW * Balance of Forces	-16.526**	5.609
Side A CW Production * Balance of Forces	-1.945	3.695
Side A CW Suspicion * Balance of Forces	1.755	3.96
Side B NW * Balance of Forces	-8.222**	3.504
Side B Probable NW * Balance of Forces	-7.813	10.853
Side B NW Production * Balance of Forces	-8.472**	2.429
Side B NW Suspicion * Balance of Forces	2.114	3.913
Side B BW * Balance of Forces	-7.748**	3.361
Side B Probable BW * Balance of Forces	-2.894	7.905
Side B BW Production * Balance of Forces	-13.933**	6.981
Side B BW Suspicion * Balance of Forces	-8.310*	4.326
Side B CW * Balance of Forces	9.216**	3.317
Side B Probable CW * Balance of Forces	-10.263*	5.96
Side B CW Production * Balance of Forces	2.797	4.907
Side B CW Suspicion * Balance of Forces	3.706	4.435

* Represents significance at the .1 level, ** significance at the .05 level. The model was estimated with robust standard errors and measures the effect of each independent variable on the initiation of conflict.

The results for all-out war, shown in table 6 above, highlight the importance of having nuclear weapons in the international security environment. When the original challenger, state A, has nuclear weapons, all-out war is significantly more likely. However, when the defender has nuclear weapons, war is significantly less likely. This provides a rebuke of sorts to Fearon and Gray, demonstrating that nuclear weapons do

have relevance at higher levels of international disputes. However, given the significance of many of the control variables (see Appendix B), it is not possible to conclude that nuclear weapons matter *more* than regime-specific variables. The 95% confidence interval for the known possession of nuclear weapons by state A also included some negative values. This means that first differences or relative risks are necessary to determine its true relative impact.

When either state A or state B has nuclear production capabilities, escalation to war is significantly less likely. It is unclear why this is the case and this question deserves more attention in the future. The biological weapons capabilities of side A have no impact on the escalation of conflict, while possession of biological weapons or biological weapons production facilities makes escalation significantly less likely. This is significant, because it demonstrates that while biological weapons are generally not considered usable in a traditional warfare sense, fear of those weapons may still provide a deterrent, especially to the original challenger in a dispute. Probable possession of chemical weapons by state A or state B has a strong but negative impact on the escalation of international disputes to war, but known possession of chemical weapons by state B makes escalation more likely.[31]

Discussion of the results

While these results are very preliminary and should be treated as such, this new data does suggest a few important facts about the way biological weapons, chemical weapons, and variations in certainty about WMD possession influence international

[31] One possibility is that the results are skewed by World War I, when widespread use of chemical weapons occurred on both sides. However, a data run excluding the World War I cases did not alter the direction or significance of the coefficient.

conflict. Even when variations in certainty are included, the findings for nuclear weapons are remarkably robust. When defending states have nuclear weapons, escalation is substantially less likely. However, when the original challenging state has nuclear weapons, escalation is more likely. Joint possession of nuclear weapons makes conflict escalation extremely unlikely. Unfortunately, since wars in the nuclear age are almost entirely confined to the Cold War, it is difficult to see if this was a consequence of bipolarity or the weapons themselves. However, the data on defending states provides some support for scholars such as Fearon (1994), Jervis (1988), and Waltz (1995), who all argue (though for very different reasons at certain points), that the possession of nuclear weapons makes conflict less likely. The data on conflict initiations shows that nuclear weapons may not be as useless for international security as scholars such as Geller (1990) think. Even when conventional capabilities are taken into consideration, challengers possessing nuclear weapons are significantly likely to escalate conflicts. At lower levels of certainty concerning nuclear weapons capabilities, the impact for international conflict is not as clear. States with nuclear production capabilities or possible nuclear arsenals are more risk prone than their counterparts, though the effect is somewhat mitigated at higher levels of conflict.

The results for chemical and biological weapons show that none of the current theories seem to have it right. Hypothesis one is correct insofar as biological weapons do not seem to be useful for challengers. Defenders do not regard the possibility of biological weapons use as credible, either because of perceived difficulties weaponizing biological agents or because of the international taboo. Conversely, having nascent biological weapons capabilities can help deter countries from initiating and escalating

disputes. This is one area where Schelling may be applicable. It is possible that the use of biological weapons is not a credible threat for challengers because, though obviously risk acceptant to a certain level, they are not seen as likely to risk the massive consequences of using biological weapons. On the other hand, when defending the homeland or otherwise after being challenged, biological weapons threats are more credible. This statistical effect gets larger as conflicts escalate, with biological weapons capabilities making escalation to both sides using force or full-scale war especially unlikely. The positive and significant coefficient for probable biological weapons possession by the defender in cases when the defender deters the challenger from escalating to military force highlights this result and provides some validation for hypothesis two.[32] The results in general suggest that biological weapons are more useful for the defender because the interests of the defender in a given dispute are generally likely to be higher, meaning they will be more risk acceptant. This could mean the balance of interests theory posited by Betts (1987) to explain nuclear crises also explains the impact of biological weapons on international security.

