Nuclear Superiority and the Balance of Resolve: Explaining Nuclear Crisis Outcomes

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Abstract Scholars have long debated whether nuclear superiority or the balance of resolve shapes the probability of victory in nuclear crises, but they have not clearly articulated a mechanism linking superiority to victory, nor have they systematically analyzed the entire universe of empirical cases. Beginning from a nuclear brinkmanship theory framework, I develop a new theory of nuclear crisis outcomes, which links nuclear superiority to victory in nuclear crises precisely through its effect on the balance of resolve. Using a new data set on fifty-two nuclear crisis dyads, I show that states that enjoy nuclear superiority over their opponents are more likely to win nuclear crises. I also find some support for the idea that political stakes shape crisis outcomes. These findings hold even after controlling for conventional military capabilities and for selection into nuclear crises. This article presents a new theoretical explanation, and the first comprehensive empirical examination, of nuclear crisis outcomes.

What determines the outcome of nuclear crises? The nature of conflict between nuclear-armed countries is a central question in political science. The study of international politics has long been devoted to understanding the causes, conduct, and outcomes of international conflict.[1] For centuries, conventional military competition was a principal means by which states settled international disputes and, in turn, scholars carefully scrutinized the causes and outcomes of international war.[2] The introduction of nuclear weapons to the international system in

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1. See, for example, Thucydides 1954; Morgenthau 1948; and Waltz 1979.
2. See Russett 1993; and Reiter and Stam 2002.

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1945 and the corresponding nuclear revolution, however, fundamentally transformed the nature of international political competition.[3] Nuclear weapons raised the cost of war and reduced the incidence of direct military confrontation among their possessors.[4] Nuclear weapons did not, however, eliminate political conflicts of interest among states.[5] Deterred from engaging in direct military combat, the nuclear crisis became the primary arena in which nuclear-armed states settled important international disputes. As Hoffmann writes, the post-1945 international political system is characterized by "the substitution of crises for wars."[6] The ability to prevail in nuclear crises, therefore, became a central determinant of the distribution of international power and influence in the contemporary international system.

In a nuclear crisis, a state exerts coercive pressure on its adversary by raising the risk of nuclear war until one of the participating states prefers to capitulate rather than run any additional risk of catastrophe. A standoff between nuclear-armed opponents is a nuclear crisis whether or not nuclear weapons are used, are explicitly threatened, or are the subject of the dispute, because the very existence of nuclear weapons and the possibility that they could be used have a decisive bearing on bargaining dynamics.[7]

Because of their importance, nuclear crises have become the subject of a large scholarly literature and an intense intellectual debate. On one hand, many international relations scholars hold that the nuclear revolution transformed the nature of international political conflict from a competition in military capabilities to a "competition in risk taking."[8] According to this nuclear-brinkmanship-theory approach, the state that is willing to run the greatest risk of nuclear war before submitting will be most likely to win a nuclear crisis. Therefore, they argue, it is the balance of resolve, not the balance of nuclear forces, that determines the outcome of conflict between nuclear powers.

On the other hand, other scholars, historians, and policy analysts claim that nuclear superior states have used their nuclear advantage to coerce opponents into submission in important historical cases.[9] Yet, these scholars have not articulated a clear logic by which nuclear superiority translates into improved crisis outcomes.[10]

Moreover, members of these competing schools of thought have not considered whether their arguments may be complementary, rather than in competition, and

3. See Schelling 1966; Jervis 1989; and Powell 1990.
4. See Waltz 1995; and Gaddis 1987.
5. See Schelling 1966, 1–34; and Powell 1990, 1–32.
6. Hoffmann 1965, 236.
7. See Nitze 1956, 195; Schelling 1966, 1–34; and Powell 1990, 1–32.
8. See Schelling 1966, 92–125; Jervis 1984, 126–46; and Powell 1990, 33–109.
9. See, for example, Trachtenberg 1985.
10. Analysts have explained how a first-strike capability, the ability to completely disarm an opponent's nuclear arsenal by launching a nuclear attack, can provide a state with strategic advantages; but analysts have not articulated how a nuclear advantage translates into diplomatic influence once an opponent can absorb a first strike and launch a retaliatory nuclear strike.

whether nuclear superiority might influence nuclear crisis outcomes precisely through its effect on the balance of resolve. In addition, neither set of theoretical claims has been subjected to systematic empirical investigation against the entire universe of cases.

To examine nuclear crisis outcomes, I develop a new theory that synthesizes nuclear brinkmanship theory with arguments about the advantages of nuclear superiority. By incorporating the strategic nuclear balance into a standard nuclear brinkmanship model, I demonstrate that nuclear crises are competitions in risk taking, but that nuclear superiority—defined as an advantage in the size of a state's nuclear arsenal relative to that of its opponent—increases the level of risk that a state is willing to run in a crisis. I show that states that enjoy a nuclear advantage over their opponents possess higher levels of effective resolve. More resolved states are willing to push harder in a crisis, improving their prospects of victory. While the cost of a nuclear exchange is unacceptable for all states, nuclear superior states are more likely to win nuclear crises because they are willing to run a greater risk of nuclear war in a crisis than their nuclear inferior opponents. In sum, I show that the balance of resolve and nuclear superiority are not alternative explanations, but combine to form a coherent logic of nuclear competition.

Drawing on a new data set of fifty-two nuclear crisis dyads that includes information on nuclear arsenal size and delivery vehicles, I examine the impact of nuclear superiority on nuclear crisis outcomes. I find a powerful relationship between nuclear superiority and victory in nuclear crises and some support for the idea that political stakes also shape crisis outcomes. These findings hold even after controlling for conventional military capabilities and selection into nuclear crises. The results are also robust to the exclusion of each individual crisis and even to the exclusion of each individual country, alleviating concerns that the intermediate population size might render the results sensitive to coding or modeling decisions.

This project is novel in several respects. First, it brings together nuclear brinkmanship theory with arguments about the advantages of nuclear superiority to provide a new theoretical explanation of nuclear crisis outcomes. Second, this article presents the first comprehensive empirical examination of nuclear crisis outcomes. To date, the literature on nuclear crises has been dominated by formal theoretical models and qualitative studies of a few high-profile cases. Third, these findings are highly relevant to policy debates about arms control, nuclear disarmament, and nuclear force sizing.[11] This research suggests that states that possess nuclear superiority over their rivals will be more likely to achieve their basic goals in future nuclear crises. These results do not necessarily imply, however, that states should pursue nuclear superiority. Rather, as I elaborate in the conclusion, there are possible disadvantages to the possession of large nuclear arsenals and policymakers must carefully weigh the full range of costs and benefits before making any decisions about nuclear force size.

11. On arms control, see, for example, Adler 1992.

Explaining Nuclear Conflict

Nuclear deterrence theorists have written about the logic of mutually assured destruction (MAD).[12] When two states possess secure second-strike capabilities, both sides have the ability to launch a devastating nuclear response even after absorbing an enemy first strike. In this environment, neither state can physically defend itself against a nuclear attack and, therefore, must rely on deterrence to protect itself. Because the threat of nuclear exchange raises the cost of conflict, scholars have argued that nuclear weapons deter international war and may have contributed to an unprecedented period of great power strategic stability.[13]

The nuclear revolution, however, also raises significant theoretical and empirical problems. While nuclear weapons alter the logic of military conflict, they do not eliminate international competition. Nuclear-armed states still seek to coerce nuclear-armed adversaries. They cannot, however, credibly threaten a nuclear exchange that would result in their own destruction. How then can states credibly threaten nuclear-armed adversaries? And what determines the outcomes of conflict in the nuclear era? Much of nuclear deterrence theory is a response to these questions.

Schelling proposed nuclear brinkmanship as an answer.[14] According to Schelling, states cannot credibly threaten a nuclear attack, but they can make "a threat that leaves something to chance."[15] If nuclear war is not entirely in the collective control of the participants, but could result from accident or inadvertent escalation, then states can threaten to take steps that increase the risk of nuclear war.[16] States can credibly threaten to engage in a process—the nuclear crisis—that could spiral out of control and result in catastrophe. As long as the benefit of winning the contested issue is potentially greater than each incremental increase in the risk of nuclear war, threats to escalate nuclear crises are inherently credible.

In the nuclear era, therefore, states coerce adversaries by manipulating risk; political conflicts of interest become games of nuclear brinkmanship. States can escalate crisis situations, raising the risk of nuclear war in an effort to force a less-resolved opponent to submit. As the crisis progresses, the less-resolved state will prefer to back down rather than risk nuclear exchange. The more-resolved state—the state that is willing to run the greatest risk of nuclear war—prevails. In short, the nuclear revolution can be understood as a transformation of international politics from a competition in military capabilities to a "competition in risk taking."[17]

12. See Brodie 1946; and Kahn 1960.
13. Waltz 1995. For an opposing argument, see Sagan 1995.
14. See Schelling 1960, 187–204, and 1966, 92–125. In addition to brinkmanship, theorists have posited limited nuclear war as an additional solution to the credibility problem under MAD. See, for example, Powell 1989.
15. Schelling 1960, 187.
16. For the argument that nuclear war could result from accident or inadvertent escalation, see Sagan 1993; and Feaver 1994.
17. See Schelling 1966, 92–125; Jervis 1984, 126–46; and Powell 1990, 33–109.

