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ABSTRACT

When crises occur between nuclear-armed states, do relative nuclear capabilities affect the outcome? The literature offers no consensus about nuclear superiority's effect on crisis victory, but this article demonstrates that this effect depends on the size of the disparity between states' nuclear arsenals. Although superiority is correlated with victory in crises between states with similarly sized nuclear arsenals, superiority provides no advantage in asymmetric crises. Because a vastly inferior state risks annihilation in a nuclear conflict, it will acquiesce to an opponent's demands before the crisis occurs, unless backing down implies an existential threat as well. Given an asymmetric crisis has emerged, therefore, the inferior side will be willing to bid up the risk of nuclear war, deterring superior opponents. Using quantitative analyses of crisis data, this article shows that the positive association between nuclear superiority and crisis victory decreases as the disparity between competing states' arsenals increases.

What role do nuclear weapons play in international crisis politics? How does nuclear superiority affect the likelihood that a state achieves its goals in an international crisis? Most scholars argue that having large nuclear arsenals does not especially benefit states in crisis situations. However, others have concluded that, in a crisis, the state with a larger nuclear arsenal than its opponent is more likely to achieve its goal.

In this article, we introduce a new theory about nuclear superiority that offers a different prediction. Our theory accounts for the interaction between nuclear superiority and the size of the disparity between the competing states' arsenals. We argue there is a limit to the potential advantages of nuclear superiority. Specifically, states with superior nuclear arsenals are at a disadvantage during crises against asymmetric nuclear opponents. In such crises, highly inferior nuclear states are better able to demonstrate resolve and therefore are able to deter their superior opponents.

We test this theory using data on crises between nuclear states. We expand on previous work by adding several new cases of nuclear crises. Descriptive analysis demonstrates that as the disparity between crisis

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participants' nuclear arsenal sizes increases, the state with the larger nuclear arsenal becomes less likely to achieve their goals during a crisis. In addition, we use a new measure of nuclear superiority, which takes into account the difference between states' arsenal sizes and which addresses inference challenges faced by previous work using the nuclear ratio. Using this new measure, we show that there are few benefits of nuclear superiority when a state faces a nuclear adversary equipped with a far inferior nuclear arsenal.

Our findings have significant implications for existing thought on nuclear superiority and deterrence. We find that the benefits of nuclear superiority come with significant limits, contrasting with the conclusions of scholars and policymakers alike who have argued for the importance of possessing greater nuclear capabilities than one's adversaries. In addition, we show that small nuclear arsenals still have significant deterrent power. However, we also find that when adversaries' nuclear arsenals are similarly sized, crises are less likely to involve high-stakes issues. That is, superiority can enable general deterrence, but states with small arsenals may have superior capabilities when it comes to immediate deterrence.

The debate over the importance of nuclear superiority has significant implications for the future of nuclear policy. If states only need small, survivable arsenals, as some scholars have suggested, then nuclear policy ought to be oriented toward arms control, including reductions in arsenal size. However, if nuclear superiority provides states with meaningful strategic advantages, then disarmament would have serious strategic drawbacks. Our findings offer nuance by suggesting the disparity between states' arsenal sizes influences the effect of superiority. Moreover, we address a critical puzzle: When superior nuclear powers face crises with significantly inferior adversaries, they often cannot accomplish their objectives, despite obvious military and material advantages. Our theory suggests this occurs because superiority is not especially beneficial at high levels of arsenal disparity, due to the emergence of high-stakes crises in asymmetric dyads but not symmetric ones.

Does Nuclear Superiority Matter?

Scholars have long been skeptical about the benefits of nuclear superiority. In 1987, Glenn H. Snyder and Paul Diesing argued that even states with small nuclear arsenals should be able to successfully threaten superior opponents, since the costs of nuclear war for any state, regardless of nuclear capability, would be massive.[1] In 1945, Bernard Brodie wrote that

[1]Glenn H. Snyder and Paul Diesing, *Conflict among Nations: Bargaining, Decision Making, and System Structure in International Crises* (Princeton, NJ: Princeton University Press, 2015 [1977]), 183–280.

"it would make little difference if one power had more bombs and were better prepared to resist them than the opponent," as any nuclear war would be so destructive to both sides.[2] An important implication is articulated in *The Illogic of American Nuclear Strategy*, an influential work where Robert Jervis argues that, though second-strike capabilities were essential to deterrence, capabilities much beyond this point held little practical utility.[3] Jervis explains: "It does not matter which side has more nuclear weapons … Deterrence comes from having enough weapons to destroy the other's cities; this capability is an absolute, not a relative one."[4] In a world where nuclear war would be all-out, completely devastating, and irreversible, nuclear superiority ought not to matter.

Scholars and politicians have disputed the idea that nuclear wars can be won. President Ronald Reagan stated that "a nuclear war cannot be won and must never be fought."[5] Similarly, by the end of his presidency, Harry Truman believed that "starting an atomic war [would be] totally unthinkable for rational men.[6] In 1982, McGeorge Bundy, George F. Kennan, Robert S. McNamara, and Gerard Smith famously wrote: "Any use of nuclear weapons … carries with it a high and inescapable risk of escalation into the general nuclear war which would bring ruin to all and victory to none."[7] If this is correct, then even nuclear superiority cannot allow states to meaningfully win a nuclear war. In turn, superior states should have few advantages over their inferior opponents, so long as those inferior opponents can credibly demonstrate that they are willing to risk nuclear escalation.

More recent academic literature echoes this argument. Barry M. Blechman and Robert Powell argue nuclear superiority is not useful once a nuclear country has a second-strike capability.[8] According to Todd S. Sechser and Matthew Fuhrmann, "nuclear weapons are uniquely poor instruments of compellence," meaning nuclear states do not have an advantage over non-nuclear ones in an effort to compel opponents to make concessions or

[2]Bernard Brodie, "The Atomic Bomb and American Security," *Yale Institute of International Studies Memorandum*, no. 18 (1945): 12.

[3]Robert Jervis, *The Illogic of American Nuclear Strategy* (Ithaca, NY: Cornell University Press, 1984).

[4]Robert Jervis, "Why Nuclear Superiority Doesn't Matter," *Political Science Quarterly* 94, no. 4 (Winter 1979–80): 618.

[5]Daniel Deudney and G. John Ikenberry, "Who Won the Cold War?" *Foreign Policy*, no. 87 (Summer 1992): 123–38.

[6]Gregory F. Treverton, review of *Danger and Survival: Choices about the Bomb in the First Fifty Years*, by McGeorge Bundy, *Foreign Affairs* 68, no. 2 (Spring 1989): 178.

[7]McGeorge Bundy et al., "Nuclear Weapons and the Atlantic Alliance," *Foreign Affairs* 60, no. 4 (Spring 1982): 753.

[8]Barry M. Blechman and Robert Powell conceptualize a second-strike capability as a "robust" nuclear arsenal that is "capable of withstanding an attack and retaliating with devastating effect." Blechman and Powell, "What in the Name of God Is Strategic Superiority?" *Political Science Quarterly* 97, no. 4 (Winter 1982–83): 590.

act in certain ways.[9] Charles L. Glaser also concludes that superiority ought not to affect crisis outcomes, writing that the case for nuclear superiority "is weak, proponents have done little to support their claims, and efforts to fill in the logical gaps in their arguments encounter overwhelming difficulties."[10] Studying crises from 1900 to 1980, Paul Huth and Bruce Russett determine that "a quest for strategic nuclear superiority is unlikely to be the most effective means for providing security to America's friends and allies in a crisis, or to America itself."[11]

Yet policymakers still invest in "overkill" capabilities and seemingly believe in the importance of nuclear superiority.[12] Many policymakers have, for example, attributed American success in the Cuban Missile Crisis to nuclear superiority over the USSR.[13] Similarly, strategists argued the United States should fear Soviet nuclear superiority, as it could threaten the US ability to make credible threats.[14] David S. McDonough has covered the history of US nuclear strategists' interest in strategic superiority.[15] Kier A. Lieber and Daryl G. Press explain that, throughout the Cold War, "both superpowers were well aware of the benefits of nuclear primacy, and neither was willing to risk falling behind."[16] This logic suggests nuclear superiority lowers a state's expected costs should nuclear war break out. Therefore, a superior state can demonstrate stronger resolve, providing a crisis advantage over states with more to lose. Bryan R. Early and Victor Asal make a similar argument, explaining that when superior states can levy existential threats against states with "significant existential vulnerability," then superior states' "nuclear deterrence policies should work."[17]

[9]Todd S. Sechser and Matthew Fuhrmann, "Crisis Bargaining and Nuclear Blackmail," *International Organization* 67, no. 1 (Winter 2013): 173.