As the WMD most often used in armed conflict since their creation, chemical weapons should have a large effect on international conflict. However, in early stages of a militarized dispute, possession or probable possession of chemical weapons by the challenger actually makes conflict initiation or victory short of war for the challenger less likely. Victories for the challenger are also highly correlated with possession of chemical weapons by the defender. This converse effect holds true for victories by the defender: chemical weapons possession by the challenger strangely makes victory by the defender

[32] One thing that may cut against this conclusion is the fact that probable biological weapons possession also correlates highly with victories short of war by the challenger. This would suggest it *is* difficult to credibly threaten the use of biological weapons.

more likely in cases short of war. At higher levels of the escalation ladder, while chemical weapons capabilities held by the challenger make escalation less likely, capabilities held by the defender make escalation more likely. These results show that states should be wary of attempting to acquire chemical weapons to enhance their national power, given that acquisition makes international challenges and escalation significantly more likely. The one exception is the possession of probable chemical weapons capabilities by the defender, which makes escalation to all-out war more likely. In general, while tests provide some support for hypothesis two, suggesting that chemical weapons matter, further testing is clearly necessary to discern their specific impact on international conflict.

The conclusions for Fearon's hypothesis about the interaction of information, uncertainty, and dispute initiation and escalation are difficult to discern. If Fearon is right, then the variables for suspected programs and production capabilities should be negative at lower levels of conflict but positive at higher levels. The reverse should be true for probable and known arsenals. Unfortunately, there is no discernable pattern among the variables that represents Fearon's prediction. The variables seem to have relatively consistent effects across the increasing levels of the dependent variable, rather than the variables representing uncertainty about capabilities taking on positive values at lower levels of conflict and negative values at higher levels of conflict, and vice versa for the variables representing certainty about capabilities. It is entirely possible this is due to the setup of the model, rather than a fault with the theory. More exact tests are required to further flesh out hypothesis four.

The results do demonstrate a rebuke to Waltz's understanding of information and probability, hypothesis five. Though in general states seem to be risk averse when confronted by WMD arsenals, the vast variation in behavior, depending on the type of capabilities, described in section III above, suggests that his theorizing on this specific point is too simplistic. For example, while known possession of nuclear weapons by the challenger makes it statistically less likely that the defender will concede short of war if the challenger uses force, uses of force by probable nuclear states or states with nuclear production capabilities make concessions by the defender more likely. This may suggest something about the credibility of nuclear threats similar to the arguments of Sagan and Feaver. The perception by the defender that the challenger may have nuclear weapons and that if they have them, they may not be secure, generates incentives to concede. This is exactly what Schelling suggested over forty years ago: threatening states with the possibility of uncontrollable escalation, rather than making definite threats, makes deterrence more likely to hold.

V. Limitations

While this paper represents an important first step towards a more nuanced understanding of the way WMDs influence international conflict, several challenging obstacles remain. First, the theories in this area need refinement. While exporting theories from the nuclear weapons literature to biological and chemical weapons was acceptable as a first cut into these issues, more in-depth thinking is necessary. In this vein, more case study work on specific instances of CBW threats and responses to threats

by states with CBWs will assist in developing and testing theories about the utility of CBWs. Second, the coding of the WMD variables could benefit from additional sources of information. The closer to the present one gets, the more information on suspected WMD programs becomes available. However, measuring relative WMD capabilities in the pre-1945 period and even the early Cold War is challenging. Additionally, while the author attempted to maintain maximum transparency when choosing between conflicting sources of information, more explicit coding criteria to allow the legitimate privileging of some sources of information over others would substantially aid the dataset development process.

Third, while the statistical models used for this project are generally appropriate, the lack of specific interactive data on threats and responses on a wide scale makes it difficult to capture the type of interactions the case study literature really discusses. While some attempts to create such datasets have occurred, notably the extended deterrence dataset of Huth and Russett (1984, 1988, 1990), there are simply too few observations in that dataset and it is only focused on cases of extended deterrence. Other datasets measuring interactions between challengers and targets at an extended level of depth (Huth and Allee 2002) focus solely on territorial disputes. Given that one of the major important consequences of WMDs may be the ability to hold at risk military and civilian targets in a much wider geographic area, expanding beyond territorial disputes is clearly necessary. Also, while several of the results suggest that powerful states are likely to challenge those with WMDs, in line with the predictions of preventive war theory, other results indicate that possessing even lower-level WMDs like biological and chemical weapons enhances deterrence. A very interesting question for future research

may be whether or not the behavior demonstrated by the Bush administration in the Iraq case regarding WMDs is statistically consistent with similarly situated states. While some thought was given in this project to developing an interactive variable to measure the way nuclear, biological, and chemical weapons may function together in the international environment, the author could not complete such a variable in time. That is a clear path for future research.

Finally, determining the true substantive effect of these variables requires deriving first differences (the probability of a change in the dependent variable from one level to another when all independent variables except a variable of interest are held at their means and the variable of interest is varied from its minimum to its maximum) and relative risk scores. However, due to the overwhelming computational power necessary to conduct such analysis on a dataset of this size, presenting those results at this time will not be possible. Future research should clearly include them.