Brinkmanship theorists do not claim, however, that states eagerly bid up the risk of nuclear war.[18] Rather, they assume that leaders badly want to avoid nuclear war and face gut-wrenching decisions at each stage of a crisis. They can quit the crisis to ensure that they avoid nuclear war, but only at the cost of conceding an important geopolitical issue to their opponents. Or, they can remain in the game a bit longer in an attempt to win, but only by increasing the risk that the crisis ends in a nuclear catastrophe.

Uncertainty plays an important role in brinkmanship theory.[19] If states possessed complete information about their own resolve and the resolve of their opponents, nuclear crises would never occur. The less-resolved state would simply concede the contested issue rather than enter a nuclear crisis that it has no prospect of winning. Brinkmanship theory assumes, therefore, that states possess incomplete information about their adversary's level of resolve. Nuclear crises are in part instruments for revealing information about an opponent's resolve.

According to brinkmanship theorists, the level of risk a state is willing to tolerate depends primarily on the state's political stakes in the conflict.[20] The higher the stakes, the more risk the state can credibly threaten to run. A state fighting over its national existence, for example, will be willing to accept a greater risk of nuclear war than a state fighting over a trade dispute or geopolitical influence in a distant region. The state that has the greater stake in the crisis, therefore, is more likely to ultimately prevail.

Brinkmanship theorists have not, however, explicitly incorporated the nuclear balance into their theoretical models.[21] Rather, they assume that both states possess secure, second-strike capabilities and that the cost of nuclear war is, therefore, equally devastating for both sides. Indeed, brinkmanship theorists explicitly argue that "nuclear superiority does not matter" in nuclear crises because they theorize that the outcomes of nuclear crises are shaped by states' stakes in the crisis.[22]

Others have argued that nuclear superiority provides states with a coercive advantage.[23] Yet, these scholars have not articulated a clear logic by which nuclear superiority translates into improved crisis outcomes. As Trachtenberg writes, "those who emphasize the strategic balance tend to assume that its effects are virtually automatic: the Soviets were outgunned [in the Cuban Missile Crisis in] in 1962, and they had no choice but to accept the terms the United States insisted on."[24] Similarly, according to Glaser, "the logical case" for the argument that a nuclear advantage provides states with bargaining leverage "is weak, proponents have done

18. Powell 2003, 90.
19. See Powell 1990; Snyder 1971; Snyder and Diesing 1977; and Wagner 1982.
20. See Schelling 1966, 92–125; Jervis 1989; and Powell 1990, 33–109.
21. See, for example, Powell 1990.
22. Jervis 1979–80.
23. See Horelick 1964; and Nitze 1976–77.
24. Trachtenberg 1985, 140.

little to support their claims, and efforts to fill in the logical gaps in their arguments encounter overwhelming difficulties."[25]

Moreover, neither set of theoretical claims has been subjected to systematic empirical investigation. Existing scholarship has congregated around a few high-profile cases but has not examined the entire empirical universe. Indeed, scholars advocating opposing positions often point to the exact same cases in support of their theoretical claims. In addition, the results of the more systematic inquiries have proven inconclusive. In the widest-ranging examination of historical cases to date, Betts analyzes explicit nuclear threats during the Cold War and concludes that neither the balance of resolve nor the balance of nuclear forces argument provides a satisfactory explanation.[26]

Scholars have also studied related topics including: the relationship between nuclear weapons possession and the timing, frequency, and severity of international conflict; the political utility of nuclear weapons; the dynamics and outcomes of interstate crises, and the effect of nuclear weapons possession on crisis outcomes.[27] These scholars have not, however, focused on crises between nuclear-armed states, nor have they examined the relationship between nuclear superiority and crisis outcomes.

The Advantages of Nuclear Superiority

I begin by considering a standard model of nuclear brinkmanship in which the balance of stakes underlying a crisis determines its outcome.[28] I then modify the model to include nuclear superiority. By incorporating the nuclear balance into the model, I demonstrate that nuclear superiority increases a state's level of resolve, improving its prospects for victory in nuclear crises.

Two states, S_I and S_{II} are edging toward a nuclear crisis. Play begins with S_I, a potential challenger, deciding whether to escalate the crisis or submit to its adversary, S_{II}. If S_I submits, the game ends with the payoffs (s_I, w_{II}), with s being the payoff of submitting the contested issue to the adversary, and w the payoff of winning the crisis. If S_I escalates, play shifts to S_{II}. S_{II} now has two options, to escalate or to submit. Submission ends the game with the payoffs (w_I, s_{II}). If S_{II} escalates, the game continues. At this stage in the game, nature imposes accidental nuclear war with probability f. If there is a nuclear war, the states

25. Glaser 1990, 38–39.

26. Betts 1987, 175.

27. See, for example, Gartzke and Kroenig 2009; Huth 1990; Atkinson 2010; Slantchev 2005; Gelpi and Griesdorf 2001; and Beardsley and Asal 2009. Others, including Huth, Gelpi, and Bennett 1993, have included nuclear weapons possession as a control variable in studies devoted to exploring the effect of other factors on the nature of international conflict.

28. For a complete description of nuclear brinkmanship models and their solutions, see, for example, Powell 1987, 1988, 1990, and 2003.

receive (d_{I}, d_{II}), where d is the payoff of disaster. If there is no disaster, play shifts back to S_{I}. S_{I} must then again decide whether to submit or escalate. If S_{I} escalates in this round it can do so only by generating a risk of disaster of $2f$. If there is no disaster, the play shifts back to S_{II}, who must now create a risk of $3f$ if it wishes to escalate. Play continues in this way until one state submits or until there is a disaster.

For each state, the game can end in one of three ways. The state can win, lose, or suffer a disaster. Since winning is preferable to losing and losing is preferable to disaster, and the status quo is preferable to either losing or disaster, $w_{\mathrm{I}} > 0 > s_{\mathrm{I}} > d_{\mathrm{I}}$.

In equilibrium, a state will be willing to escalate as long as the payoff to doing so is greater than or equal to the payoff to submitting.[29] S_{I}'s expected payoff to running a risk of disaster r is its payoff to winning the crisis, weighted by the probability of avoiding disaster, plus the payoff of disaster weighted by the probability of suffering a disaster. This is $w_{\mathrm{I}}\,(1 - r) + rd_{\mathrm{I}}$. A state's payoff to submitting, as defined above is s_{I}. Formally, S_{I} would be willing to run a risk of r if $s_{\mathrm{I}} \leq w_{\mathrm{I}}\,(1 - r) + rd_{\mathrm{I}}$. From this expression, I derive R_{I}, the largest risk of disaster that a state would be willing to run. In symbols this largest risk, or S_{I}'s resolve, is $\mathrm{R}_{\mathrm{I}} = (w_{\mathrm{I}} - s_{\mathrm{I}})/(w_{\mathrm{I}} - d_{\mathrm{I}})$. In other words, a state's resolve is the maximum risk of disaster that a state is willing to run in order to win the crisis.[30] A state's resolve is defined, therefore, as a function of the payoff to winning, the payoff to submitting, and the payoff to disaster.

The more resolved state, which can be thought of as the state that is willing to tolerate the greatest risk of nuclear war, will win as long as the crisis does not end in disaster. The game is similar in form to an auction in which the winner is the player that bids the highest level of risk.[31]

Of course, a nuclear crisis would never occur if states possessed complete information about the balance of resolve.[32] The less-resolved state would prefer to submit immediately rather than run any risk of nuclear war to participate in a game that it stands to lose. To spark a crisis, therefore, states must be uncertain about the balance of resolve. Crises result when each state has reason to believe that it might be more resolved than its opponent. Uncertainty about an opponent's resolve could result from incomplete information about an opponent's payoff to winning, its payoff to submitting, or its payoff to disaster. The outcomes of brinkmanship games with incomplete information, therefore, are a function of a state's resolve, its beliefs about its opponent's resolve, and its opponent's beliefs about its resolve. More specifically, the more resolute a state is, the more resolute it is believed to be, and the less resolute it believes its adversary to be, the harder a state is willing to push a crisis.[33]

29. Powell 2003.
30. See Brams 1985; and Powell 1987 and 2003.
31. See Powell 1990, 154–55, and 2003, 95.
32. See Powell 1990; Snyder 1971; and Wagner 1982.
33. Powell 2003, 96.