[10]Charles L. Glaser, *Analyzing Strategic Nuclear Policy* (Princeton, NJ: Princeton University Press, 2014 [1990]), 39.

[11]Paul Huth and Bruce Russett, "What Makes Deterrence Work? Cases from 1900 to 1980," *World Politics* 36, no. 4 (July 1984): 524.

[12]David Alan Rosenberg puzzles over nuclear "overkill," or the ability to destroy much more than necessary for the purposes of nuclear deterrence. Rosenberg, "The Origins of Overkill: Nuclear Weapons and American Strategy, 1945–1960," *International Security* 7, no. 4 (Spring 1983): 3–71. Although the crisis literature does not offer an explanation, other scholars have addressed overkill by focusing on the deterrent value of nuclear weapons and other strategic advantages. See: Keir A. Lieber and Daryl G. Press, *The Myth of the Nuclear Revolution: Power Politics in the Atomic Age* (Ithaca, NY: Cornell University Press, 2020); Brendan Rittenhouse Green, *The Revolution That Failed: Nuclear Competition, Arms Control, and the Cold War* (Cambridge: Cambridge University Press, 2020).

[13]Marc Trachtenberg, "The Influence of Nuclear Weapons in the Cuban Missile Crisis," *International Security* 10, no. 1 (Summer 1985): 137–63; Richard K. Betts, *Nuclear Blackmail and Nuclear Balance* (Washington, DC: Brookings Institution Press, 1987).

[14]Karl Kaiser et al., "Nuclear Weapons and the Preservation of Peace: A Response to an American Proposal for Renouncing the First Use of Nuclear Weapons," *Foreign Affairs* 60, no. 5 (Summer 1982): 1157–70.

[15]David S. McDonough, *Nuclear Superiority: The "New Triad" and the Evolution of Nuclear Strategy*, Adelphi Paper 383 (New York: Routledge, 2013).

[16]Keir A. Lieber and Daryl G. Press, "The Rise of U.S. Nuclear Primacy," *Foreign Affairs* 85, no. 2 (March–April 2006): 45.

[17]Bryan R. Early and Victor Asal, "Nuclear Weapons and Existential Threats: Insights from a Comparative Analysis of Nuclear-Armed States," *Comparative Strategy* 33, no. 4 (2014): 316.

Early and Asal explain that the inability to impose reciprocal existential threats makes inferior states vulnerable.

Using a quantitative approach, Matthew Kroenig has linked nuclear superiority and political victory during crises.[18] Kroenig argues that nuclear superiority provides states with significant strategic advantages. Because a superior state would win a nuclear war against an inferior opponent, a superior state can more credibly threaten nuclear escalation.[19] As a result, we might expect that the greater a state's nuclear superiority over its opponent, the larger an advantage the state has in competitions of brinkmanship.

Mark S. Bell and Julia Macdonald offer an alternative pathway toward the same conclusion by suggesting there may be far greater incentives for counterforce operations by the superior state and "use them or lose them" pressures for the inferior state in asymmetric circumstances.[20] This reality, in turn, could increase the likelihood of a nuclear exchange in asymmetric crises relative to symmetric ones and thereby increase the utility of nuclear superiority in asymmetric cases. This is because superiority becomes more valuable as the likelihood of a nuclear exchange increases; the utility of superiority is related to damage limitation in a nuclear war through the ability to minimize an opponent's retaliatory capabilities.

More work is needed to reconcile the current literature's disparate conclusions. This article attempts to adjudicate between those arguing that nuclear superiority provides essential strategic benefits during political crises and those who, to the contrary, suggest nuclear superiority provides few benefits at all.

A key challenge with existing approaches in the literature is that they often treat superiority as a binary condition—a state either has greater nuclear capabilities than its opponent or it does not. A state achieves functional superiority through a combination of many factors, including the number and yield of its nuclear weapons and its delivery capabilities, posture, targeting, and other elements that are critical to a nuclear arsenal's functionality. Even with this multifaceted definition of superiority, though, scholars still often think of superiority as a binary determination of which state would "win" a nuclear war. In quantitative work, this simplification of superiority is often even more explicit, with superiority defined as when

[18]Matthew Kroenig, *The Logic of American Nuclear Strategy: Why Strategic Superiority Matters* (New York: Oxford University Press, 2018); Matthew Kroenig, "Nuclear Superiority and the Balance of Resolve: Explaining Nuclear Crisis Outcomes," *International Organization* 67, no. 1 (Winter 2013): 141–71.

[19]Sechser and Fuhrmann have questioned Kroenig's empirical results, showing that nuclear superiority provides no advantage to states that make compellent threats against their adversaries and highlighting methodological concerns with Kroenig's approach. Matthew Fuhrmann and Todd S. Sechser, "Debating the Benefits of Nuclear Superiority for Crisis Bargaining, Part II," *Duck of Minerva*, 25 March 2013, https://duckofminerva.com/2013/03/debating-the-benefits-of-nuclear-superiority-for-crisis-bargaining-part-ii.html.

[20]Mark S. Bell and Julia Macdonald, "How to Think about Nuclear Crises," *Texas National Security Review* 2, no. 2 (February 2019): 41–64.

a state simply has more nuclear weapons than its opponent. This simplification is especially problematic, as it misses many of the aforementioned crucial components of nuclear capabilities.

Any such binary approach misses critical nuance. The size of the difference between competing states' nuclear capabilities is also essential to understanding the effects of nuclear superiority.[21] Superiority ought to operate differently in crises at "parity," in which states have similar nuclear capabilities, than in asymmetric cases, in which one state's nuclear arsenal is vastly larger and more sophisticated than that of its opponent.

Work on nuclear superiority also does not adequately consider the endogeneity of crisis stakes to the balance of power between the players in that crisis. That is, whether a crisis is going to occur over core or peripheral issues is determined by whether the players in question have similar or vastly different nuclear capabilities; by not considering these two types of dyads separately, more binary approaches to conceptualizing superiority cannot explore this insight. We argue that failing to recognize how the disparity between states' nuclear capabilities influences the stakes of crises minimizes the crucial function of resolve in brinkmanship. In the following section, we propose a new theory that considers how nuclear superiority operates differently in symmetric and asymmetric crises.

Deterrence Determined by Arsenal Disparity

The magnitude of the disparity between two states' nuclear arsenals influences the effect of nuclear superiority when the states compete in a crisis. Pro-superiority scholars would argue the positive effects of superiority should increase as the disparity between arsenals increases, precisely because a larger superiority advantage should provide states a more reliable guarantee of victory in a nuclear exchange. Work by Jervis and others instead suggests that, since even small nuclear arsenals can successfully deter, nuclear superiority generally should not provide an advantage regardless of the disparity between arsenals. In contrast to both approaches, we argue that nuclear superiority poses a unique disadvantage when states

[21]Incorporating the size of the difference between competing arsenals negates the need to assess many of the components of functional superiority because, with very large disparities, even elements such as strategy, intelligence, platform diversity, etc. would not be able to compensate for the size difference. In addition, characterizing asymmetric crises based only on the magnitude of numerical disparity provides a hard test of our argument. When one state has, for example, more than fifty times the nuclear weapons of its opponent, differences in delivery capabilities, posture, and other factors are unlikely to change which player would suffer fewer costs in nuclear war. In contrast, these factors may matter when states have similarly sized nuclear arsenals. One side's nuclear capabilities or posture could outweigh its opponent's slight numerical advantage. Therefore, if nuclear superiority matters at all, but numerical superiority does not accurately measure this concept in symmetric cases, then numerical disparities should only be correlated with victory in highly asymmetric crises. Our theory predicts the opposite, however. We argue nuclear superiority does not matter in asymmetric crises but may provide an advantage in symmetric ones. The use of our superiority measure therefore strongly biases against our hypothesis.

face far inferior opponents but may provide some benefits when crises occur between states with nuclear parity. Below, we outline our expectations for the role of superiority in symmetric, and then asymmetric, crises.

