Nuclear Proliferation Dynamics and Conventional Conflict[*]

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Abstract

New nuclear nations are more prone to militarized conflict, though the overall effect of nuclear weapons on conventional disputes is neutral (Horowitz 2009, Gartzke & Jo 2009). Several processes might explain the non-linear relationship between proliferation and conflict. Nominal nuclear status could constitute a capability shock, altering the balance of power and increasing the probability of disputes. Alternately, proliferation might introduce uncertainty about relative power, again increasing the risk of conflict. Familiarity with nuclear weapons should allow countries to manage conflict more effectively, even as a growing nuclear stockpile may exacerbate tensions. Informational factors (uncertainty and learning) are statistically significant determinants of conflict, while material factors (nuclear status and stockpiles) are not so salient.

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1 Introduction

The immense destructive power of nuclear explosives led early observers to conclude that the advent of nuclear weapons had radically altered world affairs (Brodie 1946, Kissinger 1957, Kahn 1960). Less may have changed than was initially imagined. Despite fears of the inevitability of nuclear holocaust, no contest has involved the actual use of nuclear weapons since 1945. While a number of scholars point to the absence of nuclear war as evidence that nuclear capabilities have had a profound impact (Mearsheimer 1984, Waltz 1990), too many other changes have occurred in the aftermath of World War II to make it easy to conclude that nuclear deterrence was the major determinant of Cold War peace (Bueno de Mesquita & Riker 1982, Mueller 1988, Geller 1990).

Given limited signs of a nuclear revolution, researchers have begun to look for, and to find, more subtle evidence of a nuclear evolution. Nuclear weapons have not irrevocably altered the behavior of nations under anarchy, but there are indications that these weapons help to shift the calculus of countries facing particular challenges and opportunities. Nuclear capable states appear no more (or less) likely to experience conventional military contests (Gartzke & Jo 2009). Instead, nuclear nations shift the kinds of warfare in which nations engage, experiencing more low-level disputes and relatively fewer wars (Rauchhaus 2009). Nuclear states appear to wield greater diplomatic influence (Gartzke & Jo 2009), and they get their way more often in crises (Beardsley and Asal 2009a, 2009b). Perhaps most intriguing, nuclear status affects the timing of conflict, increasing disputes among new proliferators, but decreasing conflict involving mature nuclear powers (Horowitz 2009).[1]

While research to date has done a great deal to identify key relationships and dispel old myths, questions remain about causal processes. In particular, it will be useful to better understand why proliferation temporarily increases conflict behavior, even while this relationship does not persist over time. Several factors appear to be candidates for an explanation. First, nuclear status may create a capability shock, shifting the balance of power and increasing conflict. Traditional perspectives in international relations emphasize the relationship between the balance of power and the potential for disputes or war (Morgenthau 1973 [1948], Waltz 1979). A substantial increase in

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[1]Horowitz finds that new nuclear powers are more likely to reciprocate disputes begun by other nations, while other states are more likely to reciprocate disputes begun by new nuclear powers. Time reverses these effects.

power may make a state more aggressive, or it could lead opponents to pursue preventative conflict. Second, rather than power per se, it might be uncertainty about the balance of power that increases conflict. Bargaining theories emphasize that private information can lead to diplomatic impasse and interstate disputes. Rather than inducing conflict through a shift in capabilities, proliferation might lead nations to be uncertain about where the balance of power lies. On the other end of the process of shock and decline, nations gradually develop an understanding of the implications of nuclear capabilities, about managing their forces, more effectively deploying diplomatic influence, and new relationships under the auspices of the bomb. Learning may generate exponential decay, rapid at first but slowing asymtotically as the most easily knowable elements of the relationship have already been absorbed. Finally, vertical proliferation could influence dispute propensity. The number of nuclear weapons in a nation's arsenal often changes over time. If the size of stockpiles matters for whether states fight, the tendency will be to bias a näive assessment of nuclear learning.

Does nominal nuclear status or the size of a nation's nuclear arsenal matter more in determining whether nations experience disputes? Is initial uncertainty or eventual learning more important in conditioning international conflict? It is difficult to address any of these questions in isolation, and so I explore them together. I begin by outlining possible ways that proliferation might impact dispute behavior. I then develop measures of key concepts (nuclear status, numbers, uncertainty, time), using the measures to examine the relative contributions of these processes. I find that neither nuclear status, nor the number of nuclear weapons make much difference for a country's dispute propensity. Instead, the dynamic effects of proliferation are better characterized by informational processes. Uncertainty increases the propensity of nuclear nations to initiate disputes, while over time learning reduces the likelihood that proliferators will precipitate a conventional conflict.

2   Literature: Conventional Thinking about Nuclear Weapons[2]

The advent of the nuclear era posed profound hazards for the world, and a not inconsiderable set of difficulties for strategic theorists. Weapons of mass destruction appeared to lack a rational purpose for any contest short of oblivion. Much of the early scholarly struggle involved attempts to fashion

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[1]The title comes from Morgenthau (1976), "The Fallacy of Thinking Conventionally About Nuclear Weapons."

a theory of nuclear foreign policy (Brodie 1946, 1959; Kahn 1960; Kissinger 1957). The research of Thomas Schelling (1960, 1966) looms large in this effort. By imagining that leaders could compete, not through a willingness to perpetrate nuclear war, but through a willingness to let accident accomplish the unintended, Schelling offered a way to reconcile finite aims with extreme means. Yet, the threat that leaves something to chance still requires a level of irrationality. A nation's nuclear forces can never fully be put on auto-pilot, and even to the degree that this is possible, leaders have incentives to introduce protocols, such as authorization codes and fail safe measures, that enable the leadership to intercede. Ultimately, a willingness to take unreasonable risks in nuclear brinkmanship trumps reasoned calculations about costs and benefits. Indeed, pretending irrationality is highly rational within the logic of brinkmanship, but only if other nations have reasons to believe that competitors are irrational, which in turn makes the rational calculation of nuclear brinkmanship somewhat redundant. Powell (1990) reconciles some of the logical conundrums posed by Shelling, but only by introducing mixed strategies in game theory, which lack obvious empirical equivalents.

The study of nuclear (in)security also poses important challenges for quantitative research. The paucity of cases makes inference difficult, even as we must prefer that nuclear security remain a data poor environment. Despite difficulties, scholars have begun to develop econometric models of the determinants of nuclear proliferation (Meyer 1985, Singh & Way 2004, Jo & Gartzke 2007, Kroenig 2009, Fuhrmann 2009), and to examine the impact of nuclear weapons status on wars (Rauchhaus 2009), crises (Asal & Beardsley 2007, Beardsley & Asal 2009b), and militarized disputes (Gartzke & Jo 2009, Horowitz 2009). These studies focus on horizontal proliferation. Scholars are concerned with why nations obtain nuclear capabilities and what these capabilities yield in terms of aggravating or inhibiting military force.[3] Little attention has been paid to vertical proliferation.