While less deterministic than games with complete information, therefore, resolve still plays a critical role in games with incomplete information.[34] All else being equal, more-resolved states are willing to push harder in a crisis and are more likely to win than their less-resolved counterparts.[35]

Brinkmanship theorists have drawn from this specification of resolve to derive hypotheses about the outcomes of nuclear crises. Brinkmanship theory demonstrates that S_I is more likely to prevail over S_{II} when $R_I > R_{II}$.[36] The specification of resolve here illustrates that R_I is increasing in w_I and decreasing in s_I. Therefore, if $w_I > w_{II}$, or $s_I < s_{II}$, and other values are held constant, then S_I will be more likely to prevail. These values, the values that a state places on winning (w_I) and on submitting (s_I) in a nuclear crisis, are defined as a state's stakes in the crisis. According to Powell, "this specification of resolve formalizes the role played by the political stakes underlying the crisis. A state's resolve increases as its payoff to prevailing or cost to submitting go up."[37] Brinkmanship theorists have concluded, therefore, that states with a greater political stake in a crisis will be more likely to prevail.

Brinkmanship theorists have not, however, included the strategic nuclear balance in their formal theoretical models of nuclear crisis dynamics. Rather, existing models assume that the nuclear balance is not pertinent because both sides have secure second-strike capabilities and, therefore, the cost of a nuclear catastrophe, d, is equivalent for all states.[38] These assumptions are made despite the fact that many nuclear-armed states do not possess second-strike capabilities and that many leading nuclear strategists have argued that an imbalance in nuclear forces, even among states with second-strike capabilities, can make nuclear war more costly for some states than for others.

To build on existing models, therefore, I incorporate the nuclear balance into the payoff structure. To aid in this task, I draw on two insights well developed in the nuclear strategy literature.[39] First, nuclear strategists recognize that not all nuclear wars would be equally devastating. To calculate the varying effects of nuclear war, analysts consider factors such as total number of deaths and casualties, economic destruction, expected length of time for society to recover from war, and all of these factors relative to an opponent.[40] As Kahn argued, "Few people differentiate between having 10 million dead, 50 million dead, or 100 million dead. It all seems too horrible. However, it does not take much imagination to see

34. Scholars have identified equilibria in which states with lower levels of resolve may prevail because of bluffing strategies in games with incomplete information. See, for example, Powell 1987 and 1988.

35. Powell 2003, 96–97.

36. Powell 2003.

37. Ibid., 94.

38. An exception is Powell 2003, which considers how missile defenses could reduce the costs of a nuclear disaster.

39. For a thorough review of this literature, see Kaplan 1991; Sagan 1989, 10–57; and Freedman 2003.

40. See Kahn 1960; Kaplan 1991; Freedman 2003; and Huntington 1982, 38–42.

that there is a difference."[41] For Kahn, nuclear war scenarios in which a country suffers 10 million deaths and requires five years to regain prewar levels of economic output versus one with 80 million deaths and fifty years of economic recuperation are "tragic, but distinguishable" outcomes.[42] Nuclear strategists also draw distinctions between postwar outcomes often considered to be in the realm of mutually assured destruction. For example, at the height of the Cold War, then Secretary of the Air Force Harold Brown argued that "even 25 percent casualties might not be enough for deterrence if U.S. casualties were disproportionately higher—if the Soviets thought they would be able to recover in some period of time while the U.S. would take three or four times as long, or would never recover, then the Soviets might not be deterred."[43] Similarly, defense analysts argued that even if the Soviet Union could destroy all major U.S. cities in a nuclear attack, it might be prevented from killing U.S. citizens living in small and medium-sized cities and in rural and outlying areas and that the United States had both a strategic incentive and a moral responsibility to protect these lives.[44]

Second, nuclear strategists recognize that nuclear superiority reduces the expected costs that a country would incur in the event of nuclear war. As Glaser elaborates in his study of U.S. nuclear strategy, analysts in the "damage limitation school" maintain that U.S. nuclear "superiority would reduce the cost to the United States in an all-out nuclear war."[45] States plan for counterforce nuclear targeting, that is, using nuclear weapons to destroy the nuclear weapons of an opponent, in an attempt to limit the damage that the opponent could impose in a nuclear attack. According to then U.S. Secretary of Defense Harold Brown, "we have always considered it important, in the event of war, to be able to attack the forces that could do damage to the United States and its allies."[46] States that enjoy nuclear superiority are expected to perform better in counterforce exchanges because they have more firepower with which to blunt the retaliatory capability of their opponents.[47]

In sum, strategic nuclear analysts and defense planners assess that nuclear war might exhibit varying levels of destruction and that nuclear superiority limits the expected damage that a country would incur in the event of a nuclear exchange.

To incorporate these insights into the nuclear brinkmanship model, let us assume S_{I} enjoys nuclear superiority over S_{II}. The payoff to disaster for S_{II}, d_{II}, is the cost of absorbing a nuclear attack by S_{I} in the event of a disaster. The payoff to disaster for S_{I}, d_{I}, is the cost of absorbing a nuclear attack by S_{II} in a disaster. Since S_{II} possesses a smaller arsenal than S_{I}, in the event of a complete nuclear exchange, S_{I} would absorb fewer nuclear strikes than $S_{II,}$ making $d_{I} > d_{II}$. In addition, nuclear

41. Kahn 1960, 20.
42. Ibid.
43. U.S. Senate 1968, 186.
44. Glaser 1990, 211–12.
45. Ibid., 133.
46. U.S. Department of Defense 1980, 66.
47. See Kaplan 1991, 201–19; Freedman 2003, 117–30; and Glaser 1990, 133–65.

superiority provides S_I with a counterforce advantage, making it better able to limit the damage that S_{II} could impose in the event of nuclear war. If the brinkmanship game were to end in disaster, therefore, S_I could not prevent S_{II} from launching an attack, but it would be better positioned to reduce the costs that S_{II} could impose, again rendering $d_I > d_{II}$.

Of course, the payoff to disaster is still large and negative for both sides and a nuclear exchange is still the worst possible outcome, even for nuclear superior states. Nevertheless, by incorporating nuclear superiority into the model, I show that it is an unrealistic simplification to assume that all nuclear disasters are equally costly.

Returning to the above specification of resolve, I show that R_I is increasing in d_I. Therefore, if $d_I > d_{II}$, and other values are held constant, then $R_I > R_{II}$. S_I will be willing to run a greater risk of disaster and will be more likely to prevail in a crisis. Operating from within the framework of nuclear brinkmanship theory, I show that providing a state with nuclear superiority, much like increasing a state's political stake in the crisis, creates a theoretical expectation that a state's effective resolve will be increased.

This is not to argue that leaders in nuclear superior states believe that they can fight and win nuclear wars, nor is it to claim that they eagerly bid up the risk of nuclear war in a crisis. Rather, the intuition is more subtle. If the costs of catastrophe are lower for one state than another (even if the costs are high for both sides), then as leaders make the gut-wrenching decision about whether to submit or escalate, the submit option looks relatively more attractive to leaders in the nuclear inferior state at each stage of the crisis. In calculating the payoff to escalation, leaders in nuclear inferior countries factor the probability of nuclear war by a relatively higher cost of catastrophe. One should expect, therefore, that, on average, leaders in nuclear inferior states will be more likely to opt for submission. On the other hand, as leaders in nuclear superior states make the same anguished calculations about whether to escalate the crisis or submit, they scale the probability of nuclear exchange against a relatively lower cost of nuclear disaster. Leaders in nuclear superior states still badly want to avoid a nuclear exchange, but because the costs of a nuclear exchange are relatively lower, one should expect that they will be willing, on average, to hazard a higher risk of disaster than their nuclear inferior opponents, making them more likely to ultimately win nuclear crises. In more colloquial terms, the logic of the argument is that in a game of chicken between two cars on a collision course, one might expect the smaller car to swerve first, even if a crash would be disastrous for both.[48]

Indeed, there is evidence to suggest that nuclear superiority has encouraged policymakers to escalate nuclear crises in historical cases. By the beginning of the Cuban Missile Crisis in 1962, the Soviet Union had acquired the ability to inflict unacceptable damage on the United States in the event of a nuclear war, but Wash-

48. Betts 1987, 187.

ington retained nuclear superiority over Moscow.[49] U.S. leaders were cognizant of their advantage and the favorable nuclear balance appears to have increased the resolve of key U.S. policymakers. For example, during the Cuban Missile Crisis, General Maxwell Taylor, Chairman of the Joint Chiefs of Staff, wrote in a memo to Secretary of Defense Robert McNamara, "we have the strategic advantage in our general war capabilities . . . this is no time to run scared."[50] Similarly, Secretary of State Dean Rusk argued to the members of the executive committee of the National Security Council, a special body of senior government officials convened to advise President John F. Kennedy during the Cuban Missile Crisis, "One thing Mr. Khrushchev may have in mind is that . . . he knows that we have a substantial nuclear superiority . . . he also knows that we don't really live under fear of his nuclear weapons to the extent . . . that he has to live under ours."[51] Finally, when asked whether he would have been comfortable navigating the Cuban Missile Crisis from a position of nuclear inferiority, a senior U.S. official replied simply, "Hell no."[52]