Symmetric Crises

We are largely agnostic about whether superiority provides an advantage when there is a small disparity in the size of states' nuclear arsenals. States with similar nuclear arsenals will likely be able to deter each other from making significant incursions against their respective sovereignty. Yet smaller crises may still emerge.[22] Due to these crises' low stakes, neither side should be able to very credibly threaten nuclear escalation; thus nuclear superiority should be largely irrelevant, but it may have some marginal effect in increasing the risk tolerance of superior states.

That is, a conflict's stakes are endogenous to the players' nuclear balance of power, such that crises between states with similarly sized nuclear arsenals should generally occur over low-stakes issues. The proposition that the stakes of a crisis may be able to moderate the effects of nuclear superiority is certainly not new. The side facing a graver threat has been theorized to be more likely to prevail.[23] In our analysis, we consider crises to involve "high stakes" for the inferior state if the crisis threatens the inferior state's political leadership, threatens its territorial boundaries, or threatens grave or existential damage to the state overall.

The literature to date, however, has found little empirical evidence that stakes play a role in crisis outcomes. Kroenig, for example, finds no evidence that the threat level of a nuclear crisis affects the outcome.[24] Kroenig does show that proximity to the crisis location is associated with a higher chance of victory, but he finds no evidence that the effect of nuclear superiority is conditional on proximity. Sechser and Fuhrmann, using the Militarized Compellent Threat (MCT) dataset, account for whether a threat is made over leadership or territory in contrast to lower-stakes issues such as economic policy. They find no evidence that the balance of stakes influences outcomes.[25]

[22]On the stability-instability paradox, see: Mark S. Bell and Nicholas L. Miller, "Questioning the Effect of Nuclear Weapons on Conflict," *Journal of Conflict Resolution* 59, no. 1 (February 2015): 74–92; Michael Krepon, "The Stability-Instability Paradox, Misperception, and Escalation Control in South Asia," in *Prospects for Peace in South Asia*, ed. Rafiq Dossani and Henry S. Rowen (Stanford, CA: Stanford University Press, 2005), 261–79; Glenn H. Snyder, "The Balance of Power and the Balance of Terror," in *The Balance of Power*, ed. Paul Seabury (San Francisco: Chandler, 1965), 184–201. Kenneth N. Waltz also recognizes the stability-instability paradox: Waltz, *Man, the State, and War: A Theoretical Analysis*, anniversary ed. (New York: Columbia University Press, 2001), 236.

[23]Kroenig, "Nuclear Superiority and the Balance of Resolve," 145.

[24]Kroenig, "Nuclear Superiority and the Balance of Resolve"; Kroenig, *Logic of American Nuclear Strategy*.

[25]Sechser and Fuhrmann, "Crisis Bargaining and Nuclear Blackmail."

In this previous work, however, "grave threats" are conceptualized as exogenous to the nuclear balance, but comparative capabilities are, in fact, an essential element of the threat states face. Therefore, nuclear superiority shapes the stakes of a crisis; the stakes will be low in symmetric crises and high in asymmetric ones. High stakes facilitate demonstrations of resolve that can deter superior opponents. This theory has an important observable implication: states with superior nuclear arsenals should be unlikely to win crises—and vastly inferior states should be very unlikely to lose crises—when the nuclear arsenal size disparity is large.

The literature on nuclear parity suggests comparably sized nuclear arsenals encourage peace because both states can inflict significant damage on the other.[26] Thus, only crises over lower-stakes issues will emerge between nuclear states at parity (that is, states at parity are able to impose general deterrence on each other). This insight underlies the "cold" nature of the Cold War—rather than directly threaten each others' territory or sovereignty, the United States and Soviet Union fought distant conflicts through proxies. In symmetric crises, because nuclear use carries very high costs for both sides, they both have incentives to avoid escalation. Indeed, this is the crux of the argument for why nuclear weapons compel states to caution.

Does nuclear superiority matter during low-stakes, symmetric crises? Here we are largely agnostic. Our theory suggests neither state should be able to very credibly threaten nuclear escalation. As a result, nuclear superiority should largely be irrelevant. However, even if nuclear superiority is not a focus in these crises, it could remain a background factor affecting states' risk tolerance. There may also be rare symmetric crises where, for idiosyncratic reasons, states believe that their adversary could escalate to the nuclear level, even if the crisis is not over a core interest. After all, the "madman" theory of deterrence is designed to produce just this perception.

Even if nuclear superiority could theoretically provide an advantage in symmetric crises, this argument is difficult to test because of challenges associated with operationalizing nuclear superiority. For states with similarly sized nuclear arsenals, a handful of additional weapons does not necessarily indicate functional superiority. Measuring superiority in this way would require case-by-case assessments of states' delivery capabilities, platform diversity, second-strike capabilities, missile defense, counterforce capabilities, intelligence, targeting policies, nuclear postures, geographical size, population size, and more elements.[27] Many of these factors are

[26]Jacek Kugler and Frank C. Zagare, "The Long-Term Stability of Deterrence," *International Interactions* 15, nos. 3/4 (1990): 255–78; McDonough, *Nuclear Superiority*.

[27]Although Early and Asal use many of these factors to estimate the threat nuclear states posed to each other, they do not code this index in a panel format. Rather, they measure the index for all

classified and difficult to estimate. This also means measuring superiority requires not only knowing states' actual capabilities but also knowing what each state estimates for its opponents. Moreover, to the extent nuclear superiority may matter in a crisis, it is most likely because states believe their opponent would be willing to use their nuclear arsenal, even over a relatively nonessential issue. This belief requires subjective measurements about the reputations and leaders of nuclear states. These factors vary between states, years, and crises, making accurate, systematic measurement difficult. Thus we focus primarily on the role of superiority in asymmetric crises.

Asymmetric Crises

Whereas many scholars would argue the effect of superiority should increase as the disparity between arsenals increases, we argue it actually disappears entirely, precisely because of the endogeneity of stakes to the nuclear balance of power. Vastly inferior states likely face existential consequences from backing down during a crisis; otherwise, they would have acquiesced to their superior opponent's demands. Vastly inferior states cannot threaten a superior opponent's core interests militarily, so the superior side likely does not face existential risks from backing down during a crisis. Because states should be unwilling to use nuclear weapons over a noncritical issue, the superior side will be risk averse in an asymmetric crisis. This dynamic suggests vastly inferior states will be more willing to escalate, demonstrating sufficient resolve to prevent superior opponents from achieving their goals.

We therefore argue that nuclear superiority matters in asymmetric crises—but not as scholars have traditionally thought. Instead, the superior state's nuclear capabilities in an asymmetric crisis allow it to severely threaten the core interests of its inferior competitor in a way it could not against a symmetric opponent. In turn, the inferior state must demonstrate a very high level of resolve, and this demonstration is only credible because the superior state knows the inferior one cannot back down. That is, because the balance of power shapes the stakes of a crisis, superiority should be less useful when the superior state is much more powerful than its opponent compared to when it has only a marginal degree of superiority.

nuclear-armed states at the point in time when they wrote their article. We have information for some aspects of the index, such as ballistic missile capacity, in our data. Other aspects of their Nuclear Annihilation Threat (NAT) index, however, such as *Foreign Policy*'s Failed States Index or data from Thomas Brinkhoff on urban agglomeration over 1 million, are not available going back to the early 1950s. Replicating these measures for all years in our data is therefore not within the scope of this article. Moreover, the use of numerical superiority biases against our hypothesis. Thus, we do not use the NAT index as a way of measuring superiority here. See: Early and Asal, "Nuclear Weapons and Existential Threats"; Thomas Brinkhoff, "Major Agglomerations of the World," accessed on 16 August 2011, https://citypopulation.de/en/world/agglomerations/.

An inferior state's ability to demonstrate resolve is different when states' nuclear arsenals are of vastly different sizes. In such cases, the inferior side likely faces an existential risk from escalating or backing down. This regularity follows from James D. Fearon's work, which concludes that high-capability defenders are likely to be challenged on low-stakes issues, whereas low-capability defenders are likely to be challenged on high-stakes issues.[28] Perhaps counterintuitively, an inferior state in an asymmetric dyad is therefore likely to respond to a crisis with demonstrations of resolve that can effectively deter a superior opponent. The implications of this observation have largely been missed in the current literature on nuclear superiority.