Some have pointed to the near absence of major war in the nuclear era as evidence that nuclear weapons proliferation is benign or even beneficial (Mearsheimer 1993, Waltz 1990). Others argue that the association between nuclear weapons and negative peace is merely circumstantial (Mueller 1988). Still others view nuclear contests, or nuclear accidents, if rare, as too great a risk to contemplate, even if nuclear arsenals on balance generate some increment of deterrence

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[3]Nuclear weapons neither increase or decrease conflict propensity (Gartzke & Jo 2009), but they have important effects on the intensity, duration, and timing of conflict (Beardsley & Asal 2009b, Horowitz 2009, Rauchhaus 2009).

(Sagan 1993). This diversity of inferences is facilitated by the complex, multi-causal environment of international affairs. A qualitative approach will have difficulty determining whether nuclear weapons are causal, or merely coincident with any of the many changes in international affairs since 1945. At the same time, quantitative tests confront the reality of very limited information. With no cases of nuclear use since World War II, and relatively few (or poorly documented) incidents of nuclear brinkmanship, it is difficult (though not impossible) to rely on central tendencies.

Understanding the determinants of nuclear war is thus at once essential and to a frustrating degree unfathomable. Still, if the forces that are unleashed in a nuclear detonation have so obvious and dramatic an impact on the conduct of military affairs, they must surely have "trickled down" to the behavior of nuclear-capable nations and their opponents, not merely in nuclear contests but in every interaction that could potentially lead to nuclear war. If nuclear weapons matter a great deal, they must cast a shadow, even indirectly, on other aspects of international relations, including conventional conflict. It makes little sense to argue that nuclear weapons only deter nuclear war, when nuclear war is only a possibility with nuclear weapons. Nuclear weapons may well lack any practical foreign policy utility, but this proposition must also be considered empirically. Continuity between the effects of nuclear weapons in averting or propelling nuclear contests and any impact of nuclear weapons on the diminution or exacerbation of conventional conflict stands as the basis for any inferences about nuclear strategy and war in the period since Hiroshima and Nagasaki.

Logic dictates that the horizontal proliferation of nuclear weapons must at least nominally increase the risk of nuclear war (Sidel & Levy 2003, Burroughs & Spies 2007, Ruff 2008). After all, nations cannot experience a nuclear contest unless at least one of them possesses nuclear weapons. It is unclear, however, whether the hazard of nuclear conflagration is counter-balanced by a reduction in conventional conflict. If nuclear weapons status makes states less likely to fight in general, then one can potentially prefer proliferation, even with some (very finite) increase in the risk that nuclear weapons will be used in anger. Nor do we know whether the world is (relatively) better off if it faces rarer and bigger, or more frequent but modest, nuclear contests. Indeed, vertical proliferation by existing nuclear powers could arguably increase or decrease the risk of nuclear war. Singer and Tago, for example, claim that larger nuclear stockpiles could actually serve to deter other nations

from attempting to proliferate (Singer & Tago 2004). While intriguing, this argument does as much to illustrate our collective ignorance about the empirical consequences of vertical proliferation as it does to highlight available insights. Even a cursory review of the literature reveals that very little systematic empirical research has been done, surprising given a subject of so much consequence.

What does the world know (or think it knows) about vertical proliferation? More attention has obviously been applied to the spread of nuclear capabilities than to their stockpiling. The wisdom of this focus on horizontal proliferation is not immediately clear. After all, it is the number of nuclear weapons in the world that is presumably the source of greatest concern, not just the fact that more countries may have them. There must be some metric relating the relative hazard of one additional nuclear weapon in the hands of an existing nuclear power, versus one weapon that also creates a new nuclear power. Until researchers know this metric, a preference for vertical proliferation over horizontal proliferation must be treated as a value judgement. It may be that one is more pernicious than the other, but it remains likely that some quantity of one form of proliferation is better than a great deal of the other. Indeed, efforts to counter horizontal proliferation can be seen as benefitting existing nuclear powers, especially if existing powers remain free to increase the quantity or quality of their stockpiles. It seems both risky and unnecessary to assume that peace is enhanced (or diminished) by nuclear preponderance. Until we have systematic evidence of the relationship between numbers and members, we must equally fear both forms of proliferation.

In 1996, the International Court of Justice ruled that "there exists an obligation to pursue in good faith and bring to a conclusion negotiations leading to nuclear disarmament in all its aspects under strict and effective international control." Efforts to actually implement calls for vertical de-proliferation have been quite limited, however. Article VI of the Nuclear Non-Proliferation Treaty, which requires nations to reduce nuclear stockpiles, has not been heeded by any of the five "permanent" nuclear powers (Sidel 2007).[4] The argument that vertical proliferation must stop prior to restraining horizontal proliferation is often used by new or aspirant proliferators, and is disputed by nations with large extant nuclear stockpiles (Schrafstetter 2002), just as the fight against horizontal proliferation often appears to mimic the interests of established nuclear powers.

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[4]Nuclear stockpiles among the permanent five have declined substantially since the end of the Cold War. However, it seems obvious that this is a response to strategic and economic conditions, not a decision to honor Article VI.

While empirical research cannot determine which legal or moral obligation is the greater imperative, it may be possible to identify the relative impact of vertical versus horizontal de-proliferation.

Reasons for the lack of attention to vertical proliferation are unclear. Empirical research relies on change to identify relationships and test theories. Measuring the quantity of nuclear weapons, rather than just the presence or absence of nuclear status increases the information available to the researcher. At the same time, it makes no sense to fetishize numbers, per se. The temptation is to focus on material variables, factors that one can readily see, touch, and count. But these variables are usually also observable to strategic actors, making it difficult in the social sciences to disentangle the effects of material factors from cognition of material factors and indeed from intangible processes, such as learning or socialization. Researchers must seek to identify differences in how material, materially inspired, or psychological variables are likely to interact, and to differ in their consequences for events by looking for situations where each offers unique empirical implications. Even if one can maintain the plausible fiction that observable variables are constant, cognition continues. Learning in particular is temporally dynamic. Rapid change also reduces the confidence and competence of both subjects and researchers in previously identified relationships. It is thus easy to conflate material causes, time, and uncertainty in the study of any social phenomenon.

3   Theory: Time, Numbers, and Uncertainty

If humanity ceases to exist in this new century, it may very well be as a result of nuclear weapons. Fear of nuclear holocaust, and hope that this fear will serve to hold holocaust in abeyance constitute the dual horns of the nuclear security dilemma.[5] Nations facing daunting or compound threats may pursue proliferation in seeking to guarantee sovereign integrity or political autonomy. Proliferators may gain a freer hand for aggressive foreign policies, while the need for second strike capabilities may also enhance the appeal of acquiring additional weapons. The challenge for students of international politics in the nuclear era is to identify how these weapons influence world affairs, taking into account that relevant relationships are unlikely to be simple or readily observable. There are at

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[5]The security dilemma does not actually constitute a dilemma; the confusion seems to have resulted from analogies to the prisoners' dilemma. Nuclear security, in contrast, really does pose a dilemma, at least under MAD.

least four ways that nuclear weapons could alter a nation's propensity to clash with other countries.