VI. Conclusion

This paper represents an attempt at both data and knowledge generation. It creates new variables measuring the possession of biological and chemical weapons, nuclear arsenal size and type, and certainty regarding how close countries are to obtaining nuclear, biological, and chemical weapons. Nuclear weapons do appear to be a critical element shaping the international security environment. States with asymmetric edges in nuclear capabilities are more likely to initiate and escalate conflicts, while defenders with asymmetric nuclear edges are more likely to deter them. In contrast, the relative impact

of biological weapons on international conflict appears small for challengers, though it makes escalation significantly less likely when the defender has them. Chemical weapons seem to have a more robust impact than biological weapons, though mostly at levels below full-scale war. Probable possession by challengers makes escalation less likely, but known possession by defenders makes them especially vulnerable to attack.

The impact of certainty of WMD possession on international conflict is similarly important. There were frequently shifts in the sign and significance level when each of the WMD variables moved from known possession to probable possession. While generically demonstrating the importance of information-based approaches to studying conflict, the lack of more nuanced hypotheses about the impact of uncertainty should hasten readers from drawing too many conclusions.

However, one important policy-relevant conclusion is that the US attack on Iraq, to the extent it was designed to prevent the proliferation of WMDs, significantly deviates from prior patterns of warfare in the WMD age. Iraq was thought of as likely to possess chemical weapons, though the intelligence data was far from certain, and able to produce biological weapons. Both of those categories have traditionally reduced the likelihood of escalation. However, known possession of chemical weapons by the defender makes escalation statistically more likely. This could demonstrate the impact of learning over time. Iraq was *known* to possess chemical weapons before the first Gulf War, and it is possible that those perceptions of their capabilities became sticky, influencing US policy after the situation on the ground changed. US and international perceptions of Iraqi WMD capabilities simply did not update. This could mean that lags need to be

introduced in the dataset to account for delays in international perception catching up to changing realities.

A final conclusion is that successful coercion by challengers is much more likely when the defending state does not possess an ongoing nuclear program with possible production capabilities and when it seems unlikely that the defender has biological weapons. This means a proliferated world will make it more difficult for the United States to deter its adversaries in situations short of war. Even if a proliferated world may be better for international stability in general, especially if proliferation is relatively slow and symmetrical, it may not be better for America.

Appendix A: New Data Generated

Below are tables describing the new data generated by this project.

Table 1: New CBW variables

Variable Name	*Definition*	*Measurement*
CBW Treaties		
BWC	Signatory of BWC	0,1
BWC2	Ratification of BWC	0,1
CWC	Signatory of CWC	0,1
CWC2	Ratification of CWC	0,1
HagueII	Signatory of Hague Convention Article II	0,1
HagueIIB	Ratification of Hague Convention Article II	0,1
HagueIV	Signatory of Hague Convention Article IV	0,1
HaugeIVB	Signatory of Hague Convention Article IV	0,1
Hague1907	Signatory of Hauge Convention, 1907	0,1
Hague1970b	Ratification of Hauge Convention 1907	0,1
Geneva	Signatory of 1925 Geneva Protocol	0,1
Chemical Weapons		
CWknown	Known to have CW capabilities	0,1
CWprob	Believed to have CW capabilities	0,1
CWprod	Believed to have CW production capabilities	0,1
CWposs	Suspicion of CW capabilities	0,1
CWres	Believed to doing R&D on CW capabilities	0,1
CWsusp	Either CWposs or CWres = 1	0,1
CWsmall	Known or Believed to have CW capabilities	0,1
CWbig	Any sign of interest in acquiring CW capabilities	0,1
CWlinear	0=no CW, 1=R&D, 2=Suspicion, 3=Production, 4=Belief, 5=Known	0 through 5
bothchem	Both sides have chemical weapons	0,1
Biological Weapons		
BWknown	Known to have BW capabilities	0,1
BWprob	Believed to have BW capabilities	0,1
BWprod	Believed to have BW production capabilities	0,1
BWposs	Suspicion of BW capabilities	0,1
BWres	Believed to doing R&D on BW capabilities	0,1
BWsusp	Either BWposs or BWres = 1	0,1
BWsmall	Known or Believed to have BW capabilities	0,1
BWbig	Any sign of interest in acquiring BW capabilities	0,1
BWlinear	0=no CW, 1=R&D, 2=Suspicion, 3=Production, 4=Belief, 5=Known	0 through 5
bothbio	Both sides have biological weapons	0,1