Consider a state facing a potential crisis against a vastly superior nuclear adversary with only a very small negative consequence associated with conceding to the superior power's demands. In such a situation, an actual crisis should not emerge, since the vastly inferior state should anticipate the existential consequences of noncompliance. However, this situation will be rare. High levels of disparity in the balance of power mean that the stakes for the vastly inferior state are often very high—such as having its territory or sovereignty threatened by inaction. In this case, the weaker state may be willing to resist its opponent and risk nuclear escalation. Thus superiority affects selection into crises and also determines their stakes. In this way, our theory helps explain why high-level crises frequently emerge in asymmetric situations.

Given that a crisis occurs, even having a vastly inferior arsenal means the inferior state possesses nuclear weapons and can therefore credibly threaten to inflict significant damage. If the vastly inferior state were nonnuclear, the costs of escalation to the superior state may not be high enough for this strategy to work. As a result, the theory does not necessarily apply to nonnuclear states.[29] In a nuclear dyad, however, a vastly inferior state can impose significant costs if escalation occurs—even if it cannot impose reciprocally severe costs.

Because the risk of nuclear conflict is only worthwhile for a vastly inferior state if the payoff of successful deterrence is significant, asymmetric crises should typically involve existential stakes for the inferior side. Yet the payoff of successful deterrence will often be high because vastly inferior states have little that they can lose before their vastly superior opponents can exert too much pressure on them. Given these high stakes, the vastly inferior state should take risks rather than make concessions. Simply

[28]James D. Fearon, "Signaling versus the Balance of Power and Interests: An Empirical Test of a Crisis Bargaining Model," *Journal of Conflict Resolution* 38, no. 2 (June 1994): 236–69.

[29]We also apply our method to crises between nuclear and nonnuclear states; see Online Appendix I. We find that nuclear powers do not have a strong advantage over nonnuclear opponents. Nuclear states fail to achieve their goals in crises with nonnuclear states 56% of the time.

put, states fighting for their continued existence will accept a higher risk of nuclear war than states fighting over low-stakes issues.

In this way, an inferior nuclear state facing an existential threat can demonstrate sufficient resolve to deter a superior opponent. Vastly inferior states, therefore, can prevent opponents from winning crises, even if they cannot necessarily compel superior opponents. Because asymmetric crises are unlikely to emerge unless the core interests of the vastly inferior state are threatened, superiority should not provide an advantage when the arsenal disparity between competing states is large. This leads to our hypothesis that vastly superior states will fail to achieve victory in crises with vastly inferior states.

Although there is usually an imbalance of stakes in asymmetric crises, there may be some cases in which the vastly superior state also has high stakes. In these cases, the vastly superior state should be less willing to back down in response to the vastly inferior state's credible threat to inflict significant damage. These cases are rare because there are few issues that truly threaten superior states' integrity. However, in cases where the superior state does have high stakes—such as the Cuban Missile Crisis, where the threat to the United States was close, immediate, and existential—backing down to the nuclear threat from the inferior Soviet arsenal was not a viable option for United States. In these rare cases, nuclear superiority may once again play an influential role in crisis outcomes.

Empirical Analysis

We provide evidence for our theory in two stages. First, we provide descriptive statistics on crises in the International Crisis Behavior (ICB) dataset, showing superiority does not lead to victory at high levels of arsenal disparity. Second, we use statistical tests to show superiority is counterproductive in asymmetric crises. In these crises, inferior states are able to prevent superior opponents from achieving their goals.

The Nuclear Balance and Crisis Outcomes

We must both assess the impact of nuclear superiority at high levels of disparity and investigate whether inferior states face high stakes. We test our theory using nuclear crisis data from the ICB dataset, which includes 24 unique crises involving 9 unique nuclear-armed states. Note that the dyadic structure of the ICB data presents a limitation, since crises often involve more than 2 states. In Online Appendix D, we collapse all dyads in which allied states shared similar goals in a crisis against a joint adversary; our findings are robust to this specification.

Table 1. Vastly inferior states have high stakes in their crises and prevent superior states from achieving victory.

Crisis Dyad (Superior vs. Inferior)	Nuclear Ratio	Inferior Stakes	Outcome
Afghanistan Invasion (USSR vs. US)	1.1	Low (Influence)	Superior Victory
Kaluchak (Pakistan vs. India)	1.1	High (Grave Damage)	No Victory
War in Angola (US vs. USSR)	1.4	Low (Influence)	Inferior Victory
Able Archer Exercise (USSR vs. US)	1.5	Low (Limited Military Threat)	No Victory
Nicaragua MIG-21S (USSR vs. US)	1.6	Low (Influence)	No Victory
Yom Kippur War (US vs. USSR)	1.8	Low (Influence)	Superior Victory
India Parliament Attack (India vs. Pakistan)	2.0	High (Political)	Superior Victory
Cienfuegos Submarine Base (US vs. USSR)	2.2	Low (Limited Military Threat)	Superior Victory
Kargil (India vs. Pakistan)	2.6	Low (Limited Military Threat)	Superior Victory
India/Pakistan Nuclear Tests (India vs. Pakistan)	3.3	Low (Influence)	No Victory
Kashmir 1990 (India vs. Pakistan)	3.4	High (Existential)	No Victory
Six-Day War (US vs. USSR)	3.7	Low (Influence)	Superior Victory
Congo II (US vs. USSR)	5.9	Low (Influence)	Superior Victory
Cuban Missile Crisis (US vs. USSR)	8.2	High (Grave Damage)	Superior Victory
Berlin Wall (US vs. USSR)	9.8	Low (Influence)	Inferior Victory
Suez Nationalization (US vs. USSR)	10.8	Low (Influence)	Superior Victory
Berlin Deadline (US vs. USSR)	11.3	High (Grave Damage)	No Victory
Taiwan Straits (US vs. China)	27.4	High (Political)	Superior Victory
Suez Nationalization (USSR vs. UK)	28.4	High (Grave Damage; Territory)	Superior Victory
Berlin Deadline (USSR vs. UK)	39.5	Low (Grave Damage)	No Victory
Berlin Wall (USSR vs. UK)	49.4	Low (Influence)	Superior Victory
Korean War (US vs. USSR)	73.8	High (Territory)	Inferior Victory
Sino-Soviet Border (USSR vs. China)	210.8	High (Territory; Political)	No Victory
North Korea Satellite Launch (US vs. North Korea)	511.3	High (Political)	No Victory
North Korea Nuclear 2006 (US vs. North Korea)	758.3	High (Political)	No Victory
Yom Kippur War (USSR vs. Israel)	1224.2	High (Grave Damage)	No Victory
War of Attrition (USSR vs. Israel)	1455.4	High (Grave Damage)	No Victory
Six-Day War (USSR vs. Israel)	4169.5	High (Existential)	Inferior Victory
Berlin Wall (USSR vs. France)	∞	Low (Influence)	Superior Victory

Every nuclear state except South Africa appears in our dataset. South Africa is omitted only because, according to the ICB data, it does not experience any crises with other nuclear states during the years in which it possesses nuclear weapons. Data on the approximate sizes of states' nuclear arsenals are from Hans M. Kristensen and Robert S. Norris.[30] The ICB data codes a victory if a state achieves its goals; since not all goals are mutually exclusive, crises can have multiple or no winners. We categorize data according to the level of arsenal disparity within a dyad.

Table 1 depicts all crises in our dataset. The first column presents the crisis dyad, with the superior state listed first. The second column records the ratio between the nuclear arsenals of the states. The third column presents an approximation of the stakes experienced by the inferior state in the dyad. We use two datasets for this coding. The first is the ICB

[30]Hans M. Kristensen and Robert S. Norris, "Global Nuclear Weapons Inventories, 1945–2013," *Bulletin of Atomic Scientists* 69, no. 5 (2015): 75–81.

dataset, which codes crises in terms of their gravity. We code threats that are political, territorial, threats of grave damage, and threats to existence as high stakes. We consider threats to influence, economic threats, and limited military threats as low-stakes issues.[31] We also use the MCT dataset, which contains a subset of the ICB cases where compellence was used.[32] The MCT dataset notes whether the compellent threat at the core of the crisis was about a political or territorial issue, which we consider high stakes, or whether the crisis was about lower-stakes issues. The table also lists crisis outcomes.[33]

As our theory predicts, asymmetrically inferior states often have high stakes and prevent their superior opponents from achieving victory. If we consider asymmetric superiority to require an arsenal fifty times larger than the inferior state, then every time an inferior state in an asymmetric crisis dyad had high stakes, the superior state failed to achieve its goals. Moreover, the inferior state had high stakes in all but one asymmetric crisis.[34]

We find that asymmetrically inferior states are more likely to win a crisis than asymmetrically superior states. Asymmetrically superior states are more likely to lose than to win. They typically end up in stalemates, draws, and compromises. Nuclear superiority appears to provide no advantage as the degree of superiority gets very large. We find that states with asymmetric nuclear superiority over their opponents fail to achieve their crisis objectives more often than they accomplish them.