First, the advent of nuclear weapons may upset the balance of power. Nuclear weapons proliferation constitutes an endogenous capabilities shock, benefitting the relative power of the proliferator at the expense of competitors. If the balance of power matters for conflict and cooperation, then nuclear capabilities may increase the propensity of nuclear nations to experience disputes. By their nature shocks are discrete events. The advent of a capabilities shock should be salient (or not) for cooperation or conflict among nations as long as the shift in relative power persists. Proliferation should make nations more (or less) dispute prone as long as states retain nuclear capabilities.

Conventional scholarship on the directional effects of capabilities shocks is fairly unequivocal. The proliferator should become more aggressive to the degree that it experiences military advantages due to nuclear proliferation. A debate remains about how effective nuclear weapons might be as instruments of military foreign policy (Morgenthau 1964, Schelling 1966, McNamara 1983, Huth 1990), but to a large degree this is an empirical question. If more powerful countries are more aggressive, then nuclear weapons should lead states to more often initiate disputes. By the same token, other states should be less likely to behave aggressively toward a state with nuclear weapons than a state without nuclear weapons. These implications of capabilities shocks due to nuclear proliferation suggest a hypothesis about potential initiators and targets in directed dyads:

Hypothesis 1 *Nuclear powers are more likely (less likely) to initiate (to be the target of) disputes.*

Second, the number of nuclear weapons may matter for whether nations fight. The effects of nuclear arsenals could be cumulative. A country with one nuclear weapon could arguably behave much as a state with no nuclear capability. Alternately, there may be separate consequences of nuclear status and the amassing of a large nuclear stockpile. While the appropriate threshold is more an empirical matter than a theoretical one, some increase in nuclear capabilities may be necessary before the head of state feels competent to behave aggressively. The quantity of nuclear weapons is an important factor in establishing a secure second-strike capability; nations with few nuclear weapons can more easily have their capabilities eliminated by a preemptive strike, while large arsenals increase the chances that some retaliatory capability will remain (Betts 1977). There may also be an increase in the quality (accuracy, delivery capacity, yield) of nuclear weapons

that coincides with the accumulation of additional devices. Finally, more nuclear weapons means that threatening or using these weapons is possible without significantly depleting the nation's deterrent capability. Having nuclear weapons to spare may make the country less averse to risky confrontations in which opponents are more capable, numerous, or protected by other nations.

These arguments mimic the traditional claims for nominal nuclear status. Countries that acquire a large stockpile of nuclear weapons should be more prone to initiate conventional disputes than states with a small nuclear arsenal or no nuclear weapons. Conversely, deterrence will be affected by the quantity (and perhaps quality) of the deterrent. Countries with many nuclear weapons should be better able to discourage aggression than nations with limited or no nuclear capabilities.

Hypothesis 2 *The size of a nation's nuclear arsenal should increase a country's propensity to initiate a dispute, and decrease the tendency to become the target of a militarized dispute.*

A third possibility is that uncertainty about nuclear weapons status increases the hazard of militarized disputes. In contrast to the classical approach that emphasizes power relations, contemporary research on the causes of conflict focuses on the role of asymmetric information (Fearon 1995, Wagner 2000). Nations are more likely to fight if they underestimate one another's respective resolve or capabilities. Bargaining breaks down when competitors cannot identify acceptable offers. Bargaining failures in turn heighten the probability of disputes. If nations are more likely to fight when they are uncertain about an enemy's capabilities, then capability shocks that make nations uncertain about the balance of power will lead to an increase in conflict. Countries with new military advantages may not yet be perceived as possessing significant advantages. Alternately, the proliferating country may itself overestimate the scale of its advantage. Nuclear proliferation is particularly prone to producing this type of uncertainty, given the extreme nature of nuclear capabilities shocks, the secrecy that enshrouds nuclear programs, and the fact that nuclear capabilities are not actually exercised (as opposed to the influence nuclear nations wield). Just as uncertainty peaks with the advent of possible new nuclear status, it decays quickly with the revelation of nuclear capabilities. Certainty about nuclear weapons capability may make countries no more dispute prone than certainty about the lack of nuclear status. War and peace are conditioned on nuclear secrecy or on nuclear uncertainty, not on the proliferation of nuclear weapons per se.

The effects of uncertainty about nuclear status on whether nations initiate, or are the targets of, conflict are a bit more complicated to unravel. It is possible that uncertainty about nuclear status could lead to bargaining failure, and thus to a greater risk of a contest for either a potential initiator or a target. In the standard bargaining story, a state possesses an advantage about which its counterpart is dubious, either because other states also claim such an advantage, or because it is difficult to ascertain the consequences of the advantage for warfare, should conflict occur. Opponents can also be uncertain about the resolve or preferences of a nation, underestimating not capabilities but the willingness to use them if necessary. In the context of nuclear proliferation, one can imagine that other nations doubt claims of nuclear capabilities, or that they are uncertain about the willingness of a nation to pursue nuclear brinkmanship under certain circumstances, or that the opponent of the new nuclear power discounts delivery systems, command and control, or some other aspect affecting the veracity of threats. A nascent nuclear nation may feel compelled to press advantages that are not yet accepted by other powers. In doing so, the nuclear state risks a greater likelihood of a military contest. While either a potential attacker or a target can be uncertain about capabilities or resolve, it is much more in the nature of a challenger to be dissatisfied with the status quo. Proliferators are preference outliers. The same incentives that lead nations to seek out nuclear capabilities also encourage attempts to use newly acquired leverage to seek to effect change. Once demands are made, underestimation can lead to bargaining failures and warfare.

Uncertainty about nuclear capabilities can thus equally affect an initiator or a target, but new nuclear states are much more likely to act as challengers. The real issue of initiation hovers around dissatisfaction. Either state may be uncertain. The question of which state initiates conflicts involves another layer of analysis. A satisfied power that errs in its estimation of an opponent may give cause for a dissatisfied challenger to initiate aggressive behavior. The converse is not true, unless striking first presents the possibility of major military advantages. Assuming that the status quo favors existing power balances (Powell 1999), and that the advent of nuclear weapons has some effect on the balance of power, it should be the nuclear proliferator that is more likely to act, regardless of which state errs in its calculations of the balance of capability and/or resolve.