Table 2: New Nuclear and Combined Variables

Variable Name	*Definition*	*Measurement*
Nuclear Treaties		
NPT	Signatory of NPT	0,1
NPT2	Ratification of NPT	0,1
CTBT	Signatory of CTBT	0,1
CTBT2	Ratification of CTBT	0,1
Nuclear Weapons		
nukes	Binary capabilities variable based on Bennett/Stam	0,1
NWknown	Known to have NW capabilities	0,1
NWprob	Believed to have NW capabilities	0,1
NWprod	Believed to have NW production capabilities	0,1
NWposs	Suspicion of NW capabilities	0,1
NWres	Believed to doing R&D on NW capabilities	0,1
NWsusp	Either NWposs or NWres = 1	0,1
NWsmall	Known or Believed to have NW capabilities	0,1
NWbig	Any sign of interest in acquiring NW capabilities	0,1
NWlinear	0=no NW, 1=R&D, 2=Suspicion, 3=Production, 4=Belief, 5=Known	0 through 5
NWtac	Tactical nuclear weapons	0,1
NWstrat	Strategic nuclear weapons	0,1
NWstockbig	Assured second strike capabilities + more than 2000 warheads	0,1
NWstockmedium	Assured second strike capabilities + more than 200 warheads	0,1
NWstocklow	Established nuclear capabilities below the medium level	0,1
NWstockinit	Under 100 warheads + uncertain second strike capabilities	0,1
NWstocklinear	0=No NW, 1=very small arsenal, 2=small arsenal, 3=medium arsenal, 4= large arsenal	0 through 4
bothnuke	Both sides have nuclear weapons	0,1
Combined Variables		
NBCbig	NWbig, BWbig, CWbig	0,1
NBCsmall	NWsmall, BWsmall, CWsmall	0,1
NBClinear	0=no NBC 1=CW 2=BW 3=CW and BW 4=NW	0 through 4
CBWbig	BWbig, CWbig	0,1
CBWsmall	BWsmall, CWsmall	0,1
WMDlimitedB	NWbig, BWbig	0,1
WMDlimitedA	NWsmall, BWsmall	0,1

Appendix B: Complete Tables of Statistical Results

Table 7: Impact of Nuclear Weapons on Conflict Initiation

	Coefficient	*Robust Standard Error*
Joint Democracy	-0.501**	0.174
Side A Revisionist	9.323**	0.269
Side B Revisionist	6.646**	0.334
Contiguity	3.031**	0.144
Defense Pact	-0.396*	0.200
Neutrality Pact	0.417	0.412
Entente Pact	-0.280	0.404
Side A Relative Democracy	-0.007**	0.003
Side B Relative Democracy	-0.012**	0.002
Balance of Forces	0.485	0.452
Side A Major Power	1.919**	0.204
Side B Major Power	2.200**	0.204
Peace Years	-0.016**	0.004
Side A Known Nuclear Weapons	2.666**	1.080
Side B Known Nuclear Weapons	3.351**	1.242
Side A NW * Balance of Forces	-3.483**	1.201
Side B NW * Balance of Forces	-4.567**	1.339
Both Possess Nuclear Weapons	0.147	0.574
_cons	-6.694	0.402
Wald chi2 (18)	2727.9	
Prob > chi2	0	
Pseudo R2	0.798	
Pseudo likelihood	1662.569	

Number of observations: 85,731. * represents significance at the .1 level, ** significance at the .05 level. The model was estimated with robust standard errors and measures the effect of each independent variable on the initiation of conflict.

Table 8: Impact of all WMD variables and interaction variables on Conflict Initiation

	Coefficient	*Robust Standard Errors*
Joint Democracy	-0.192	0.188
Side A Revisionist	9.845**	0.356

Side B Revisionist	6.701**	0.389
Contiguity	3.081**	0.163
Defense Pact	-0.299	0.212
Neutrality Pact	0.202	0.416
Entente Pact	-0.507	0.417
Side A Relative Democracy	-0.007**	0.003
Side B Relative Democracy	-0.013**	0.002
Balance of Forces	-0.974*	0.564
Side A Major Power	1.442**	0.253
Side B Major Power	0.990**	0.222
Peace Years	-0.013**	0.003
Early Cold War	-0.472**	0.221
Late Cold War	-0.666**	0.197
Post Cold War	-2.006**	0.239
Both Possess Nuclear Weapons	0.096	0.657
Both Possess Biological Weapons	-0.269	0.674
Both Possess Chemical Weapons	-0.552	0.443
Side A NW * Balance of Forces	-1.407	1.681
Side A Probable NW * Balance of Forces	4.938**	2.063
Side A NW Production * Balance of Forces	-2.521	1.805
Side A NW Suspicion * Balance of Forces	0.997	2.068
Side A BW * Balance of Forces	-0.510	1.789
Side A Probable BW * Balance of Forces	0.272	2.940
Side A BW Production * Balance of Forces	7.459**	2.359
Side A BW Suspicion * Balance of Forces	1.378	1.593
Side A CW * Balance of Forces	-0.959	1.630
Side A Probable CW * Balance of Forces	-6.930**	2.597
Side A CW Production * Balance of Forces	-2.173	3.123
Side A CW Suspicion * Balance of Forces	0.721	2.006
Side B NW * Balance of Forces	-5.459**	1.666
Side B Probable NW * Balance of Forces	1.411	2.395
Side B NW Production * Balance of Forces	-7.943**	2.532
Side B NW Suspicion * Balance of Forces	2.597	1.873
Side B BW * Balance of Forces	-1.101	1.706