There is less information about the decision-making process of Soviet officials during the Cuban Missile Crisis, but the available evidence suggests that Soviet leaders were cognizant of their nuclear inferiority and that this may have encouraged them to withdraw the missiles from Cuba. Following the crisis, Vasili Kuznetzov, first deputy minister of foreign affairs, said, referring to the balance of nuclear forces that was shifting in Moscow's favor, "You Americans will never be able to do this to us again."[53] Similarly, Fidel Castro implies that the Soviet Union instructed him that nuclear inferiority forced Moscow to back down in the Cuban Missile Crisis.[54] In short, according to Betts, when explaining the outcome of the Cuban Missile Crisis, "it is hard to avoid the conclusion that the imbalance of nuclear power—U.S. superiority—was an influence."[55]

There is also suggestive evidence from other nuclear crises that nuclear superior states enjoy a coercive advantage in a crisis. In the 1999 Kargil crisis, for example, Pakistan gave in to Indian demands to withdraw its irregular forces from Indian-controlled Kashmir. Although both countries possessed nuclear weapons, India enjoyed nuclear superiority, possessing nearly three times as many nuclear warheads as Pakistan. Indian officials believed that this strategic advantage induced caution in Pakistan's leaders. As Indian Defense Minister George Fernandes pointed out, in the event of a nuclear exchange, "We may have lost part of our population," but "Pakistan may have been completely wiped out."[56]

In sum, a formal theoretical model of nuclear brinkmanship and illustrative historical evidence suggest that nuclear superior states would incur fewer costs in the

49. Press 2005, 121–27.
50. Quoted in Gaddis 1982, 229 note.
51. *International Security* 1985, 177.
52. Betts 1987, 179.
53. Bohlen 1973, 523.
54. Szulc 1986, 582–85.
55. Betts 1987, 115.
56. Quoted in Kapur 2007, 133.

event of a nuclear disaster, increasing their effective levels of resolve, and improving their prospects of victory in a crisis. This logic brings us to our first hypothesis.

H1: States that enjoy nuclear superiority will be more likely to win nuclear crises.

In addition, the degree and not simply the existence of nuclear superiority may also affect crisis outcomes. The greater a state's level of nuclear superiority, the greater its payoff of disaster relative to an opponent. In addition, greater levels of nuclear superiority enhance a state's ability to conduct counterforce strikes, further increasing a state's absolute payoff of disaster. As a state achieves greater levels of nuclear superiority over an opponent, therefore, its payoff of disaster, d_{I}, increases and, R_{I}, a state's willingness to run risks in a crisis, increases accordingly. This logic leads us to our second hypothesis.

H2: The greater a state's level of nuclear superiority, the more likely it is to win nuclear crises.

The strongest challenge to these hypotheses is that the nuclear balance is largely irrelevant to nuclear crisis outcomes because political stakes so greatly shape the probability of victory in nuclear crises.[57] I therefore include a number of variables to control for a state's stake in a crisis. I discuss these in the next sections in which I describe the data and examine the evidence for the hypotheses.

Nuclear Crisis Data

To examine the outcomes of nuclear crises, I construct an original nuclear crisis data set, drawing from the International Crisis Behavior Project's (ICB) list of international crises. The data set contains new information on the outcomes of nuclear crises, nuclear arsenal size, and the balance of political stakes from 1945 to 2001. According to the ICB, a crisis is an interstate dispute that threatens at least one state's values, has a heightened probability of military escalation, and has a finite time frame for resolution.[58] A nuclear crisis is defined as a crisis in which both states in the crisis possess nuclear weapons.[59] As stated earlier, a nuclear crisis can occur whether or not nuclear weapons are used, are threatened, or are the disputed issue in the crisis. I do not include crises in which only one actor in the conflict possesses nuclear weapons because this study focuses on the out-

57. See Schelling 1966, 92–125; Jervis 1979–80; and Powell 1990, 33–109.
58. Brecher and Wilkenfeld 2000.
59. Information on nuclear weapons possession is drawn from Gartzke and Kroenig 2009. Altering the universe of cases by employing different dates for when countries acquired nuclear weapons did not affect the results.

comes of crises between nuclear-armed states.[60] The unit of analysis is the dyad crisis, following past research on international crises.[61] This is the appropriate unit of analysis because a number of central variables in the analysis, such as the balance of political stakes and nuclear superiority, can be measured only at the dyadic level. I use directed dyads because the dependent variable, nuclear crisis outcomes, varies for each state in the crisis dyad. I follow a standard practice of paring states together in a crisis dyad only if one state "perceives that the other state has directed a threatening or hostile action against it."[62] Using these coding rules, I identify fifty-two nuclear crisis dyads involved in twenty unique nuclear crises from 1945 to 2001.[63] Examples of the nuclear crises contained in this data set include the Cuban Missile Crisis between the United States and the Soviet Union in 1962, the Sino-Soviet border war of 1969, and the Kargil crisis between India and Pakistan in 1999. A list of all the nuclear crises contained in the data set is available in Table 1.

The list of nuclear crises in Table 1 exhibits varying degrees of escalation, but all are properly included in a study of nuclear crisis outcomes. Some crises, such as the Cuban Missile Crisis, escalated to a high level, while others ended relatively quickly. It would be unwise, however, to select crises for study based on their level of escalation, such as excluding crises that did not reach significantly high levels of violence. After all, each of the cases included in the study meets ICB's definition of an international crisis. Moreover, as noted earlier, scholars have long maintained that nuclear weapons are an ever-present factor lurking in the background of political conflicts between nuclear-armed states. They can shape bargaining dynamics whether or not the states actually engage in direct armed-conflict, or explicitly threaten nuclear use. In addition, the nuclear brinkmanship framework employed in this study explicitly requires nuclear crises to exhibit varying levels of escalation. In some crises, states will be willing to push hard to achieve their goals, but in others they will look down the game tree, assess that they will be unlikely to prevail, and immediately decide to submit. In sum, crises between nuclear powers, regardless of their level of escalation, occur within a nuclear brinkmanship framework and provide an appropriate test of the hypotheses advanced here.

The binary dependent variable is OUTCOME. It measures whether a country achieves victory in a nuclear crisis. The variable is drawn from an ICB variable that measures whether the outcome of a crisis for each actor is victory, compromise, stalemate, or defeat. I made three minor revisions to the ICB's coding of crisis outcomes, to better harmonize them with established historical interpreta-

60. For an analysis that includes nonnuclear states, see the section on robustness tests.

61. See Gelpi 1997; Hewitt 2003; and Beardsley and Asal 2009.

62. For example, in the 1973 Arab-Israeli war, Israel is included in a crisis dyad against the Soviet Union, but not the United States. Hewitt 2003, 674.

63. Of course, observations of the dependent variable (crisis outcome) are not independent across all dyads within each crisis. I account for this problem by clustering the standard errors by crisis dyad, which allows for nonindependence of dyads within a crisis.

TABLE 1. *Nuclear crises, 1945–2001*

Crisis name	*Year*	*Nuclear-armed participants*
Korean War	1950	Soviet Union, United States
Suez crisis	1956	Great Britain, Soviet Union,* United States*
Berlin deadline	1958	Great Britain, Soviet Union, United States
Berlin wall	1961	France, Great Britain, Soviet Union,* United States
Cuban Missile Crisis	1962	Soviet Union, United States*
Congo crisis	1964	Soviet Union, United States*
Six-Day War	1967	Israel,* Soviet Union, United States*
Sino-Soviet border war	1969	China, Soviet Union*
War of attrition	1970	Israel, Soviet Union
Cienfuegos submarine base	1970	Soviet Union, United States*
Yom Kippur War	1973	Israel, Soviet Union, United States*
War in Angola	1975	Soviet Union,* United States
Afghanistan invasion	1979	Soviet Union,* United States
Able Archer exercise	1983	Soviet Union, United States
Nicaragua, MIG-21S	1984	Soviet Union, United States
Kashmir	1990	India, Pakistan
Taiwan Strait crisis	1995	China, United States*
India/Pakistan nuclear tests	1998	India, Pakistan
Kargil crisis	1999	India,* Pakistan
India Parliament attack	2001	India,* Pakistan

Note: A state's victory in a crisis is denoted by an asterisk. Not all crises have victors and some crises have multiple victors. For a list of when countries acquired nuclear weapons, see Gartzke and Kroenig 2009.

tions.[64] I describe each of these alterations in detail in Appendix C.[65] Following past research on crisis outcomes, I dichotomize this variable to code whether or not a state achieves victory in a crisis.[66] A victory is defined as a crisis in which an actor achieves its "basic goals."[67] A loss is recorded if the crisis ends in compromise, stalemate, or outright defeat.[68] For example, the United States is coded as winning the Cuban Missile Crisis because it achieved its basic goal of forcing the Soviet Union to withdrawal its missiles from Cuba. The Soviet Union is coded as losing the Cuban Missile Crisis because it was unable to achieve its basic goal of maintaining its missiles in Cuba.[69] Multiple states achieve their basic goals in some crises, while many other crises do not produce a clear victor. A victory is

64. The core statistical results reported here are robust to the use of the original ICB coding of crisis outcomes.

65. Available at www.journals.cambridge.org/ino2013002.

66. See Gelpi and Griesdorf 2001; and Beardsley and Asal 2009.

67. ICB Data Codebook, available at ⟨http://www.cidcm.umd.edu/icb/dataviewer/variable.asp⟩. Accessed 15 July 2012.

68. Creating a victory variable that includes compromise, or compromise and stalemate, in the victory category produced similar results.