Hypothesis 3 *Uncertainty about nuclear status increases a nation's tendency to initiate disputes.*

A final feature of proliferation is the accumulation of nuclear acumen that gradually follows the acquisition of nuclear capabilities. States or their leaders may take time to become familiar with the potential and limitations of nuclear weapons, and with the reactions of other states (Bracken 1985). A capabilities shock may permanently alter the nominal balance of power, but human reactions to such conditions are bound to be more dynamic. Given time, civilian and military bureaucracies can adjust to new realities (Nye 1987). The initial years of the U.S./Soviet stalemate were characterized by extreme hostility. Gradually, both sides established procedures and protocols to manage tensions. It became easier to avoid contests as opponents began to better understand what the enemy was seeking and what needed to be done to accommodate or resist given objectives.

Learning is characterized by exponential decay, with a rapid initial alteration in status followed by more and more gradual change. Eventually the marginal change approximates zero as the ability to know the world and to apply insights effectively are bounded by evolving context, institutions, and human decision making. Initial discoveries, adjustments, or innovations are seldom matched by equally effective improvements over time. Attention to learning in international relations is well established, even if the subject has yet to be thoroughly dissected (Farkas 1998, Reiter 1996, Cederman 2001). The first decade for a new nuclear power may be characterized by rapid reductions in the risk of violent confrontation, while succeeding time periods exhibit less and less improvement. Though I will not examine this possibility directly, the declining benefits of learning may produce to a convex relationship between dispute propensity and nuclear weapons status over time.

Less can be said about the respective effects of learning on initiators and targets. Learning should reduce the propensity for friction between nations, diminishing the tendency toward conflict. However, since learning can either be solitary or interactive, it is possible that familiarization with the weapons, bureaucracies, and the international context may matter for potential initiators, targets, or both. It is likely, however, that learning will have the greatest impact in diminishing disputes involving those factors most associated with increasing conflict in nuclear dyads.

Hypothesis 4 *Dispute propensity should decrease with the age of a nation's nuclear arsenal.*

4 Research Design and Data

This study uses directed dyads to capture differential effects of potential initiator and target (Bennett & Stam 2000). I apply the probit MLE, use the Huber-White correction for robust standard errors, and adjust for clustering in the dyad to address heteroskedastic error variance. I also address temporal dependence with a "peace year" variable and splines (Beck, et al. 1998).

4.1 Data

The dependent variable comes from the Correlates of War (COW) Militarized Interstate Dispute (MID) dataset (Gochman and Maoz 1984; Jones, et al. 1996; Ghosn, et al. 2004). *MID Initiation* is coded "1" if the potential challenger initiates a MID against its counterpart and "0" otherwise.[6]

The analysis involves several different variables to measure the effects of nuclear weapons on conflict. Nominal nuclear status is coded as the presence or absence of nuclear weapons by a country in a given year. The directed dyadic analysis distinguishes nuclear status with a *Nuclear Dummy* variable for each state in the dyad. Many scholars argue that dyads in which both states are nuclear powers behave differently than dyads in which only one state is a nuclear power (mutual deterrence). For this reason, I include an interaction term between the two nuclear status dummies.

This study adopts a list of dates for nuclear status used in previous research (Gartzke & Kroenig 2009). There is disagreement in the literature about when certain nations acquired the nuclear mantle. I examined eleven different codings of proliferation from the literature, ranging from narrow (publicly declared nuclear status, detonated a nuclear device) to broad (countries like Ukraine that temporarily "inherited" nuclear weapons). Results for the *Nuclear Dummy* variables are the same.

To measure uncertainty about nuclear status, I return to the eleven lists of proliferation dates just discussed. Disagreements among researchers about when countries entered the nuclear club may mirror uncertainty about nuclear status in the international community.[7] I calculate disagreement as the standard deviation of the eleven different codings. While not perfect, the measure is objective, easily coded and replicated, and does seem to capture the essence of ambiguity about nuclear status.

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[6]More restrictive (*fatal* MIDs), and less restrictive codings (MIDs initiated by *either* state) yielded similar results.

[7]Gortzak, et al. (2005) use a similar technique to assess confidence in codings of the offense/defense balance.

A separate way to calculate uncertainty is to take the lesser value of the sum of lists that code a country as possessing nuclear weapons and the sum of lists that code a country as *not* possessing nuclear weapons. If every list agrees that a given country is not a nuclear power, or if every list agrees that a country has nuclear capabilities, then this country is given the value of zero. If seven lists code a country as nuclear capable, but four do not, then the uncertainty variable is coded as "4" for that year. I construct variants of each of these codings by using the maximum value, a lagged variable (five year moving average), and a dummy for whether there is disagreement or not. Results using all variants of the nuclear status uncertainty variables are generally comparable.

A third element of nuclear status is the number of nuclear weapons a nation possesses. The Natural Resources Defense Council provides a list of annual estimates for nuclear stockpiles for relevant nations from 1945 to the present (National Resources Defense Council 2002). If there is disagreement about nuclear status, there is even more ambiguity about the quantity of warheads in a given national stockpile. Bearing in mind that particular estimates should be treated with some caution, the relevant feature of these data for the purposes here is really *relative* changes in stockpiles, both temporally and cross-sectionally. Without paying much deference to the precise metrics of resulting coefficients, these data may be sufficient to allow assessment of the hypotheses.

Finally, I evaluate the effect of learning using a count of the number of years since the initial proliferation date for each country. This approach has been used to measure learning in other contexts (Reiter 1994, Fazal 2007). I also include the square of the *Nuclear Age* variable to account for the potential for exponential decay. *Nuclear Age* should be negative, while *Nuclear Age*^{2} should be positive. Learning could occur in conjunction with a nuclear status shock, uncertainty, or both.

Other processes are bound to interact with the nuclear variables. Nuclear and conventional capabilities could be substitutes or complements. I rely on the COW Composite Index of National Capability (CINC) to measure a country's power. Since the analysis involves directed dyads, I assess the impact of capability for each state, along with an interaction term *CINC A* × *CINC B*.[8]

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[8]It is reasonable to debate the proper specification for measuring conventional capabilities. I have three objectives: 1.) The measure should be broad, able to capture many possible functional relationships. 2.) The variables for conventional capabilities should be consistent with canonical notions of how power affects the interaction of states. 3.) The measure of conventional power must be consistent with the directed dyadic research design. A common approach is to use something like $\frac{CINC\ A}{(CINC\ A + CINC\ B)}$, for example. However, this specification assumes a particular structure to these data that violates either criterion 2 or 3. If, for example, one uses directed dyads and A is the

Major powers are more active internationally, resulting in more frequent conflict. While I have concerns about the independence of the subjective major power coding, particularly in the post-World War II period (the coding of "major powers" seems heavily influenced by nuclear status), the variables are widely used. I include a dummy variable for each state in the dyad. *Major Power*, coded "1" if at least one state in a dyad is a major power according to the COW criteria.