[31]It is important to note that the ICB dataset does not code the gravity variable in an ordinal manner. However, we coded each of the threats that the dataset identified in the gravity variable as either "high stakes" or "low stakes" based on our own understanding of the likely consequences of each type of threat for a state's security.

[32]Todd S. Sechser, "Replication Data for: Militarized Compellent Threats, 1918–2001," ver. 3, 2011, https://doi.org/10.7910/DVN/VDJQ1E.

[33]All outcomes are determined by the ICB dataset, except when there is no ICB outcome coding, in which case we follow Kroenig for comparability with the literature. ICB has no US outcome coding for Taiwan Straits IV. We code a US victory for this case, following Kroenig. ICB also has no US outcome coding for Able Archer or USSR outcome coding for Cienfuegos or Nicaragua MiGs-21S. In these cases, Kroenig codes each actor as "not achieving its goals," as do we. Note that ICB codes the Korean War as an inferior victory, and we follow this convention, although Kroenig recodes this case as a stalemate. See Kroenig, "Nuclear Superiority and the Balance of Resolve."

[34]Complications with the Berlin Wall Crisis explain this anomaly. First, the data includes only crises between nuclear-armed states, and although France had conducted its first nuclear test by 1961, it had no weapons in its nuclear arsenal when the crisis occurred. Whether France counts as a nuclear power at this time is therefore debatable; in Online Appendix C, we perform our quantitative analyses after dropping the USSR-France dyad from the Berlin Crisis, which does not change our main findings. Second, the crisis occurs because of a Soviet demand for the United States and its allies to withdraw from West Berlin. Though the Soviet Union may have had nuclear superiority over France on its own, the French decision to remain in West Berlin was made in coordination with the other powers occupying Berlin. At the time of the crisis, the United States had nearly ten times as many nuclear weapons as the Soviet Union. Third, while the crisis is coded as a victory for the Soviet Union, it may more properly be considered a stalemate. The resolution of the crisis occurred when the Soviet Union erected the Berlin Wall. See Vladislav M. Zubok, "Khrushchev and the Berlin Crisis (1958–1962)" (Cold War International History Project Working Paper no. 6, Woodrow Wilson International Center for Scholars, 1993), 22–27. Successful coercion would have resulted in a French withdrawal, as the Soviets had originally demanded. For a detailed history of the crisis, see Jack M. Schick, *The Berlin Crisis, 1958–1962* (Philadelphia: University of Pennsylvania Press, 1971).

This contradicts both the predictions of scholars who argue nuclear superiority provides strategic advantages—as they would expect superiority to be more helpful as the disparity in arsenal sizes increases[35]—and the predictions of those who argue nuclear superiority is insignificant[36]—as they would not expect nuclear superiority to have a positive correlation with victory in crises at low levels of arsenal size disparity. The findings also directly contradict Bell and Macdonald,[37] who anticipate superiority to provide more of an advantage in asymmetric crises than symmetric crises.[38] Instead, we find asymmetrically inferior states are able to deter opponents in high-stakes crises.

If we relax our conception of asymmetry to require only a nuclear ratio of 30:1, we still find that asymmetrically inferior states with high stakes successfully prevent a superior victory in all cases, and we find that inferior states have high stakes in three-fourths of crises. In addition, when asymmetrically inferior states have low stakes, their crisis involvement can be explained by alliances. We can further relax our definition of asymmetry to require a much smaller nuclear ratio, such as 5:1, 3:1, or 2:1, and we still find that in at least half of all cases, the inferior state has high stakes, and the superior state does not succeed.[39]

Our argument also has implications for the frequency of asymmetric and symmetric crises. Because asymmetric crises should tend to involve high-stakes issues, concessions by asymmetric states should be rare. Instead, asymmetrically inferior states will choose to escalate to prevent their opponents from achieving their objectives. Due to asymmetric states' unwillingness to concede, we should also find that crises more often occur among asymmetric than symmetric dyads. Indeed, 23/29, or 80%, of crisis dyads are asymmetric if we use a threshold of 2:1. If instead we use a threshold of 3:1, then 20/29, or 69%, of crisis dyads are asymmetric. If we use a threshold of 5:1, then 17/29, or 58%, of crisis dyads are asymmetric. Finally, in more than half of all crisis dyads (15/29), the superior state has at least nine times as many nuclear weapons as its opponent.

Quantitative Analyses

Using the ICB data, we analyze the effect of superiority on the probability of victory in crises. The unit of analysis is the crisis-directed dyad, and

[35]Kroenig, "Nuclear Superiority and the Balance of Resolve"; Kroenig, *Logic of American Nuclear Strategy*; Early and Asal, "Nuclear Weapons and Existential Threats."

[36]Jervis, *Illogic of American Nuclear Strategy*; Blechman and Powell, "What in the Name of God Is Strategic Superiority?"; Sechser and Fuhrmann, "Crisis Bargaining and Nuclear Blackmail."

[37]Bell and Macdonald, "How to Think about Nuclear Crises."

[38]While this is an implication of other work on superiority (Kroenig's, for example), Bell and Macdonald make it explicit, which also suggests limited utility to superiority in many types of symmetric crises.

[39]Later, we test all possible thresholds. Higher thresholds should bias against our argument, since greater degrees of inferiority make states less able to threaten significant damage on their opponents.

there are 58 observations. The outcome variable in each observation identifies whether "State A" achieved victory. Winning a crisis is determined by whether a state achieves its objectives, and there are many conditions—draws, stalemates, or compromises—that can cause crises to end without a victor. Additionally, crises are not zero-sum; it is possible for both states to emerge victorious. We test the effect of nuclear superiority on victory, meaning we are comparing victory to cases in which both states lose, as well as cases in which the inferior state wins. This accurately reflects our theory. We predict asymmetrically inferior states will gain a deterrent advantage, not a compellent advantage, meaning that they are more likely to win or draw.[40] Though previous quantitative work on nuclear crises ends in 2001,[41] ICB has since been extended. This allows us to include more cases. We add three nuclear crises that occurred between 2001 and 2010: the 2002 Kaluchak terrorist attack, the 2006 North Korean nuclear test, and the 2009 North Korean satellite launch.[42]

Previous scholarship has investigated the effects of symmetry and asymmetry using a continuous measure of the nuclear ratio as the independent variable. Though advocates of nuclear superiority would suspect that, as the ratio increases, the likelihood of victory should also increase, we perform a series of robustness checks that reveal the nuclear ratio does not have a consistent effect on crisis outcomes or militarized interstate dispute outcomes.[43] However, our theory, and the descriptive statistics presented in the previous section, suggest that using the nuclear ratio to assess the relationship between superiority and victory may yield an inaccurate picture, as symmetric and asymmetric crises should instead be considered separately.

Table 1 suggests states with (1) vastly inferior nuclear arsenals tend to win crises or end up in draws (88% of the time);[44] (2) somewhat inferior nuclear arsenals tend to lose crises (90% of the time); (3) somewhat superior nuclear arsenals tend to win crises (57% of the time); and (4) vastly superior nuclear arsenals tend to lose crises or end up in draws (88% of the time). This pattern suggests the relationship between the nuclear ratio and victory is non-linear. At the lowest levels of the ratio, such as 1:4,000 or 1:1,000, the probability of victory will be high, but this probability will decline as the ratio approaches 1:1. As the ratio grows, the probability of victory will increase, before falling again as the ratio

[40]We group draws, stalemates, and compromises.