69. There are many advantages to employing the ICB data, but, like any data set, some of the coding of crisis outcomes could be questioned. Recoding questionable cases and rerunning the analysis

recorded in eighteen of the fifty-two nuclear crisis dyads. Information on the winners of nuclear crises is also available in Table 1.[70]

I construct independent variables to test the hypotheses explicated previously. SUPERIORITY measures whether a state enjoys nuclear superiority over its opponent in a crisis. To begin the construction of this variable, I gathered detailed information on the size of nuclear arsenals in each nuclear weapon state in every year from 1945 to 2001. Appendix A provides information on the coding rules and sources used to calculate nuclear arsenal sizes.[71] The size of nuclear arsenals ranges from a low of 0 (France from 1960 to 1963) to a high of 40,723 (the Soviet Union in 1986).[72] Using this information, I code a binary variable to indicate whether a country had more nuclear weapons than its opponent in each crisis.

Nuclear analysts often consider additional factors when calculating the nuclear balance between states including: total megatonnage, numbers and accuracy of delivery vehicles, and the ability of command-and-control systems to execute war plans in a crisis. Aggregating these factors into a nuclear superiority index might be desirable, but detailed information on these variables is not available for every nuclear weapon state in every year. Moreover, there is good reason to believe that simple warhead counts and more complicated assessments of nuclear capabilities are highly correlated. For example, according to almost any measure, the United States enjoyed nuclear superiority over the Soviet Union from 1945 until the mid-1970s, at which point Moscow achieved parity with, and arguably gained a strategic edge over, Washington.[73]

To examine whether states enjoyed greater levels of nuclear superiority over their opponents, I created NUCLEAR RATIO. NUCLEAR RATIO is calculated as the number of nuclear weapons possessed by state A divided by the total number of nuclear weapons in the arsenals of state A and state B combined. The theoretical and empirical range of the variable is from 0 to 1.

To account for the effects of political stakes on nuclear crisis outcomes, I include a number of control variables. One may expect that states will have a greater stake in a crisis that occurs nearer to their homeland than one that takes place in a distant geographic region.[74] Scholars argue, for example, that future nuclear confron-

did not alter the core results. For a discussion of some questionable ICB coding decisions, see Appendix E available at www.journals.Cambridge.org/ino2013002.

70. The number of participants and victors listed in the table differs slightly from the figures reported in the text of the data section because the statistical analysis employs directed dyads.

71. Available at the author's website ⟨www.matthewkroenig.com⟩.

72. Although France became a nuclear weapon state when it conducted its first nuclear weapon test in 1960, it did not begin maintaining a nuclear stockpile until 1964. National Resources Defense Council, "Table of Global Nuclear Weapon Stockpiles, 1945–2001." Available at ⟨http://www.nrdc.org/nuclear/nudb/datab19.asp⟩. Accessed 15 July 2012.

73. See Nitze 1976–77, 201–3; Betts 1987, 89; and Freedman 2003, 342–54.

74. Previous research on the effectiveness of extended deterrence offered by "major powers" has accounted for stakes by coding the major powers' "intrinsic interests" in the protégé state that is seek-

tations between the United States and regional adversaries will necessarily disadvantage Washington because geographical proximity will tip the balance of stakes in the regional adversary's favor.[75] Indeed, analysts often use the language of geography, such as core versus peripheral interests, to describe a state's stake in a crisis. PROXIMITY is a binary variable, which measures whether the geographic location of the crisis is closer to state A than it is to state B.[76] For example, in the Cuban Missile Crisis, the United States is coded 1 and the Soviet Union is coded 0 because Cuba was closer to the United States than to the Soviet Union. For nuclear crises between countries that share a common border, such as the nuclear crises between India and Pakistan, this variable is scored 0 because geographical factors did not clearly favor either side.

I also include an alternate measure of political stakes, which gauges the relative gravity of the crisis for the involved actors. GRAVITY draws on ICB data that codes the gravity of a crisis for each actor from 0 (economic threat) to 6 (a threat to national existence).[77] A state is coded as 1 if a crisis is more severe for itself than it is for its opponent. For example, the Yom Kippur War of 1973 is coded as 5 for Israel (threat of grave damage), and 4 for the Soviet Union (threat to influence). In this case, the balance of stakes favored Israel; Israel is coded 1 and the Soviet Union, 0[78]

I also include a number of additional control variables.[79] One may expect states that enjoy conventional military superiority over opponents to be more likely to prevail in nuclear crises. On the other hand, conventional military superiority might not be particularly relevant in a crisis among nuclear powers. To control for this factor, I generate CAPABILITIES. I employ a power ratio variable that assesses the

ing protection. Huth and Russett 1984. This measure of stakes cannot be incorporated into this study because it examines the outcome of crises between nuclear-armed states and not on the effectiveness of extended deterrence guarantees from "major powers" to protégé states.

75. See Jervis 1994, 130; Paul 1994; and Powell 2003, 100–6.

76. Distance is measured in number of miles between capital cities and is extracted using *EUGene*. Bennett and Stam 2000.

77. The ICB gravity variable is coded: (0) economic threat, (1) limited military damage, (2) political threat, (3) territorial threat, (4) threat to influence, (5) threat of grave damage, and (6) threat to existence.

78. I also tried a third variable to measure a country's political stake in a crisis, drawing on the ICB "issue" variable. The variable gauges the importance of the disputed issue in a crisis and ranges from 1 (most important) to 6 (least important). I dichotomized the variable to assess whether the country was fighting over a more important issue than its adversary in a crisis. The variable was not statistically significant and did not affect the core results in any of the models in which it was included.

79. In addition, and drawing from Beardsley and Asal 2009, I tried a "target" variable, which measures whether State A was the target or the initiator of the crisis. Scholars (for example, Schelling 1966, 69–78) have argued that deterrence, defined as a threat aimed at defending the status quo, is easier than compellence, defined as a threat designed to change the status quo. If this is correct, we should expect that the states targeted in a crisis, that is, states defending the status quo, will be more likely to win nuclear crises. Consistent with this perspective, the sign on the target variable was positive and statistically significant. The inclusion of this variable did not alter the other core findings. Nuclear superior states were more likely to win nuclear crises even after controlling for the initiator of the crisis.

capabilities of state A divided by the total combined capabilities of both state A and state B.[80] Capability is a composite index containing information on total population, urban population, energy consumption, iron and steel production, military manpower, and military expenditures.[81]

Gelpi and Griesdorf have argued that democracies are more likely to win crises because they select into crises they are more likely to win and because domestic audience costs enable them to make more credible commitments.[82] To assess the effect of domestic regime type on the outcomes of nuclear crises, I include REGIME. I use Polity scores that range from −10 (most autocratic) to +10 (most democratic) from the Polity IV data set.[83]

One may expect that states with larger populations are better able to absorb a nuclear attack and, therefore, may push harder in a crisis.[84] If one U.S. city were completely destroyed in a nuclear attack, for example, much of the country would remain intact. One nuclear explosion in a small country such as Israel, however, could very well threaten the state's existence. POPULATION measures the size of a state's total population, drawing on data from version 3.02 of the Correlates of War data set and extracted using *EUGene*.[85]

A country that can absorb an enemy first strike and maintain enough survivable forces to launch a devastating retaliatory response may be able to resist nuclear coercion even if the adversary possesses nuclear superiority.[86] SECOND STRIKE is a dichotomous variable that gauges whether a state possesses submarine-launched ballistic missiles (SLBMs), mobile missiles, or maintains nuclear-armed aircraft on continuous airborne alert.[87] These types of forces are especially likely to survive an opponent's first strike and virtually guarantee their possessors with an assured second-strike capability.[88] Appendix B provides information on the coding rules and sources used to calculate whether a country possesses a second-strike capability.[89]

Crises that exhibit high levels of violence may be more likely to produce a clear winner. To control for the use of force in a crisis, I include VIOLENCE. The four-point ordinal variable is drawn from the ICB data and measures the level of violence in a crisis and ranges from 1 (no violence) to 4 (full-scale war).

80. The correlations between CAPABILITIES and SUPERIORITY and CAPABILITIES and NUCLEAR RATIO are 0.631 and 0.698, respectively.

81. Data on capabilities are drawn from the Correlates of War composite capabilities index, version 3.02 and extracted using EUGene. See Singer, Bremer, and Stuckey 1972; and Bennett and Stam 2000, respectively.

82. Gelpi and Griesdorf 2001. See also Reiter and Stam 2002; and Fearon 1994.

83. Jaggers and Gurr 1995.

84. An alternate variable that gauges a country's territorial size produced similar results.

85. See Singer, Bremer, and Stuckey 1972; and Bennett and Stam 2000.

86. Wohlstetter 1958.

87. Using an alternate variable that measures a country as possessing a second-strike capability only if it possesses SLBMs produces nearly identical results.