Side B Probable BW * Balance of Forces	-4.088	2.617
Side B BW Production * Balance of Forces	-1.986	3.415
Side B BW Suspicion * Balance of Forces	-4.066**	2.147
Side B CW * Balance of Forces	5.138**	1.629
Side B Probable CW * Balance of Forces	0.300	1.910
Side B CW Production * Balance of Forces	6.206	4.407
Side B CW Suspicion * Balance of Forces	-1.239	2.772
Side A Known Nuclear Weapons	0.766**	1.510
Side A Probable Nuclear Weapons	-4.366	1.844
Side A Nuclear Production Capab	0.949	1.689
Side A Suspected Nuclear Program	-1.070	1.753
Side A Known Biological Weapons	1.707	1.596
Side A Probable Biological Weapons	0.731	2.486
Side A Biological Production Capab	-8.041**	2.145
Side A Suspected Biological Program	-0.425	1.358
Side A Known Chemical Weapons	1.278	1.437
Side A Probable Chemical Weapons	5.644**	2.162
Side A Chemical Production Capab	1.141	2.439
Side A Suspected Chemical Program	0.225	1.728
Side B Known Nuclear Weapons	4.498**	1.484
Side B Probable Nuclear Weapons	-2.103	2.227
Side B Nuclear Production Capab	7.036**	1.995
Side B Suspected Nuclear Program	-1.426	1.655
Side B Known Biological Weapons	2.110	1.494
Side B Probable Biological Weapons	3.864	2.247
Side B Biological Production Capab	0.516	2.954
Side B Suspected Biological Program	3.652	1.896
Side B Known Chemical Weapons	-3.854**	1.436
Side B Probable Chemical Weapons	-0.254	1.523

Side B Chemical Production Capab	-5.655	3.589
Side B Suspected Chemical Program	0.646	1.952
_cons	-5.203	0.491
Number of obs	85731	
Wald chi2(67)	2847.95	
Prob > chi2	0	
Log Pseudo-likelihood	-1530.6746	
Pseudo R2	0.8147	

Table 9: Multinomial Logit Model of the initiation and escalation of international conflict: all WMD variables and interaction terms included

	Coefficient	*Robust Standard Error*
DV = 1 -- Conflict initiation by State A		
Balance of Forces	-0.801	0.691
State A Revisionist	9.667**	0.357
State B Revisionist	6.665**	0.413
Joint Democracy	-0.002	0.228
Contiguity	3.080**	0.181
Defense Pact	-0.182	0.251
Neutrality Pact	0.156	0.495
Entente Pact	-0.185	0.480
State A Relative Democracy	-0.008**	0.004
State B Relative Democracy	-0.011**	0.003
State A Major Power	1.626**	0.283
State B Major Power	0.889**	0.278
Peace Years	-0.009**	0.004
Early Cold War	-1.077**	0.284
Late Cold War	-0.893**	0.241
Post Cold War	-1.701**	0.271
Side A NW * Balance of Forces	-1.304	1.856
Side A Probable NW * Balance of Forces	1.810	2.811
Side A NW Production * Balance of Forces	835.772**	180.981
Side A NW Suspicion * Balance of Forces	0.595	2.309
Side A BW * Balance of Forces	-0.512	2.055
Side A Probable BW * Balance of Forces	-1.118	3.134

Side A BW Production * Balance of Forces	4.021	2.508
Side A BW Suspicion * Balance of Forces	0.045	1.876
Side A CW * Balance of Forces	0.230	1.746
Side A Probable CW * Balance of Forces	-8.524**	2.736
Side A CW Production * Balance of Forces	1.843	3.823
Side A CW Suspicion * Balance of Forces	-1.557	3.525
Side B NW * Balance of Forces	-2.420	2.096
Side B Probable NW * Balance of Forces	8.130**	3.706
Side B NW Production * Balance of Forces	2.303	7.607
Side B NW Suspicion * Balance of Forces	0.847	2.350
Side B BW * Balance of Forces	0.794	2.263
Side B Probable BW * Balance of Forces	-8.454**	3.043
Side B BW Production * Balance of Forces	1.962	5.483
Side B BW Suspicion * Balance of Forces	-1.789	2.497
Side B CW * Balance of Forces	1.880	1.938
Side B Probable CW * Balance of Forces	2.342	2.638
Side B CW Production * Balance of Forces	4.769	4.986
Side B CW Suspicion * Balance of Forces	-0.784	3.266
Side A Known Nuclear Weapons	0.887	1.645
Side A Probable Nuclear Weapons	-2.052	2.496
Side A Nuclear Production Capab	-831.009**	180.453
Side A Suspected Nuclear Program	-0.883	1.927
Side A Known Biological Weapons	1.644	1.840
Side A Probable Biological Weapons	1.932	2.663
Side A Biological Production Capab	-3.420	2.259
Side A Suspected Biological Program	1.437	1.568
Side A Known Chemical Weapons	0.066	1.549