Regime type is another variable that is widely viewed as an important determinant of conflict (Doyle 1997, Russett 1993, Russett & Oneal 2001). Previous research suggests that democracies are more likely to develop nuclear weapons (Jo & Gartzke 2007). I construct three variables using Polity IV data (Gurr, et al. 1989; Jaggers and Gurr 1995; Marshall and Jaggers 2002). To measure the regime type of each state, I take the difference between Polity *democ* and *autoc* variables, add ten, and then divide by two. This produces a score with an interval $[0, 10]$ equivalent to the domain of the component variables. I also include the product of monadic regime scores, since it is the interaction of democracies that is said to matter most (Oneal and Russett 1999; Oneal, et al. 2003).

Neighbors fight more than distant states, if only because they can (Boulding 1962, Bremer 1992, Gleditsch 2003). *Contiguity* is an ordinal variable identifying national proximity based on the COW six-point scale.[9] I also include a metric measure of geographic proximity. *Distance* is coded as the log transformed great circle distance between capital cities of states in a directed dyad year.

Alliance is a dummy variable coded for whether dyad members are linked by a defense pact, entente, or non-aggression pact.[10] Allies are usually viewed to be less likely to fight each other (Morrow 2000, Kimball 2006). Bueno de Mesquita (1981) argues that allies are more disputatious. Others see the effect of alliances as contingent on other factors (Bremer 1992; Bearce, et al. 2006).

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potential initiator, then this framework assumes monotonicity in the ratio of $CINC\ A$ over the sum of capabilities. Yet, abundant scholarship argues that parity is the most dangerous relationship for interstate conflict (c.f., Kugler & Lemke 1996), implying a non-monotonic concave functional relationship. If instead one adopts a non-directional form, such as $\frac{CINC\ High}{(CINC\ Low + CINC\ High)}$, then one loses the ability to infer about the possible initiator versus the target.

[9]States with contiguous colonies are treated as contiguous. Results are similar for other definitions of contiguity.

[10]Comparable results can be obtained using a dummy variable coded "1" exclusively for defense pacts.

5   Results

The effects of nuclear status, numbers, uncertainty, and time on interstate dispute propensity are detailed in two tables and one figure. Table 1 examines each of the key causal variables separately. Model 1.1 looks at the effect of nuclear status on the probability that a potential initiator (State A) attacks a given target country (State B). The nuclear status of both the initiator and target appear to matter, but the joint relationship (*N. Dum.   A × N. Dum.   B*) is not statistically significant. The apparent impact of nuclear status is somewhat misleading. As previous research reveals, the propensity of nuclear nations to experience conflict is exaggerated by the tendency of enemies, major powers, and "rogue" nations to both fight more often and to acquire nuclear weapons (Gartzke & Jo 2009). Use of the nuclear status dummies ignores the endogeneity between conflict and proliferation, which should tend to underestimate the substantive contribution of the other nuclear hypotheses. In regressions where the *Nuclear Dummy* variables are included, I also ran separate regressions without the nuclear status variables. Results are generally equivalent.

The second column in Table 1 contains coefficient estimates and standard errors for the quantity of nuclear weapons each nuclear nation is said to possess (states without nuclear capabilities have by definition zero nuclear weapons). Again, nuclear weapons increase dispute initiation, but in this case the interaction term is also positive and significant. Not only does it appear that vertical proliferation may lead to additional conflict, but the most disputatious dyads appear to be those in which both nations have significant nuclear stockpiles. These results offer contradictory evidence concerning the hypotheses. On the one hand, nuclear status or the number of nuclear weapons clearly increases dispute propensity in these simple models. On the other hand, it does so for *both* initiators and targets. Contrary to the expectations of conventional theory and qualitative studies, there is no apparent deterrent effect, either of nominal nuclear status or of larger nuclear arsenals.

Model 1.3 examines the effect of uncertainty about nuclear status on the probability of a militarized dispute. The greater the disagreement about a nation's nuclear status (at least as indicated by the scholarly debate), the greater the propensity for nations to fight. Interestingly, while both states in directed dyads are more conflict-prone when observers are uncertain about their nuclear status, the effect on potential initiators is substantively larger and statistically more robust.

Table 1: The Effect of Time, Numbers, and Uncertainty on Militarized Disputes

D.V.: MID Initiation	M 1.1 Coeff. (S.E.)	M 1.2 Coeff. (S.E.)	M 1.3 Coeff. (S.E.)	M 1.4 Coeff. (S.E.)	M 1.5 Coeff. (S.E.)
Nuclear Dummy A	0.658 *** (0.050)				
Nuclear Dummy B	0.533 *** (0.051)				
N. Dum. A $\times$ N. Dum. B	0.224 (0.138)				
# Nuclear Weapons A		2.96×10^{-5} *** (2.42×10^{-6})			
# Nuclear Weapons B		2.48×10^{-5} *** (2.64×10^{-6})			
# Nukes A $\times$ # Nukes B		1.18×10^{-9} *** (1.58×10^{-10})			
Nuclear Uncertainty A			1.058 *** (0.158)		
Nuclear Uncertainty B			0.688 ** (0.222)		
Nuclear Age A				0.020 *** (0.001)	0.041 *** (0.005)
Nuclear Age A^2					-0.001 *** (0.000)
Nuclear Age B				0.015 *** (0.001)	0.045 *** (0.005)
Nuclear Age B^2					-0.001 *** (0.000)
Age A $\times$ Age B				0.000 (0.000)	

(peaceyear and spline variables omitted to save space)

Intercept	-2.497 *** (0.037)	-2.453 *** (0.038)	-2.429 *** (0.037)	-2.464 *** (0.037)	-2.478 *** (0.037)

N	1077136	1077136	1077136	1077136	1077136
Log-likelihood	-10389.741	-10639.296	-10861.327	-10546.814	-10484.787
$\chi^2_{(8,,7,8,9)}$	707.342	–	566.47	740.767	680.666

Significance levels : $\dagger : 5\%$ $* : 1\%$ $** : 0.5\%$ $*** : 0.1\%$

Models 1.4 and 1.5 evaluate different formulations of the effect of experience with nuclear status on dispute propensity. Model 1.4 includes the linear count of years passed for each state since obtaining nuclear status (if the state has not proliferated then all values will be zero), and an interaction term between the two monadic nuclear seniority variables. Surprisingly, older nuclear states appear more dispute prone than younger nuclear nations. The effect of nuclear experience on dispute propensity is not jointly contingent; the interaction term is not statistically significant.

Because of the possibility of a non-linear relationship between time and dispute propensity for nuclear dyads, and because no interaction appears to exist between the time variables, Model 1.5 replaces the interaction term with the two monadic exponential (squared) variables. The effect of nuclear seniority does appear to be non-linear, though in a manner that contradicts the argument posed in the text. Some or all of the discrepancy could be the result of model mis-specification. The *Nuclear Age* variables were never intended to be evaluated in isolation from the other nuclear variables. Assessing the passage of (nuclear) time by itself forces the *Nuclear Age* variables to fit not only the decay function but also the initial nuclear shock, along with other relationships associated with proliferation and power. Since the other regression results reveal that there is either a nuclear capabilities shock or temporary uncertainty (or both), I next combine variables and add controls.