88. For the argument that Russia and China are vulnerable to a U.S. first strike despite the possession of a second-strike capability as defined above, see Lieber and Press 2006.

89. Available at www.journals.Cambridge.org/ino2013002.

Finally, one may expect countries that exist in competitive security environments to be less likely to win nuclear crises, as each crisis may be the manifestation of an underlying and intractable dispute.[90] To control for a state's security environment, I generate SECURITY. Following Beardsley and Asal, I calculate the average number of crises that a state experiences each year.[91]

Empirical Analysis

I begin by analyzing cross tabulations of nuclear superiority and nuclear crisis outcomes. The results are presented in Table 2, which demonstrates that states are unlikely to achieve victory in nuclear crises. States have achieved a clear victory in only 35 percent of nuclear crises. In the other 65 percent of cases, nuclear crisis participants lost; they were unable to achieve their basic goals and instead experienced compromise, stalemate, or defeat.

TABLE 2. *Cross tabulations of nuclear crisis outcomes, 1945–2001*

		Outcome		
		Win	*Loss*	*Total*
SUPERIORITY	*Yes*	14 (54%)	12 (46%)	26 (100%)
	No	4 (15%)	22 (85%)	26 (100%)
	Total	18 (35%)	34 (65%)	52 (100%)

Note: $X^2 = 8.497$ ($p = 0.004$).

The table also shows, however, that the possession of nuclear superiority greatly improves a state's chances of victory in nuclear crises. States that enjoy nuclear superiority over their opponent have won 54 percent of the nuclear crises in which they have been involved, compared to only 15 percent for countries in a position of nuclear inferiority, and 35 percent for all crises participants. In fact, fourteen of eighteen, or 78 percent, of all nuclear crisis winners possessed nuclear superiority over their opponents. A chi-square test demonstrates that the probability of observing this difference between nuclear superior and nuclear inferior states, if nuclear superiority has no bearing on crisis outcomes, is 0.004. This test permits me to reject the null hypothesis that there is no relationship between nuclear superiority

90. Hassner 2007.
91. Beardsley and Asal 2009.

and nuclear crisis outcomes. In sum, cross tabulations demonstrate that states with larger nuclear arsenals are more likely to win nuclear crises.

While the nuclear crisis participant is the most appropriate unit of analysis for this study, one could focus on the crisis itself to examine how many crises were won by the country in the crisis with the most nuclear weapons. This exercise produces similar results. Of the twenty nuclear crises, 55 percent were won by the country with the most weapons in the crisis, only 20 percent were won by a country that did not have the most warheads, and 35 percent did not produce a clear winner (not shown).[92]

Next, I turn to the results of the regression analysis. I employ probit models to test claims about the correlates of nuclear crisis outcomes.[93] Robust standard errors are adjusted for clustering by crisis dyad to correct for interdependence of observations. Table 3 presents the results. I first explore the hypothesis that states that enjoy nuclear superiority over their opponents are more likely to achieve victory in nuclear crises. Turning to the statistical results, SUPERIORITY is found to be statistically significant and positively correlated with victory in nuclear crises when considered alone (Model 1), when nested within a fully specified model (Model 2), and when included in a trimmed model (Model 3). The analysis reveals a strong empirical link between nuclear superiority and victory in nuclear crises.

Using *Clarify*, I assess the substantive effect of shifting from nuclear inferiority to nuclear superiority on the expected probability of victory in nuclear crises after controlling for other confounding factors.[94] The expected probability of victory in a nuclear crisis for a country in a position of nuclear inferiority is 6 percent.[95] A country that enjoys nuclear superiority by contrast enjoys an expected probability of victory of 64 percent.[96] Therefore, a move from a position of nuclear inferiority to a position of nuclear superiority, holding all other values constant, is associated with a 57 percent increase in the expected probability of victory in a nuclear crisis.[97] Nuclear superiority has a substantively important effect on the outcomes of nuclear crises.

The examination of nuclear superiority and nuclear crisis outcomes is only the first step, however. Next, I present a more fine-grained test of the hypothesis by examining whether increasing levels of nuclear superiority are associated with improved outcomes in nuclear crises.

92. The total exceeds 100 percent because multiple countries can achieve their basic goals in a crisis.

93. King and Zeng recommend using Rare events logistic regression (ReLogit) to correct for problems from small sample size, which they define as sample sizes below 200. King and Zeng 2001, 703. Using ReLogit, instead of probit, produced similar results.

94. See King, Tomz, and Wittenberg 2000; and Tomz, Wittenberg, and King 2003. All substantive interpretations reported here are based on Model 2 of Table 3. All variables were set at their mean.

95. The 95 percent confidence interval is 0.011 to 0.163.

96. The 95 percent confidence interval is 0.374 to 0.847.

97. The 95 percent confidence interval is 0.240 to 0.832.

TABLE 3. *Nuclear superiority and nuclear crisis outcomes, 1945–2001*

Variables	*Model 1*	*Model 2*	*Model 3*	*Model 4*	*Model 5*	*Model 6*
SUPERIORITY	1.117**	2.005**	1.877***			
	(0.413)	(0.676)	(0.459)			
NUCLEAR RATIO				1.294*	4.252***	2.479***
				(0.509)	(1.306)	(0.622)
PROXIMITY		1.666***	1.196***		2.323***	1.283***
		(0.409)	(0.238)		(0.551)	(0.284)
GRAVITY		−0.760			−0.952	
		(0.755)			(0.875)	
REGIME		0.032			0.036	
		(0.038)			(0.033)	
CAPABILITIES		0.451			−1.602	
		(1.667)			(1.713)	
2ND STRIKE		2.296*	0.566		2.328	
		(1.096)	(0.501)		(1.315)	
POPULATION		−9.54e-07			2.52e-07	
		(1.44e-06)			(1.59e-06)	
VIOLENCE		0.299**	0.239*		0.333**	0.205*
		(0.104)	(0.097)		(0.119)	(0.087)
SECURITY		−7.320			−7.611	
		(5.911)			(6.719)	
Constant	−1.020***	−3.159***	−3.025***	−1.091***	−3.883***	−2.786***
	(0.277)	(0.844)	(0.898)	(0.313)	(1.030)	(0.561)
N	52	52	52	52	52	52
Wald chi^2	7.32	303.70	40.28	6.47	797.25	22.88
Log pseudolikelihood	−29.107	−22.663	−24.818	−30.240	−22.572	−26.456
Pseudo R^2	0.1322	0.324	0.260	0.098	0.327	0.211

Note: Robust standard errors adjusted for clustering by crisis dyad in parentheses. *significant at 5%; **significant at 1%; ***significant at 0.1%. All tests are two-tailed.

The results support the claim that greater levels of nuclear superiority are positively associated with victory in nuclear crises. NUCLEAR RATIO is positive and statistically significant when tested alone (Model 4), when nested in a fully specified model (Model 5), and when included in a trimmed model (Model 6). In substantive terms, a shift from the least to the most favorable nuclear balance is associated with an 88 percent increase in the probability of victory.[98] This dramatic effect is obvious in Figure 1, which plots the conditional effects of the nuclear balance on the expected probability that a state will win a nuclear crisis. The extreme left of the figure shows that countries that possess few of the aggregate number of nuclear weapons within a crisis dyad have less than a 5 percent chance of winning a nuclear crisis. Moving to the right, however, the figure shows that an increase in the proportion of nuclear weapons that a state possesses within a crisis dyad results in a corresponding increase in the probability of victory. Indeed, the extreme right of the figure shows that the probability of victory increases to more than 85 percent for states that possess nearly all of the nuclear weapons within a crisis dyad.

Next, I briefly comment on the control variables.[99] I find some support that political stakes shape crisis outcomes. PROXIMITY is positive and statistically significant in every model in which it is included. Consistent with expectation of the previous brinkmanship literature, states are more likely to win nuclear crises that take place nearer to their own territory. On the other hand, GRAVITY does not reach statistical significance in any of the models in which it is included.

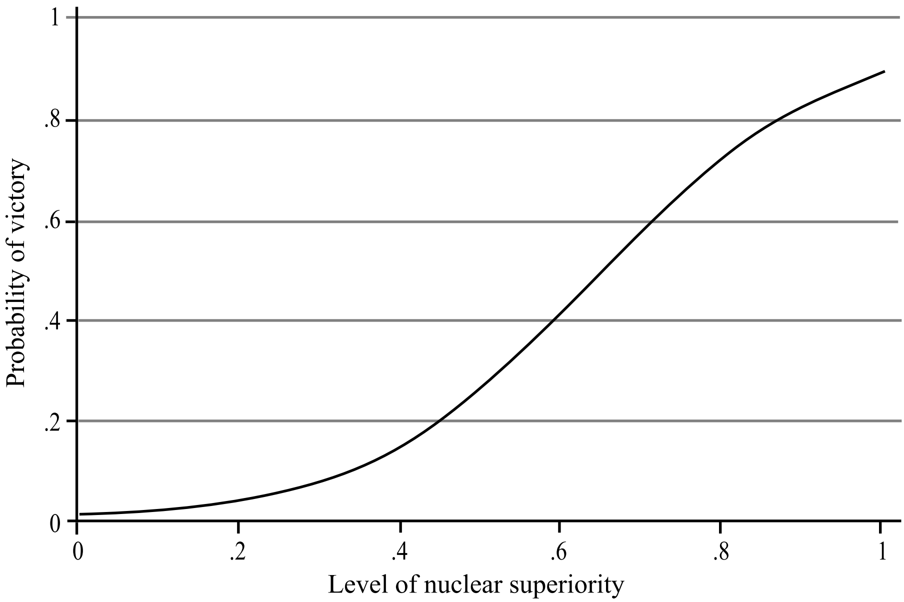
I find no support for the idea that democratic states outperform their autocratic rivals in nuclear crises. REGIME does not reach statistical significance in any of the models in which it is included. While democracies may be more likely to win international crises, the evidence presented here suggests that nuclear crises may operate according to a different logic. Neither does the conventional military balance have an important bearing on crises between nuclear-armed powers. CAPABILITIES is not statistically significant in any of the models in which it is included.