[41]Kyle Beardsley and Victor Asal, "Winning with the Bomb," *Journal of Conflict Resolution* 53, no. 2 (April 2009): 278–301; Kroenig, "Nuclear Superiority and the Balance of Resolve"; Kroenig, *Logic of American Nuclear Strategy*.

[42]ICB data also includes one US-North Korea crisis and one India–Pakistan crisis up to 2015, but information on national material capabilities, a control variable, was not available at the time of writing past 2012.

[43]See Online Appendix H.

[44]Using a cutoff of 50:1; we discuss different cutoffs in more detail above.

gets higher. Thus, accurately identifying the relationship between the nuclear ratio and victory with a linear model—as previous studies have done—would be inappropriate. The inconsistent results of Online Appendix H, which uses the ratio measurement across multiple model specifications, illustrates some of the shortcomings of this approach to studying superiority.

Therefore, we create a dichotomous measure that captures changes in the degree of superiority a state has over its opponent. This measure places each directed-dyad-year observation into one of three categories: asymmetric superiority of State A, rough symmetry of State A and State B, and asymmetric inferiority of State A. This measure facilitates a comparison of the probability of victory given asymmetric nuclear superiority versus the probability of victory given asymmetric inferiority, as well as the probability of victory given symmetry versus the probability of victory given asymmetry. In fact, using this measure, we find states with vast asymmetric superiority are no more likely to achieve victory than vastly inferior states. That is, having far more nuclear weapons than one's opponent does not provide an advantage during crises.

Specifically, we construct a separate binary indicator of superiority for each nuclear ratio threshold, thus changing the number of observations that are coded as asymmetrically superior. At each threshold, within a given dyad, one state can be coded as asymmetrically superior and the other as asymmetrically inferior, or both states can be coded as having nuclear symmetry with their opponent. When two opponents possess arsenals roughly equivalent at a particular threshold, we consider their arsenals symmetrical. To illustrate, consider an asymmetric superiority threshold of 1.5, where a state with more than 1.5 times as many nuclear weapons as its opponent is coded as asymmetrically superior. The other state will be coded as asymmetrically inferior. During the Yom Kippur War, for example, the United States possessed an arsenal that was about 1.78 times the size of the Soviet Union's arsenal. For the US-USSR dyad in the Yom Kippur War, the United States is asymmetrically superior at the 1.5 threshold and the Soviet Union is asymmetrically inferior. When the threshold is changed to 2, however, both states are coded as symmetric. To test our argument, we need to identify the effects of nuclear superiority at various definitions of what makes a crisis asymmetric. Although we purport that asymmetry requires a high threshold, we test all possible definitions of asymmetry to validate this claim.[45]

High thresholds bias against the empirical implications of our theory and reflect situations in which inferior states can neither leverage reciprocal repercussions nor hope to seriously harm their adversaries' ability to retaliate against a nuclear first strike. Our measurement strategy

[45]See Online Appendix J for the nuclear ratio in every crisis.

circumvents issues associated with the use of simple arsenal size to operationalize nuclear superiority. When arsenals are similarly sized, components such as targeting, delivery methods, and nuclear strategy can affect which state has the more capable nuclear arsenal. These elements are less important, however, when the superior state has many times more nuclear weapons than the inferior state.

For each new, distinct coding of asymmetric superiority, we use a logit model with cluster robust standard errors[46] to estimate the effect of asymmetric superiority compared to asymmetric inferiority on crisis outcomes. We use a logit model since the outcome variable is a binary measure of whether State A in the dyad achieved its goals in the crisis. We control for symmetry in each of the models, so that asymmetric inferiority is the reference category. In other words, the test estimates the effect of asymmetric nuclear superiority on the likelihood State A achieves its goals, compared to if State A was asymmetrically inferior. In all models, we control for proximity,[47] regime type,[48] material capabilities,[49] population size,[50] the level of violence in the crisis,[51] and security.[52] We also control for second-strike capability, measured by whether a state possesses submarine-launched ballistic missiles, mobile missiles, or nuclear-armed aircraft on continuous airborne alert.[53] Following Kroenig's approach,[54] we control for these factors because they may mediate or confound the effect of nuclear superiority on a state's probability of victory in a crisis. Our results are robust to the exclusion of these controls.

Note that we do not control for stakes, since we expect this to be endogenous to the nuclear balance.[55] We posit that having high stakes results from asymmetric nuclear inferiority and that asymmetrically inferior states are able to credibly signal resolve because of high stakes. Our theory

[46]We cluster by crisis dyad.

[47]Proximity is a binary variable measuring which state the geographic location of the crisis is closer to.

[48]Monty G. Marshall and Ted Robert Gurr, "Polity IV Data Series Version 2010," Center for Systemic Peace, 2010, 1–16, http://www.systemicpeace.org/polity/polity4.htm.

[49]This ratio assesses relative capabilities using the Correlates of War composite capabilities index, described in J. David Singer, Stuart Bremer, and John Stuckey, "Capability Distribution, Uncertainty, and Major Power War, 1820–1965," in *Peace, War, and Numbers*, ed. Bruce Russett (Beverley Hills, CA: Sage, 1972), 19–48.

[50]See Singer et al., "Capability Distribution, Uncertainty, and Major Power War," in Russett, *Peace, War, and Numbers*.

[51]This is a four-point ordinal variable drawn from the ICB dataset that ranges from 1 (no violence) to 4 (full-scale war).

[52]This is the average number of crises State A experiences per year, per Beardsley and Asal, "Winning with the Bomb," 9.

[53]We define second-strike capability in the same way as Kroenig for comparability. See Kroenig, "Nuclear Superiority and the Balance of Resolve," 157. We include all states with nuclear-capable submarines, but this may overstate when the Soviet Union acquired a secure second-strike capability, because early Soviet nuclear submarines were likely insufficient. However, this approach biases against our theory, which expects second-strike capability will be positively associated with the likelihood of victory, meaning even small arsenals can deter.

[54]Kroenig, *Logic of American Nuclear Strategy*; Kroenig, "Nuclear Superiority and the Balance of Resolve."

[55]See Online Appendix B for a model with stakes as a control.

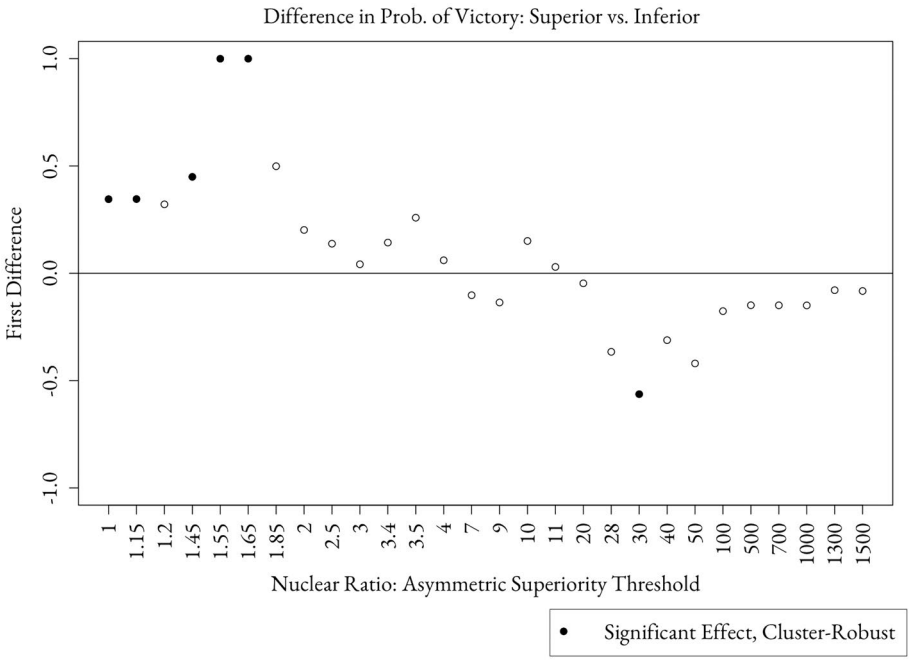

Figure 1. Difference in probability of victory: Superior vs. inferior.

therefore suggests stakes to be a posttreatment variable, and including this variable in the model would therefore produce bias.[56] Furthermore, we cannot directly test the interaction of asymmetric inferiority and high stakes because there is no meaningful variation. In all cases in our data, with the exception of France in the Berlin Wall Crisis, asymmetrically inferior states have high stakes, as our theory would predict.