Side A Probable Chemical Weapons	6.619**	2.244
Side A Chemical Production Capab	-1.562	3.264
Side A Suspected Chemical Program	1.248	2.909
Side B Known Nuclear Weapons	2.032	1.804
Side B Probable Nuclear Weapons	-44.748**	3.272
Side B Nuclear Production Capab	-38.626**	7.367
Side B Suspected Nuclear Program	0.074	2.063
Side B Known Biological Weapons	0.544	1.964
Side B Probable Biological Weapons	8.216**	2.520
Side B Biological Production Capab	-2.535	4.950
Side B Suspected Biological Program	2.268	2.143
Side B Known Chemical Weapons	-1.548	1.635
Side B Probable Chemical Weapons	-2.157	2.232
Side B Chemical Production Capab	-4.708	4.465
Side B Suspected Chemical Program	0.127	2.404
_cons	-6.508**	0.602
DV = 2 -- Conflict escalation by State A and State B does not reciprocate		
Balance of Forces	-0.794	0.633
State A Revisionist	10.237**	0.376
State B Revisionist	5.633**	0.431
Joint Democracy	-0.256	0.226
Contiguity	2.633**	0.181
Defense Pact	-0.235	0.233
Neutrality Pact	0.391	0.478
Entente Pact	-1.457**	0.617
State A Relative Democracy	-0.007**	0.003
State B Relative Democracy	-0.012**	0.003
State A Major Power	1.264**	0.288
State B Major Power	1.256**	0.266
Peace Years	-0.008**	0.004
Early Cold War	-0.259	0.265
Late Cold War	-0.465**	0.246
Post Cold War	-2.251**	0.298
Side A NW * Balance of Forces	-3.802**	1.945

Side A Probable NW * Balance of Forces	6.597**	3.223
Side A NW Production * Balance of Forces	15.053**	4.304
Side A NW Suspicion * Balance of Forces	-0.651	2.167
Side A BW * Balance of Forces	-1.653	2.025
Side A Probable BW * Balance of Forces	-0.810	3.232
Side A BW Production * Balance of Forces	-3.865	3.154
Side A BW Suspicion * Balance of Forces	1.662	2.238
Side A CW * Balance of Forces	-0.945	1.949
Side A Probable CW * Balance of Forces	-5.433**	3.053
Side A CW Production * Balance of Forces	-6.513	4.406
Side A CW Suspicion * Balance of Forces	1.993	2.342
Side B NW * Balance of Forces	-6.038**	1.844
Side B Probable NW * Balance of Forces	0.550	3.503
Side B NW Production * Balance of Forces	-8.245**	3.225
Side B NW Suspicion * Balance of Forces	2.621	1.909
Side B BW * Balance of Forces	0.058	2.027
Side B Probable BW * Balance of Forces	-6.132**	3.611
Side B BW Production * Balance of Forces	-1.572	3.774
Side B BW Suspicion * Balance of Forces	-4.365	2.730
Side B CW * Balance of Forces	6.598**	1.824
Side B Probable CW * Balance of Forces	3.331	3.064
Side B CW Production * Balance of Forces	3.559	4.101
Side B CW Suspicion * Balance of Forces	-1.898	2.830
Side A Known Nuclear Weapons	2.732	1.688
Side A Probable Nuclear Weapons	-5.363*	3.007
Side A Nuclear Production Capab	-15.332**	3.649
Side A Suspected Nuclear Program	0.274	1.821

Side A Known Biological Weapons	2.495	1.782
Side A Probable Biological Weapons	1.257	2.824
Side A Biological Production Capab	-34.539**	2.699
Side A Suspected Biological Program	-1.440	1.880
Side A Known Chemical Weapons	1.263	1.717
Side A Probable Chemical Weapons	4.693*	2.600
Side A Chemical Production Capab	3.861	3.191
Side A Suspected Chemical Program	-0.403	2.018
Side B Known Nuclear Weapons	4.852**	1.631
Side B Probable Nuclear Weapons	-1.303	3.101
Side B Nuclear Production Capab	7.800**	2.379
Side B Suspected Nuclear Program	-1.307	1.671
Side B Known Biological Weapons	1.228	1.802
Side B Probable Biological Weapons	5.459*	3.029
Side B Biological Production Capab	0.863	3.262
Side B Suspected Biological Program	3.095	2.295
Side B Known Chemical Weapons	-5.143*	1.602
Side B Probable Chemical Weapons	-3.291	2.585
Side B Chemical Production Capab	-3.981	3.364
Side B Suspected Chemical Program	0.828	2.057
_cons	-6.409**	0.554
DV = 3 -- Conflict escalation by State B and State A does not reciprocate		
Balance of Forces	-2.608	1.924
State A Revisionist	8.265**	0.545
State B Revisionist	7.227**	0.535
Joint Democracy	0.462	0.568
Contiguity	3.292**	0.376
Defense Pact	-0.243	0.463
Neutrality Pact	0.228	1.231
Entente Pact	-0.519	0.990
State A Relative Democracy	0.011	0.020