In contrast, a secure, second-strike capability may provide an advantage in a nuclear crisis, even after taking into account the numerical nuclear balance between states. The sign on the coefficient of 2ND STRIKE is positive and statistically significant in Model 2, but does not reach statistical significance in the other models. VIOLENCE is statistically significant and the sign on the coefficient is positive in

98. See King, Tomz, and Wittenberg 2000; and Tomz, Wittenberg, and King 2003. Substantive interpretations reported here are based on Model 5 of Table 3. All variables were set at their mean. The 95 percent confidence interval is 0.485 to 0.996.

99. I also tried a number of other control variables. For example, to examine whether the emergence of a worldwide "nuclear taboo" (Tannenwald 2007) in the early 1960s made it more difficult to threaten nuclear use and, therefore, more difficult to win nuclear crises, I tried a dummy variable that indicated whether a crisis occurred after 1960. I also included variables that counted the number of nuclear-armed actors in a crisis (Asal and Beardsley 2007) and a dummy that gauged whether a superpower was matched against a nonsuperpower opponent. None of these variables reached statistical significance or affected the core results.

every model in which it appears. As expected, the more violent the crisis, the more likely it will be to produce a clear winner.[100] Finally, the other control variables are not statistically significant. Population size and the severity of a state's security environment do not appear to shape the outcomes of nuclear crises.



Note: Estimates obtained from Model 5. Level of nuclear superiority is from lowest (0) to highest (1).

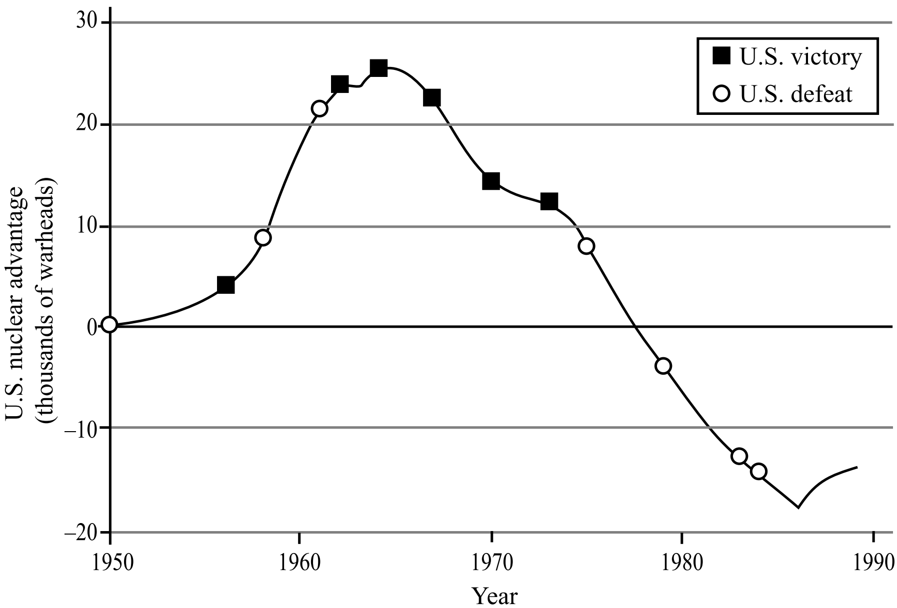
FIGURE 1. *Conditional effect of the degree of nuclear superiority on the probability of victory in nuclear crises, 1945–2001*

Nuclear Crises Between the United States and the Soviet Union, 1949–1989

Next, I analyze the outcomes of the thirteen nuclear crises that transpired between the United States and the Soviet Union during the Cold War. This analysis allows me to assess the effect of changes in the nuclear balance of power on nuclear crisis outcomes within a single dyad over time.

100. Shifting from the lowest to the highest levels of violence increases the probability of victory by 31 percent. Substantive interpretations are based on Model 5 of Table 3. All variables were set at their mean. The 95 percent confidence interval is 0.089 to 0.489.

Figure 2 depicts the size of the U.S. nuclear advantage relative to the Soviet Union, measured in numbers of nuclear warheads over the course of the Cold War period. The figure reveals the shifts in the nuclear balance between the two countries over time. Figure 2 shows that the United States enjoyed nuclear superiority over the Soviet Union at the beginning of the Cold War. The size of this advantage increased until 1964 when Washington possessed 25,530 more nuclear weapons than Moscow. Beginning in the mid-1960s, however, the Soviet Union began cutting into the U.S. margin of strategic superiority. By 1978, the Soviet Union had surpassed the United States in terms of total number of nuclear warheads and maintained this advantage until the end of the Cold War.



Note: The y-axis depicts the U.S. nuclear advantage relative to the Soviet Union measured in numbers of nuclear warheads.

FIGURE 2. *U.S.–Soviet Union nuclear balance and crisis outcomes, 1949–1989*

Figure 2 also displays the Cold War nuclear crises between the superpowers and their outcomes. The figure shows that the United States was more likely to win nuclear crises when it possessed nuclear superiority over the Soviet Union. While Washington enjoyed a nuclear advantage over Moscow, it achieved its basic goals in six out of ten or 60 percent of the nuclear crises in which it was involved. This is much higher than the 35 percent winning percentage experienced by the average nuclear crisis participant.

Moreover, the figure also shows that Washington's success in nuclear crises improved as its level of nuclear superiority over the Soviet Union increased. One can see that when Washington had at least 10,000 more nuclear warheads than Moscow, it won five out of six, or 83 percent, of the crises in which it was involved. Furthermore, the single crisis that the Untied States lost when it possessed a large margin of strategic superiority, the Berlin Wall crisis of 1961, is a conflict that some historians consider to have been a victory for the United States.[101] Arguably, therefore, the United States won 100 percent of nuclear crises when it enjoyed a high level of nuclear superiority over the Soviet Union. In contrast, the U.S. winning percentage was much lower from a position of nuclear inferiority. When the United States possessed fewer warheads than the Soviet Union, it won zero out of three, or 0 percent, of the nuclear crises in which it was involved.

In sum, this evidence suggests that the positive relationship between a nuclear advantage and nuclear crisis outcomes is also evident within a single dyad over time. The United States fared much better in its nuclear crises when it enjoyed a nuclear advantage over the Soviet Union.

Robustness Tests

This section presents the results of a number of robustness tests to examine whether the observed relationship between nuclear superiority and nuclear crisis outcomes is the result of a selection effect, the results are sensitive to modeling decisions because of the intermediate number of nuclear crises, or the findings are dependent on the character of the nuclear balance between the states.[102]

I first examine whether the results are being driven by a selection effect. It is possible that states that enjoy nuclear superiority are more likely to win nuclear crises because nuclear superior states are more likely to initiate crises they expect to win. It is also possible that leaders account for readily observable factors, such as military power, when deciding to initiate a crisis, which could have the effect of neutralizing superiority's effect on crisis outcomes.[103] To test for possible selection effects, I conducted three separate tests. First, I controlled for which state in the dyad initiated the crisis. If nuclear superior states are more likely to win crises because they select into crises they expect to win, one should find that the targets of nuclear crises are less likely to win nuclear crises and that SUPERIORITY is no longer statistically significant after controlling for crisis initiation. Second, I employ a Heckman probit model to examine the determinants of nuclear crisis outcomes conditional on selection into nuclear crises.[104] I begin by estimating a first-stage model of the onset of nuclear crises. The universe of cases is all dyads in which

101. Garthoff 1966, 119.
102. These tests are described in greater detail in Appendix D, available at www.journals.Cambridge.org/ino2013002.
103. Fearon 1994.
104. Heckman 1979.

both states possess nuclear arms from 1945 to 2001. I then estimate a second-stage regression model of nuclear crises outcomes, conditional on selection into nuclear crises. Third, as recommended by some critics of the Heckman model, I incorporated all of the observable factors that may influence selection into a single equation that models the outcome of interest only.[105] In each of these tests, NUCLEAR RATIO was positive and statistically significant even after accounting for selection into nuclear crises.[106] In addition, among the control variables, PROXIMITY, 2ND STRIKE, and VIOLENCE also found some support. In sum, a variety of tests demonstrate that the relationship between nuclear superiority and nuclear crisis outcomes is not the result of a selection effect.