Main Results

The results, displayed in a regression table in Online Appendix L,[57] and visualized more clearly in Figure 1, suggest nuclear superiority has a positive, significant effect on the probability of victory when the threshold is set at 1 or a little above 1.5. However, when the threshold increases, the significant effect mostly disappears. This means that when the superior state in a crisis has a nuclear arsenal slightly larger than the inferior state's arsenal, the superior state tends to win. However, when the superior state has an arsenal any more than 1.65 times as large as the inferior state's

[56]Paul R. Rosenbaum, "The Consequences of Adjustment for a Concomitant Variable That Has Been Affected by the Treatment," *Journal of the Royal Statistical Society: Series A (General)* 147, no. 5 (1984): 656–66; Joshua D. Angrist and Jörn-Steffen Pischke, *Mostly Harmless Econometrics: An Empiricist's Companion* (Princeton, NJ: Princeton University Press, 2008).

[57]Because we estimate a regression for each separate threshold definition of superiority, the regression table is too large to include in main section of the article.

arsenal, the superior state is no longer more likely to win. At even higher thresholds, nuclear superiority generally does not provide a meaningful strategic advantage and may even be a disadvantage. The relationship between asymmetric superiority and victory becomes negative when the threshold is more than 20 times the size of the opponent's arsenal. This negative relationship is significant when asymmetric superiority is defined as having at least 28 times as many nuclear weapons as an opponent. These findings evidence our theory.

Interestingly, the regression tables in Online Appendix L reveal that the effect of conventional military capabilities is positive and significant in models where asymmetric superiority is coded at a threshold of 3 or above. Conventional superiority appears to matter more as nuclear superiority matters less. Proximity and second-strike capability always have a positive, significant effect, whereas security always has a negative, significant effect. Violence has a positive, significant effect in all but two of the models.[58] Regime type is positive and significant, and population is negative and significant in a few models, but there is no consistent pattern between the threshold and whether these variables are significant.

Robustness Checks

In this section, we address several additional robustness checks that we perform to validate our empirical approach. These checks are designed to deal with three challenging issues: the small number of observations in our dataset and the nested structure of the data, scholarly disagreements over the interpretation of some cases in the data, and the question of how to define superiority. We accordingly perform robustness checks that: use new methods designed to provide precise statistical analysis, leverage myriad iterations of the data that drop and recode cases according to different interpretations of historical events; and operationalize superiority in a way that incorporates more than simple numerical counts of arsenal size.

Our first set of robustness tests is designed to further deal with the inference problems related to the small number of cases and nested structure of the data. Our main results use a new superiority measure to address this concern. An alternate approach is to use a different type of estimator. Sandwich estimators for data about dyads of countries, such as the cluster-robust standard errors used in the main analysis and the estimators used across the literature can be invalid if there are fewer than 50 base countries in the dataset.[59] There are only 9 base countries in our data. In

[58]Violence is insignificant at the 7 and 9 thresholds.

[59]Peter M. Aronow, Cyrus Samii, and Valentina A. Assenova, "Cluster–Robust Variance Estimation for Dyadic Data," *Political Analysis* 23, no. 4 (Autumn 2015): 570.

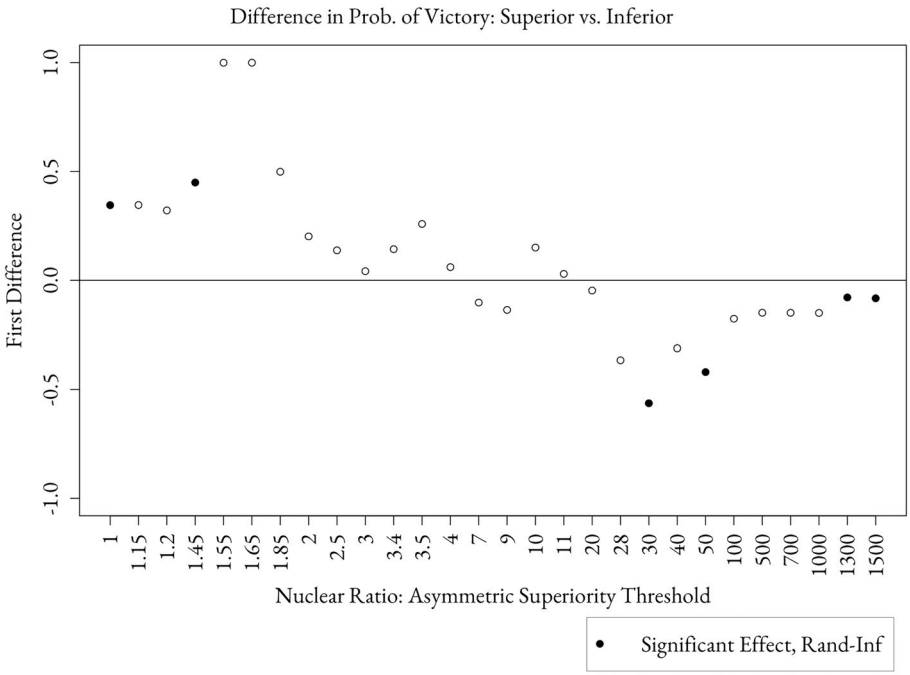

Figure 2. Difference in probability of victory: Superior vs. inferior.

addition, parametric approaches to calculating standard errors in dyadic analysis—like those approaches used thus far in our work and in previous quantitative studies on nuclear superiority—can sometimes lead to overconfident significance tests given the complex, nested structure of the data.[60] In other words, applying traditional hypothesis testing methods to dyadic data can sometimes lead to false claims of statistically significant findings. Thus, as a robustness check, we implement a nonparametric approach to estimating standard errors for dyadic data from Robert S. Erikson et al. This approach uses randomization inference, which compares an observed test statistic to a "distribution of false test statistics" obtained when we randomly scramble whether State A is asymmetrically superior to State B in a series of simulations.[61]

Figure 2 reports the outcome of this test. It shows the difference in the probability of victory between a scenario where State A is asymmetrically superior and a scenario where State A is asymmetrically inferior, with the significance determined by randomization inference.[62] In keeping with the

[60]Robert S. Erikson, Pablo M. Pinto, and Kelly T. Rader, "Dyadic Analysis in International Relations: A Cautionary Tale," *Political Analysis* 22, no. 4 (Autumn 2014): 457–58.

[61]This approach relies on the exchangeability of errors rather than any assumptions about the distribution of the underlying data. It evaluates the sharp null that nuclear superiority has no effect on the outcome of a nuclear crisis.

[62]In the randomization inference procedure, we control for the same variables as when we assessed significance with cluster-robust standard errors. We only randomize asymmetric superiority. Therefore, we do not use the randomization inference procedure to assess the significance of any controls.

results in Figure 1, we find that superiority has a significant, positive effect on crisis outcomes for most thresholds up to 1.55 but not for thresholds above that level.[63] We find that asymmetric superiority often has a significant, negative association with victory when the threshold is relatively high: for example, thirty or more times the size of the opponent's arsenal.

Additional robustness tests account for disagreements about the interpretation of certain historical cases. For example, we reestimate our models with our own amended codings for the outcomes of the Korean War and the Berlin Wall Crisis,[64] as well as with amended outcome codings Kroenig used, both of which differ from the ICB codings we use in our main analysis.[65] We also estimate a version of our models that drops the France-USSR dyads in the Berlin Wall Crisis due to limitations in French nuclear capabilities at that time.[66] The findings from the robustness tests using these variations of the dataset support our theory.

Furthermore, we provide an alternate specification intended to address concerns about the dyadic nature of the data. In Online Appendix D, we collapse dyads where allies shared goals in crises with a joint adversary. In the Berlin Wall Crisis, for example, we now consider as one observation the joint US-UK-France alliance versus the Soviet Union; our main results instead consider independently the US-USSR, UK-USSR, and France-USSR dyads. Using this approach, our main results again persist. Regardless of whether we use cluster-robust standard errors or randomization inference, we find that asymmetric nuclear superiority provides no advantage and may even have a negative effect on the probability of victory when there is a vast discrepancy between opponents' arsenal sizes.