State B Relative Democracy	-0.015**	0.007
State A Major Power	1.474**	0.639
State B Major Power	0.136	0.869
Peace Years	-0.071**	0.031
Early Cold War	0.313	0.512
Late Cold War	-0.608	0.514
Post Cold War	-1.952**	0.663
Side A NW * Balance of Forces	5.520	5.060
Side A Probable NW * Balance of Forces	3.357	6.421
Side A NW Production * Balance of Forces	-0.459	3.005
Side A NW Suspicion * Balance of Forces	5.307	6.166
Side A BW * Balance of Forces	4.376	3.758
Side A Probable BW * Balance of Forces	4.122	5.628
Side A BW Production * Balance of Forces	-2.748	4.609
Side A BW Suspicion * Balance of Forces	8.727	5.597
Side A CW * Balance of Forces	-7.141**	3.457
Side A Probable CW * Balance of Forces	4.865	3.311
Side A CW Production * Balance of Forces	-1.842	6.120
Side A CW Suspicion * Balance of Forces	-15.216**	6.066
Side B NW * Balance of Forces	-4.923	3.394
Side B Probable NW * Balance of Forces	4.257	4.739
Side B NW Production * Balance of Forces	-4.733	3.541
Side B NW Suspicion * Balance of Forces	8.023	9.217
Side B BW * Balance of Forces	-3.105	5.289
Side B Probable BW * Balance of Forces	13.303**	5.172
Side B BW Production * Balance of Forces	-3.705	8.883
Side B BW Suspicion * Balance of Forces	-1.785	3.715
Side B CW * Balance of Forces	-1.265	4.663
Side B Probable CW * Balance of Forces	-16.741**	3.503
Side B CW Production * Balance of Forces	3.420	7.674

Side B CW Suspicion * Balance of Forces	-0.020	3.981
Side A Known Nuclear Weapons	-3.886	3.865
Side A Probable Nuclear Weapons	-1.021	5.412
Side A Nuclear Production Capab	-34.165**	2.531
Side A Suspected Nuclear Program	-2.653	4.880
Side A Known Biological Weapons	-1.856	2.814
Side A Probable Biological Weapons	-43.080**	4.409
Side A Biological Production Capab	-33.987**	3.519
Side A Suspected Biological Program	-6.108	4.703
Side A Known Chemical Weapons	5.561**	3.009
Side A Probable Chemical Weapons	-4.554	2.896
Side A Chemical Production Capab	-36.101**	4.937
Side A Suspected Chemical Program	8.937	4.827
Side B Known Nuclear Weapons	4.975	2.690
Side B Probable Nuclear Weapons	-40.795**	3.360
Side B Nuclear Production Capab	-29.687**	2.879
Side B Suspected Nuclear Program	-6.823	7.991
Side B Known Biological Weapons	4.267	3.758
Side B Probable Biological Weapons	-9.769**	4.452
Side B Biological Production Capab	-35.484**	6.757
Side B Suspected Biological Program	2.466	2.904
Side B Known Chemical Weapons	0.073	3.270
Side B Probable Chemical Weapons	12.481**	2.712
Side B Chemical Production Capab	-1.586	5.717
Side B Suspected Chemical Program	-0.849	3.074
_cons	-7.013**	1.515
DV = 4 -- Conflict escalation by both sides short of war		

Balance of Forces	-0.925	0.723
State A Revisionist	9.580**	0.388
State B Revisionist	7.262**	0.410
Joint Democracy	-0.425	0.271
Contiguity	3.714**	0.199
Defense Pact	-0.326	0.261
Neutrality Pact	-0.036	0.481
Entente Pact	-0.073	0.525
State A Relative Democracy	-0.005	0.004
State B Relative Democracy	-0.014**	0.003
State A Major Power	1.341**	0.328
State B Major Power	0.584*	0.314
Peace Years	-0.019**	0.005
Early Cold War	-0.202	0.278
Late Cold War	-0.494	0.258
Post Cold War	-2.036**	0.298
Side A NW * Balance of Forces	-1.191	2.305
Side A Probable NW * Balance of Forces	8.395*	4.747
Side A NW Production * Balance of Forces	-13.085**	2.755
Side A NW Suspicion * Balance of Forces	2.183	2.765
Side A BW * Balance of Forces	-0.114	2.315
Side A Probable BW * Balance of Forces	-0.150	3.999
Side A BW Production * Balance of Forces	-0.768	4.225
Side A BW Suspicion * Balance of Forces	3.379	2.340
Side A CW * Balance of Forces	0.391	2.109
Side A Probable CW * Balance of Forces	-6.217*	3.361
Side A CW Production * Balance of Forces	-7.316*	3.983
Side A CW Suspicion * Balance of Forces	1.085	2.421
Side B NW * Balance of Forces	-6.606**	2.158
Side B Probable NW * Balance of Forces	-0.516	3.037
Side B NW Production * Balance of Forces	-6.360**	2.864
Side B NW Suspicion * Balance of Forces	1.937	2.094
Side B BW * Balance of Forces	-4.416**	2.027