Next, the intermediate number of nuclear crises raises the possibility that the results may be sensitive to coding and modeling decisions. To assess the sensitivity of the findings, I conducted a number of additional tests. First, to examine whether the inclusion or coding of any individual crisis was driving the results, I sequentially removed each crisis from the data set and reestimated the statistical models. Second, to assess whether the results were contingent on the behavior of any particular country, I removed each country in turn from the first position within the directed dyad and reran the analysis.[107] Third, one might argue that crisis participants in a defense pact with a more powerful state should not be included in the data set as separate observations. To address this concern, I removed all of the observations containing Britain and France from the data set and repeated the above statistical tests. In all three sets of tests, the core results were unaltered. SUPERIORITY and NUCLEAR RATIO remained statistically significant and positive in every model. In sum, the core results are not sensitive to the removal of particular crises, or even entire countries from the data set.

One may wonder whether the findings of this analysis extend to dyads between nuclear states and nonnuclear opponents. Nuclear brinkmanship theory is a theory about behavior between nuclear-armed states, so a case universe including nonnuclear states is not an appropriate environment in which to test hypotheses derived from brinkmanship theory. Nevertheless, if nuclear superiority provides a strategic advantage against other nuclear-armed states, then it is reasonable to expect that it might have a similar effect against nonnuclear states. To test this idea, I compiled data on 709 international crisis dyads from 1945 to 2001. Repeating the above tests, SUPERIORITY and NUCLEAR RATIO were positive and statistically significant in every model. Nuclear superiority provides countries with a strategic advantage, not only against other nuclear-armed states, but against nonnuclear weapon states as well.

Finally, I assess whether the findings presented here hold only below a certain threshold of nuclear arsenal size and sophistication. It is possible that nuclear superiority may help states win nuclear crises when one or more of the countries

105. See Puhani 2000; and Simmons and Hopkins 2005.
106. Using SUPERIORITY produced similar results.
107. There are thirty-eight observations that do not contain the United States and thirty-one observations that do not contain the Soviet Union.

involved possess small or unsophisticated arsenals that could be vulnerable to an opponent's first strike. Nuclear superiority may provide less of an advantage, however, once both states possess a secure second-strike capability. To examine this possibility, I conducted a series of tests in which I examined the relationship between nuclear superiority and nuclear crisis outcomes in subsamples of data in which both states in the dyad possessed a secure second-strike capability. In each successive test, I raised the threshold of nuclear capabilities required to be included in the sample. Analyzing these subsamples of data, I find that nuclear superiority is correlated with nuclear crisis outcomes even among states with large and sophisticated nuclear arsenals. In sum, there is no evidence to suggest that the observed relationship between nuclear superiority and nuclear crisis outcomes holds only beneath a certain threshold of nuclear arsenal size and sophistication.

Discussion and Conclusion

This article examined the outcomes of nuclear crises. I found that in order to explain the patterns of victory in crises involving nuclear-armed states, one must look to the nuclear balance between states. States that enjoy nuclear superiority over their opponents are more likely to prevail in nuclear crises. This finding holds even after controlling for the conventional military balance of power and for selection into nuclear crises. The results were also robust to the exclusion of each individual crisis and each individual nuclear weapon state. I derived a new theoretical implication of nuclear brinkmanship theory to account for the observed relationship between nuclear superiority and victory in nuclear crises. I argue that nuclear crises are competitions in risk taking, but that nuclear superior states are willing to run greater risks than their nuclear inferior opponents. Nuclear superiority increases the length of time that a state can remain in a nuclear crisis before the costs of escalation outweigh the costs of submission. A nuclear advantage thus allows states to push harder in a crisis, making them more likely to ultimately prevail. In contrast to previous debates that pitted the balance of resolve against nuclear superiority, I demonstrate that the two factors come together to form a coherent strategic logic. Nuclear superiority aids states in games of nuclear brinkmanship by increasing their levels of effective resolve.

This article also provides some support for the idea that political stakes shape crisis outcomes. States are more likely to win crises that occur nearer to their own territory. In contrast, the gravity of the crisis did not appear to bear on crisis outcomes. Fearon theorized that stakes are important in international politics, but that because states select into crises based on observable interests, stakes might not have much of an effect on the outcomes of the crises that do occur.[108] I found that

108. Fearon 1994.

proximity to the location of the crisis was correlated with crisis outcomes, however, both in tests in which selection was and was not taken into account. This finding is consistent with previous nuclear brinkmanship literature, which maintains that political stakes are an important determinant of victory in nuclear crises. In contrast to the previous brinkmanship literature, however, this article demonstrates that stakes alone do not determine crisis outcomes. Instead, a state's resolve to press a nuclear crisis is a function of both political stakes and the balance of nuclear forces.

In 2005, Schelling won the Nobel Prize in Economics, in part, for his pioneering work on nuclear deterrence theory. For decades, Schelling and other leading scholars argued that nuclear weapons completely and irrevocably altered the nature of international conflict.[109] Unlike in previous eras when larger militaries translated into greater political influence, it was thought that, following the nuclear revolution, the balance of political stakes determined the outcome of disputes. Nuclear superiority was thought to be irrelevant to a state's political influence and its ability to shape international political conflicts to its advantage.[110] The argument and findings of this article demonstrate that conflict in the nuclear age is in some ways very similar to competition in earlier eras; the balance of military power continues to shape the outcome of international political disputes.

On 19 February 2009, the International Atomic Energy Agency assessed that Iran had acquired enough uranium to produce its first nuclear weapon if the uranium were enriched to higher levels.[111] As it appeared increasingly likely that Iran would join the nuclear club, analysts struggled to grasp the meaning of Iran's nuclear ascendancy for U.S. national security. Some claimed that a nuclear Iran would not pose a serious threat because Iran could be deterred from using nuclear weapons.[112] The research of other scholars suggested that whether or not Iran would intentionally use nuclear weapons is irrelevant because nuclear weapons in Iran, even if they were never used, would transform U.S.-Iranian conflicts from traditional military competitions into games of nuclear brinkmanship.[113] According to this line of thought, conventional military power provided Washington with a significant source of leverage in the past, but the United States would be at a distinct disadvantage in nuclear crises against Iran. Given that the most likely conflict scenarios between these two states would occur in the Middle East, the balance of political stakes in future confrontations would tend to favor Tehran. The brinkmanship approach adopted in this article concurs that proliferation in Iran would disadvantage the United States by forcing it to compete with Iran in risk taking, rather than in more traditional arenas. On the other hand, the findings of this article also

109. Schelling 1966, 1–34.
110. See, for example, Jervis 1979–80.
111. Julian Borger, "Iran has Enriched Enough Uranium to Make Bomb, IAEA Says," *The Guardian* (Internet ed.), 19 February 2009.
112. Posen 2006.
113. Powell 2003, 100–6.

suggest that Washington could fare well in future nuclear crises. As long as the United States maintains nuclear superiority over Iran, a prospect that seems highly likely for years to come, Washington will frequently be able to achieve its basic goals in nuclear confrontations with Tehran.

On 8 April 2010, U.S. President Barack Obama and Russian President Dmitri A. Medvedev signed a historic arms control agreement, vowing to reduce the total number of deployed strategic nuclear warheads in each country to 1,550, down from a previous high of 2,200.[114] Proponents celebrated the agreement as a step toward a safer world, while critics argued that the reductions could weaken America's nuclear deterrent. The findings of this article suggest that cuts in the size of the U.S. nuclear arsenal could reduce America's ability to achieve its basic goals in future nuclear crises. This does not necessarily imply, however, that the United States or any other country should pursue nuclear superiority. A nuclear advantage improves a state's prospects for victory only by permitting it to push harder in confrontations with other nuclear-armed states. For this reason, it is necessary to consider the strategic nuclear balance when explaining nuclear crises outcomes. However, states that escalate high-stakes nuclear crises are also more likely to experience accidental nuclear wars. Indeed, nuclear superiority provides a coercive advantage only because there is a real risk that events could spiral out of control and result in catastrophe. The possession of nuclear superiority, therefore, much like a seat on Damocles's throne, promises greater influence only at the risk of grave danger. In addition, nuclear arsenal size might affect many other outcomes including nuclear terrorism, nuclear and conventional arms races, nuclear proliferation decisions in other states, the credibility of security guarantees to allied states, the outcomes of nuclear exchanges, and the probability of nuclear war.[115] It is possible that some of these national security objectives might best be met with smaller nuclear arsenals. When designing a nuclear posture, therefore, policymakers must carefully assess how the composition of nuclear forces might affect a broad range of national security interests.

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114. Michael D. Shear, "Obama, Medvedev Sign Treaty to Reduce Nuclear Weapons," *Washington Post* (Internet ed.), 8 April 2010.

115. On arms races, see, for example, Kydd 2000. On proliferation, see, for example, Kroenig 2010.

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