Table 2 contains three regressions that include all four categories of nuclear variables, plus an expanding list of control variables. Results for the key nuclear variables change in informative ways. Model 2.1 offers the first econometric "horse race" among the four types of nuclear variables. Most of these key variables remain statistically significant, though some of the *Nuclear Age* variables and in particular the *Nuclear Uncertainty* variables are no longer statistically significant. This result appears to favor materialist factors. However, the analysis still assumes that nothing other than nuclear weapons matter. Obviously, I need to address the effects of other, non-nuclear variables.

Nations fought before the nuclear age, and continue to do so today without nuclear weapons. Conventional capabilities are a salient feature of both dispute propensity and nuclear weapons status. Omitting a broader measure of capabilities will tend to exaggerate the effect of nuclear status and numbers, since both nuclear variables correlate closely with conventional military, industrial, and demographic power. Model 2.2 introduces the Correlates of War CINC scores for each state

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Table 2: Additional Controls for Time, Numbers, and Uncertainty on Militarized Disputes

D.V.: MID Initiation	Model 2.1		Model 2.2		Model 2.3	
	Coeffi.	(S.E.)	Coeffi.	(S.E.)	Coeffi.	(S.E.)
Nuclear Dummy A	0.666 ***	(0.104)	0.112	(0.119)	0.138	(0.114)
Nuclear Dummy B	0.631 ***	(0.106)	0.007	(0.166)	0.046	(0.124)
N. Dum. A × N. Dum. B	0.161	(0.120)	-0.077	(0.139)	-0.200	(0.204)
# Nuclear Weapons A	0.000 ***	(0.000)	0.000	(0.000)	0.000	(0.000)
# Nuclear Weapons B	0.000 **	(0.000)	0.000	(0.000)	0.000	(0.000)
# Nukes A × # Nukes B	0.000 ***	(0.000)	0.000	(0.000)	0.000	(0.000)
Nuclear Age A	-0.017 †	(0.007)	0.000	(0.008)	-0.028 **	(0.010)
Nuclear Age A^2	0.000 **	(0.000)	0.000	(0.000)	0.001 ***	(0.000)
Nuclear Age B	-0.010	(0.008)	0.011	(0.010)	-0.002	(0.012)
Nuclear Age B^2	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)
Nuclear Uncertainty A	0.148	(0.240)	0.793 ***	(0.188)	0.787 ***	(0.193)
Nuclear Uncertainty B	-0.264	(0.274)	0.463 †	(0.236)	0.089	(0.216)
CINC A			3.385 ***	(0.504)	1.398	(0.951)
CINC B			3.446 ***	(0.661)	1.738	(1.212)
CINC A × CINC B			30.440 ***	(7.342)	19.450	(23.160)
Maj. Power A					0.404 ***	(0.127)
Maj. Power B					0.263 †	(0.127)
Maj. A × Maj. B					0.265	(0.258)
Democracy A					0.033 ***	(0.006)
Democracy B					0.051 ***	(0.007)
Dem. A × Dem. B					-0.008 ***	(0.001)
Contiguity					-0.276 ***	(0.054)
Distance					-0.031	(0.033)
Alliance					-0.047	(0.049)

(peaceyear and spline variables omitted to save space)

Intercept	-2.501 ***	(0.038)	-2.541 ***	(0.037)	-1.239 ***	(0.085)

N	1077136		1077136		1051218	
Log-likelihood	-10349.954		-10156.067		-6910.268	
$\chi^2_{(29)}$	–		–		2855.896	

Significance levels :   † : 5%   ∗ : 1%   ∗∗ : 0.5%   ∗ ∗ ∗ : 0.1%

in the dyad, plus an interaction term. The effect of measuring conventional capabilities is striking. The *Nuclear Dummy* and *# Nuclear Weapons* variables are no longer statistically significant. As is clear from Model 2.2, a key weakness of the previous regressions is that the material nuclear variables conflated the effects of conventional and nuclear capabilities. All three CINC variables are highly statistically significant; powerful states and dyads fight more than weak states and dyads.

In contrast to the effects of the material nuclear variables in Model 2.2, the nuclear uncertainty variables seem to fare better once the effects of conventional capabilities are taken into account. While all of the *Nuclear Age* variables are now statistically insignificant, both uncertainty variables are now functioning as anticipated by the hypotheses. *Nuclear Uncertainty A* is highly significant, while *Nuclear Uncertainty B* is significant at the 5% level. The discrepancy between significance levels for uncertainty for State A and State B may reflect asymmetries of motivation or bargaining initiative. The initiator in a dispute will often be a challenger who has been (or expects to be) rebuffed in negotiations. This dissatisfied state is much more likely to be misperceived in bargaining (if the capabilities of the challenger were perfectly perceived, there would be no need for a dispute).

Finally, Model 2.3 includes a much broader set of additional variables, introducing major power status, regime type, contiguity, distance, and alliances. Several of these additional variables prove highly statistically significant. In particular, democracies seem to be more dispute prone, though they are significantly less likely to fight each other. Contiguous states are also more dispute prone.

The results of Model 2.3 are more compelling still for informational variables over material factors. Uncertainty about the nuclear status of a potential initiator is a key aspect of nuclear proliferation prompting nations to initiate disputes. As expected, uncertainty about the nuclear status of a target is no longer statistically significant. Instead, the time lag associated with the potential initiator's nuclear status is now statistically significant. As nuclear powers age, either they or their opponents learn to interact less conflictually, though this decay in dispute propensity itself declines with time. Nations are more uncertain about the nuclear status of new nuclear powers. This may lead nuclear powers to demand concessions, which are more often rebuffed, in turn leading to conflict. As time passes, uncertainty subsides and opponents identify acceptable bargains, even as nuclear nations become more adept at managing their arsenals and conducting foreign affairs

in the shadow of the bomb. Improvements have their limits, however, as the association between nuclear age and dispute reduction is itself counteracted by time. Nuclear nations eventually return to a pattern of dispute behavior that is not much different from their non-nuclear counterparts.

Material nuclear variables appear not to be significant determinants of dispute behavior, once other relevant variables are taken into account. Nuclear powers are no more likely to initiate, and no less likely to become the target of, conventional disputes. The size of a nation's nuclear stockpile does not appear to be a significant determinant of whether a country becomes involved in a conventional contest, either as challenger or challenged. If one accepts that Model 2.3 is a reasonable approximation of the forces at work in the decision to fight, then we must conclude that neither nuclear status nor the number of nuclear weapons matter much for whether nations fight.