Side B Probable BW * Balance of Forces	-6.407**	3.208
Side B BW Production * Balance of Forces	-10.803**	1.957
Side B BW Suspicion * Balance of Forces	-3.939	2.543
Side B CW * Balance of Forces	8.258*	1.931
Side B Probable CW * Balance of Forces	2.153	2.584
Side B CW Production * Balance of Forces	231.832**	45.337
Side B CW Suspicion * Balance of Forces	-1.898	2.940
Side A Known Nuclear Weapons	0.019	2.022
Side A Probable Nuclear Weapons	-7.939	4.349
Side A Nuclear Production Capab	9.856**	2.037
Side A Suspected Nuclear Program	-2.418	2.368
Side A Known Biological Weapons	1.036	2.037
Side A Probable Biological Weapons	1.464	3.225
Side A Biological Production Capab	-36.316**	3.722
Side A Suspected Biological Program	-2.421	1.963
Side A Known Chemical Weapons	0.106	1.827
Side A Probable Chemical Weapons	5.334**	2.607
Side A Chemical Production Capab	4.219	2.580
Side A Suspected Chemical Program	0.022	2.026
Side B Known Nuclear Weapons	5.431**	1.906
Side B Probable Nuclear Weapons	0.336	2.817
Side B Nuclear Production Capab	-30.342**	2.571
Side B Suspected Nuclear Program	-1.256	1.783
Side B Known Biological Weapons	4.225**	1.732
Side B Probable Biological Weapons	5.871**	2.667
Side B Biological Production Capab	-25.153**	1.738
Side B Suspected Biological Program	3.410	2.186

Side B Known Chemical Weapons	-6.279**	1.682
Side B Probable Chemical Weapons	-1.149	2.042
Side B Chemical Production Capab	-226.785**	45.164
Side B Suspected Chemical Program	1.806	2.115
_cons	-6.796**	0.640
DV = 5 -- Conflict escalation by both sides to full scale war		
Balance of Forces	-2.492*	1.400
State A Revisionist	9.061**	0.470
State B Revisionist	6.930**	0.522
Joint Democracy	-1.495	1.104
Contiguity	2.974**	0.329
Defense Pact	-0.503	0.591
Neutrality Pact	0.486	1.030
Entente Pact	-38.229**	0.491
State A Relative Democracy	-0.007	0.007
State B Relative Democracy	-0.017**	0.005
State A Major Power	1.920**	0.518
State B Major Power	1.017*	0.529
Peace Years	-0.075**	0.028
Early Cold War	-1.977**	0.550
Late Cold War	-1.764**	0.573
Post Cold War	-38.632**	0.959
Side A NW * Balance of Forces	9.175*	4.749
Side A Probable NW * Balance of Forces	1.291	6.962
Side A NW Production * Balance of Forces	-13.764**	3.864
Side A NW Suspicion * Balance of Forces	7.936	5.748
Side A BW * Balance of Forces	-0.223	2.818
Side A Probable BW * Balance of Forces	5.022	4.223
Side A BW Production * Balance of Forces	-1.904	6.623
Side A BW Suspicion * Balance of Forces	2.972	5.823
Side A CW * Balance of Forces	1.234	2.309
Side A Probable CW * Balance of Forces	-16.526**	5.609
Side A CW Production * Balance of Forces	-1.945	3.695
Side A CW Suspicion * Balance of Forces	1.755	3.960

Side B NW * Balance of Forces	-8.222**	3.504
Side B Probable NW * Balance of Forces	-7.813	10.853
Side B NW Production * Balance of Forces	-8.472**	2.429
Side B NW Suspicion * Balance of Forces	2.114	3.913
Side B BW * Balance of Forces	-7.748**	3.361
Side B Probable BW * Balance of Forces	-2.894	7.905
Side B BW Production * Balance of Forces	-13.933**	6.981
Side B BW Suspicion * Balance of Forces	-8.310*	4.326
Side B CW * Balance of Forces	9.216**	3.317
Side B Probable CW * Balance of Forces	-10.263*	5.960
Side B CW Production * Balance of Forces	2.797	4.907
Side B CW Suspicion * Balance of Forces	3.706	4.435
Side A Known Nuclear Weapons	-9.577**	4.444
Side A Probable Nuclear Weapons	-39.016**	6.279
Side A Nuclear Production Capab	-24.380**	2.937
Side A Suspected Nuclear Program	-7.265	4.788
Side A Known Biological Weapons	2.363	2.383
Side A Probable Biological Weapons	0.125	3.473
Side A Biological Production Capab	-34.317**	5.790
Side A Suspected Biological Program	-2.034	4.983
Side A Known Chemical Weapons	-1.165	2.068
Side A Probable Chemical Weapons	11.489**	4.006
Side A Chemical Production Capab	3.046	3.061
Side A Suspected Chemical Program	0.086	3.090
Side B Known Nuclear Weapons	6.407**	2.962
Side B Probable Nuclear Weapons	-31.225**	8.942
Side B Nuclear Production Capab	-25.400**	2.216

Side B Suspected Nuclear Program	-0.995	3.056
Side B Known Biological Weapons	7.739**	2.463
Side B Probable Biological Weapons	5.931	6.541
Side B Biological Production Capab	-24.633**	5.693
Side B Suspected Biological Program	9.647**	3.449
Side B Known Chemical Weapons	-7.595**	2.694
Side B Probable Chemical Weapons	7.219**	4.284
Side B Chemical Production Capab	-1.995	4.214
Side B Suspected Chemical Program	-3.184	3.633
_cons	-5.962**	1.181
Number of obs =	85731.000	
Wald chi2(320)	713445.110	
Prob > chi2	0.000	
Log pseudo-likelihood	-3298.341	
Pseudo R2	0.685	

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