Figure 1 illustrates the relationship between the number of years a nation has possessed nuclear weapons, uncertainty about nuclear status, and militarized disputes. As is clear from the figure, new nuclear states with high uncertainty about their nuclear status are at the greatest risk for initiating a conflict with another nation. The tendency to attack declines quickly with time and with reductions in nuclear uncertainty. The dispute-related effects of proliferation do not last long.
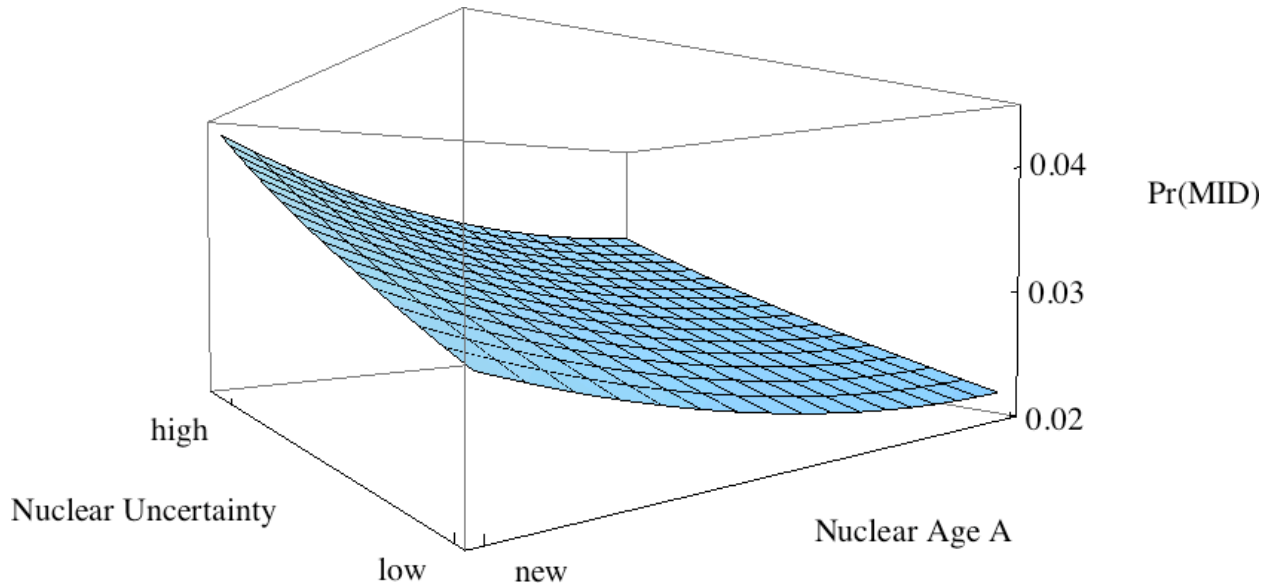

Figure 1: The Effect of Nuclear Uncertainty and Nuclear Age on MID Initiation

The analysis to this point includes all MID initiations. Most of these are low intensity events,

many lacking any actual fatalities. The traditional literature on nuclear weapons focuses much more narrowly on major crises and war. It can be argued that nuclear weapons have relatively little salience for minor disputes, where the shadow of nuclear conflagration is distant or non-existant. Theories of nuclear deterrence or arguments like Snyder's (1961) stability-instability paradox do imply relationships that carry downward to minor disputes. Informational arguments should also be salient for minor disputes. Uncertainty is at least as likely to spark minor contests as major ones. Similarly, there is some risk of escalation in even the smallest of conflicts; if nations fear nuclear war, then they should be a bit more afraid of any altercation against a nuclear power.

Focusing on war simplifies the analytical task of the theorist and causes no particular inconvenience for qualitative research, which must focus on only a few events in any case. Eliminating a large number of observations in quantitative research can be decidedly more damaging. MIDs themselves are rare events. Removing most MIDs dramatically reduces the variation available to evaluate relationships. Wars are scarce in the nuclear age, something that has even been attributed to nuclear weapons (Waltz 1981, Mearsheimer 1984). Thus, evaluating the weak form of nuclear claims involves weakening the empirical testbed for such assessments. This could make it harder or easier for hypotheses to demonstrate statistical significance. On the one hand, narrowing the focus to big conflicts is more appropriate in terms of where theories of nuclear security, strategy, and diplomacy predict the greatest impact. If so, then Tables 1 and 2 are preliminary, or even ancillary to this statistical "main event." On the other hand, statistical significance generally declines when using smaller samples. Thus, tests of the effects of nuclear weapons on wars or major disputes may actually bias against relationships revealed by analysis of the all MIDs sample. Readers can decide for themselves whether they prefer the all MIDs analysis or just using wars or fatal disputes.

While casual observation of the Cold War could lead one to conclude in favor of a nuclear peace, such a conclusion is perhaps too casual given the complexity and multifaceted nature of the relationships involved, and the weighty nature of the topic (Rosato 2003; Slantchev, et al. 2005). Table 3 lists coefficient estimates, standard errors, and other statistics for two regressions involving the same right-hand-side regressors as in Model 2.3. Model 3.1 predicts the probability of countries initiating or becoming the target of a fatal dispute. While broader than wars, fatal MIDs are a

useful "middle way," combining a more exclusive definition of conflict with a sample of disputes that is much larger than for wars. The results appear similar to those of the all-disputes sample, though several relationships are weaker, and one in particular is stronger. All of the material nuclear variables remain statistically insignificant. Coefficients for *Nuclear Age A* and *Nuclear Age*^{2} are in the appropriate direction, though the relationships are weaker than in the all-MIDs sample. The age of the target's nuclear capabilities is not a significant determinant of a fatal dispute initiation.

Finally, the nuclear uncertainty variables are both positive and highly statistically significant in Model 3.1. Ambiguity about nuclear status is particularly pernicious for fatal dispute initiation. One surprise involves the statistical significance of Nuclear Uncertainty B. Uncertainty about the nuclear status of the target appears to increase with the intensity of fatal disputes. Initiators tend to be more capable than targets. It may be that nuclear status uncertainty matters only for initiators at low levels of conflict intensity because there is less uncertainty in general about how a target will respond to low-intensity conflict. The salience of uncertainty about the target's capabilities and intentions may grow as the magnitude of costs and casualties increases. We can test the hypothesis that the trend in target nuclear uncertainty will continue in the war sample.

Model 3.2 examines the determinants of wars.[11] The nuclear uncertainty variables are substantively even stronger in their impact than in previous analyses, with the largest increase associated with *Nuclear Uncertainty B*. The trend toward the increasing impact of uncertainty about the target's nuclear status appears to support the contention that nuclear uncertainty increases in salience as dispute costs increase, making it more questionable whether the target will be able to resist.

Evidence favoring nuclear peace appears in the interaction of the quantity of nuclear weapons. Dyads in which both nations have large nuclear stockpiles are less war-prone than dyads with fewer or no nuclear capabilities. This is consistent with the special form of deterrence known as Mutual Assured Destruction (MAD). Yet, the lack of other nuclear relationships in this and the other models poses something of a riddle. Nuclear status has no significant effect on war propensity. The number of nuclear weapons is also insignificant for both potential initiator and target. Scholarship on nuclear deterrence gravitates toward the US-Soviet relationship to illustrate MAD, but these

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[11]Disputes in which at least 1000 fatalities are recorded are considered wars for the purposes of this analysis.

Table 3: Time, Numbers, and Uncertainty on Fatal Disputes or Wars

D.V.: MID Initiation	Model 3.1		Model 3.2	
	Fatal MID Init.		War Initiation	
	Coeffi.	(S.E.)	Coeffi.	(S.E.)
Nuclear Dummy A	-0.077	(0.202)	-0.070	(0.205)
Nuclear Dummy B	0.055	(0.188)	0.360	(0.219)
N. Dum. A × N. Dum. B	-0.006	(0.245)	0.496	(0.351)
# Nuclear Weapons A	-1.55×10^{-5}	(1.43×10^{-5})	-5.92×10^{-5}	(3.15×10^{-5})
# Nuclear Weapons B	-6.25×10^{-6}	(1.29×10^{-5})	-2.006×10^{-4}	(1.712×10^{-4})
# Nukes A × # Nukes B	1.03×10^{-8}	(2.95×10^{-8})	-1.667×10^{-4} ***	(3.5×10^{-5})
Nuclear Age A	-0.050 †	(0.024)	-0.016	(0.026)
Nuclear Age A^2	0.001 †	(0.001)	0.001	(0.001)
Nuclear Age B	-0.013	(0.025)	-0.031	(0.035)
Nuclear Age B^2	0.000	(0.001)	0.001	(0.001)
Nuclear Uncertainty A	1.040 ***	(0.319)	1.313 ***	(0.303)
Nuclear Uncertainty B	0.791 ***	(0.243)	1.157 ***	(0.327)
CINC A	-0.804	(2.114)	-0.817	(2.499)
CINC B	0.180	(2.696)	-1.390	(3.037)
CINC A × CINC B	32.525	(27.606)	35.534	(38.223)
Maj. Power A	0.691 **	(0.226)	0.607 **	(0.212)
Maj. Power B	0.312	(0.236)	0.203	(0.295)
Maj. A × Maj. B	0.136	(0.514)	0.552	(0.493)
Democracy A	0.033 *	(0.012)	0.029	(0.021)
Democracy B	0.043 ***	(0.012)	0.042 †	(0.021)
Dem. A × Dem. B	-0.008 ***	(0.002)	-0.014 **	(0.004)
Contiguity	-0.189 †	(0.089)	0.768 ***	(0.214)
Distance	-0.098	(0.053)	-0.089 ***	(0.025)
Alliance	-0.113	(0.067)	-0.166	(0.160)

(peaceyear and spline variables omitted to save space)

Intercept	-1.815	(0.142)	-3.621	(0.313)

N		1,051,218		1,051,218
Log-likelihood		-1695.383		-328.807
$\chi^2_{(28,29)}$		2291.104		519.046

Significance levels : † : 5%   ∗ : 1%   ∗∗ : 0.5%   ∗ ∗ ∗ : 0.1%

results indicate that a large nuclear capability only deters other nations if the potential attaker in turn is also capable of deterring the deterrer. Mutual assured destruction appears to create a special peace, not unlike the democratic peace relationship, where the effect only occurs dyadically.

The effects of regime type evolve almost in lock step with the increasing salience of nuclear uncertainty about the target state, and with the apparent impact of MAD on wars. Democratic dyads are less dispute prone than autocratic or mixed dyads at all levels of dispute intensity. In contrast, democratic monads appear more disputatious than non-democracies, though this relationship declines in significance at higher dispute intensities. The democratic peace relationship observed here appears to be much more dynamic than that described in the literature. Rather than becoming stronger as dispute intensity increases, the dyadic relationship remains relatively constant, emerging from the shroud of monadic democratic fractiousness that partially obscures it at lower dispute intensities. The same cannot be said for dyadic nuclear peace, which appears to be generated only at high dispute intensities, with no countervailing effect occurring for minor MIDs.

6 Conclusion

The results reported here suggest some useful, and possibly surprising answers to the questions with which I began. The shock and decay in dispute behavior associated with nuclear proliferation appear to result from uncertainty about nuclear status, and with the gradual learning process that may allow nations to better bargain in the face of differences, tensions, and nuclear weapons. Nuclear status and nuclear numbers as material variables do not appear to be important determinants of whether states fight, with the exception of nuclear dyads and wars. Instead, uncertainty and learning about nuclear weapons seem to be much more salient as determinants of war and peace.

These findings do not imply that nuclear weapons are benign, or that one can safely ignore either horizontal or vertical nuclear proliferation. At the very least, material nuclear variables form the basis for pernicious uncertainty. Nations that do not proliferate, and that make clear their commitment not to pursue nuclear capabilities, need not face the temporary increase in dispute behavior associated with the acquisition of nuclear weapons. Similarly, while there is no net increase in the number of disputes associated with rising nuclear arsenals, this is not the same

thing as saying that vertical proliferation has no deleterious effects. We have been fortunate to date that no repeat of the use of nuclear weapons has occurred since the final months of World War II. While the prospect of a nuclear war may in actual fact be low, larger stockpiles ensure that any such contest will be catastrophic, possibly even extinguishing the human race. If nations with larger stockpiles are no more likely to engage in conflict, the converse is also true; smaller stockpiles show no reduction in deterrence. Indeed, there appears to be no deterrent effect of nuclear weapons unless it is to deter other nuclear powers. Like other powerful, dangerous, and impractical objects, nuclear weapons may be best kept in small quantities (if at all), enough to influence other nations (Gartzke & Jo 2009, Beardsley & Asal 2009b), but not so many as to create lethal externalities. Nuclear war is unlikely. Let us also ensure that, should nuclear war occur, humanity survives.

At the same time that fewer actual weapons does no harm, and almost certainly is better in terms of safety and third-party effects, these results suggest the value of thinking more about the dangers of proliferation in terms of information, and uncertainty. Efforts to resist proliferation encourage countries bent on acquiring nuclear capabilities to do so secretly. Covert development programs in turn make it more difficult to establish the true nature and timing of a nation's nuclear status. The less that is known about what a country can do, the greater the likelihood that opponents will misperceive, underestimate, and fail to bargain effectively. We may be witnessing in the increase in dispute behavior among new nuclear nations a side-effect of efforts to prevent proliferation. The tradeoff between discouraging acquisition of nuclear capabilities and increasing, temporarily, the tendency to experience militarized disputes may be acceptable, but it is certainly worth considering *as a tradeoff*. There is no "free lunch" in counter-proliferation. Indeed, attempts to discourage proliferation make the most sense in terms of efforts to limit the ability of opponents to resist the will of the few existing nuclear powers. Nations with nuclear weapons are no more prone to fight than other nations, once their status as nuclear powers, and possibly increased expectations, are recognized and accommodated. As far as the effect of nuclear weapons on dispute behavior is concerned, information is more important than the actual weapons proliferation.

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