Additionally, we estimate the models after discarding the US-USSR dyads from the Six-Day War, and the USSR-Israel dyads from the Six-Day War, War of Attrition, and Yom Kippur War, as well as the Congo and Nicaragua MiGs-25s crises entirely, given concerns about whether these crisis dyads actually involved a nuclear component.[67] This robustness check therefore eliminates 12 observations from the data, including all cases of asymmetric superiority above a threshold of 1,000. The much lower N makes inference more difficult. With cluster-robust standard errors, we find that superiority above a threshold of 100 has a positive, significant effect on crisis victory. This finding, which runs counter to all our

[63]Due to the small sample size, perfect separation occurs in some iterations. We discard these iterations. We perform 10,000 simulations in our procedure, so even when we discard iterations, there are still thousands of simulations that form the basis of our calculation. There are not more than 200 simulations to be discarded.

[64]See Online Appendix F.

[65]Kroenig, "Nuclear Superiority and the Balance of Resolve"; Kroenig, *Logic of American Nuclear Strategy*. See Online Appendix G.

[66]See Online Appendix C.

[67]See Online Appendix E.

previous analyses, could potentially suggest the cases omitted in this test drove our main results—but this effect disappears when we use randomization inference. Recalling that cluster-robust standard errors can produce false significance with small-N data, we suggest that the randomization method is more appropriate for this robustness test. Furthermore, in Online Appendix E, we make the case that these dyads should be included in our analysis and do represent meaningfully nuclear crises.

We also estimate our main models using asymmetric inferiority as the primary independent variable instead of asymmetric superiority.[68] In this case, asymmetric superiority becomes the reference category. This allows us to assess the prediction that the probability of victory for the inferior state increases as the disparity between the states' arsenal sizes in the dyad increases. Recall that our main results test whether the probability of victory for the superior state declines as the disparity between the arsenal sizes increases. This additional robustness test is useful because victory is not zero-sum in our dataset, so a loss by an inferior state, for example, does not necessarily imply a victory by the superior opponent. We find that, at low thresholds of the nuclear ratio, inferior states are more likely to lose crises. However, inferior states do have an advantage at larger arsenal size disparities. The probability of victory for the inferior state increases as the disparity between arsenal sizes increases. These findings match our theoretical predictions.

Finally, we use a simpler, binary measure of superiority to reestimate our results. In this measure, superiority is the condition where one state possesses a second-strike capability and a nuclear arsenal at least three times the size of its opponent's. This reflects a stylized standardization of the capabilities presumed to be sufficient for adequately damaging an opponent's nuclear arsenal in a first strike or for responding to a second strike. This operationalization reflects the fact that nuclear targeting often assigns multiple nuclear weapons per target.[69] It also recognizes that nuclear strategists have long emphasized the necessity of survivable capabilities that ensure retaliatory abilities. Thus, while this is still a binary measure that cannot speak to the disparity between nuclear arsenal sizes, it still represents an improvement on previous quantitative approaches, which operationalized superiority as having at least one nuclear weapon more than one's opponent. Using both logit models and randomization inference models, with and without the inclusion of a measure of stakes, and using both the original ICB outcome measures and the recoded versions from

[68]See Online Appendix A.

[69]In damage estimates, Kroenig presumes states would assign up to three nuclear weapons per target. Kroenig, *Logic of American Nuclear Strategy*, 39–65.

Kroenig's work, we find no effect of this version of superiority on the likelihood of victory.[70]

In sum, these robustness tests show that—across numerous specifications—nuclear superiority provides few advantages and, indeed, results in disadvantages when states face opponents with significantly weaker nuclear capabilities. These tests account for various challenges that have made inference difficult in previous work, such as the small number of observations, ongoing debates about the nature of various crises, and the lack of a consensus around a sufficient definition for nuclear superiority. Using multiple strategies to address each concern, we robustly demonstrate support for our theory.

Discussion

Though nuclear superiority may help states win crises when their nuclear arsenals are only slightly larger than their opponents (although there could be many reasons for this correlation), superiority provides no advantage and may actually be a disadvantage against opponents with much smaller arsenals. In fact, the positive effect of nuclear superiority uncovered in previous work is driven by cases where states have arsenals that are fewer than 1.5 times larger than their opponents'. Moreover, in the most asymmetric crisis dyads, the superior state is actually more likely to lose the crisis. Our findings are robust to a number of specifications, including tests designed specifically to account for the small number of nuclear crises.

We argue these outcomes occur because inferior states in asymmetric crises are highly threatened; they face a nuclear risk from escalating, but they also cannot back down in response to very credible threats against their core interests. This difficult position has a silver lining. It allows the inferior state to successfully demonstrate resolve in a way that would not be credible in a lower-stakes scenario. With this, inferior states can persuade vastly superior opponents not to continue escalating. Superior opponents will be unwilling to risk nuclear exchange. In this way, asymmetry provides inferior states with a way to counter superior opponents. We now illustrate our theory using the crises between the United States and North Korea, as well as the US-Soviet dynamics in the Korean War.

US-North Korea Crises

This logic is evident in many of the crises between the United States and North Korea. This dyad is clearly asymmetric, with North Korea having fewer than one hundred nuclear weapons and the United States having

[70]See Online Appendix K.

thousands. This asymmetry is considered a key obstacle to North Korean denuclearization.[71]

At the core of recent crises between the United States and North Korea is a commitment problem involving tensions over the future of both the North Korean nuclear program and regime. Because the United States cannot credibly commit to refrain from a regime-change policy, North Korea cannot commit to disarm. Backing down to US threats is not an option, as doing so would pose an existential threat to the North Korean regime.

North Korea must instead signal resolve in the face of American threats to its territory or leadership. Otherwise, the United States could initiate a war that would pose an existential threat to the regime. The United States has repeatedly made clear that its ultimate goal with North Korea is regime change. The *2022 National Defense Strategy* unequivocally states that "there is no scenario in which the Kim regime could employ nuclear weapons and survive."[72] Former Central Intelligence Agency director Mike Pompeo stated that President Donald Trump had ordered the agency to "separate the North Korean regime from its missiles and nuclear weapons."[73] President Barack Obama explained that the Kim regime was "brutal and it's oppressive … you will see a regime like this collapse … and that's something we are constantly looking for ways to accelerate."[74] President George W. Bush reported that he "loathed" Kim Jong Il, and Bush administration officials stated the lesson from Iraq for North Korean leaders was that they should "take a number."[75] This regime-change policy has long been entangled with demands for disarmament and sanctions designed to encourage denuclearization. Yet acquiescing to these demands would leave the North Korean regime highly vulnerable should the United States choose to act on its long-promised desire for regime change. The United States cannot credibly promise to stop at denuclearization. (After all, the United States pursued regime change in Libya after its disarmament deal.) The imbalance of power makes it difficult for superior states to limit the scale of their demands, since they cannot credibly commit not to threaten more significant interests at a later stage.

Strong demands on North Korea are therefore likely to be interpreted as existential risks for the regime. Moreover, when the United States makes much smaller demands, such as that North Korea release US citizens held

[71]Erwin Tan and Jae Jeok Park, "The US-North Korean Asymmetrical Security Dilemma: Past the Point of Nuclear No Return?" *International Area Studies Review* 23, no. 2 (June 2020): 194–209.

[72]US Department of Defense, *2022 National Defense Strategy of the United States of America* (Washington, DC: US Department of Defense, 2022), 12.

[73]Richard Sokolsky and Aaron Miller, "Regime Change in North Korea: Be Careful What You Wish For," Carnegie Endowment for International Peace, 2 August 2017,

[74]Aidan Foster-Carter, "Obama Comes Out as a North Korea Collapsist," *Diplomat*, 30 January 2015.

[75]Robert S. Litwak, "Non-proliferation and the Dilemmas of Regime Change," *Survival* 45, no. 4 (Winter 2003–04): 8.

as political prisoners, Pyongyang is better off acquiescing than resisting (and generally has done so). This illustrates how crises that are high stakes for the inferior side are much more likely to emerge in asymmetric settings; low-stakes issues can be sorted, but often the issue in asymmetric cases is one of regime survival.

When faced with high stakes such as the threat of regime change, North Korea cannot back down. Pyongyang is therefore left with the option of an offensive strategy, using threats and provocations to signal its resolve in an attempt to deter the United States from taking further actions. Indeed, North Korea tends to react to crises by escalating, such as demonstrating its nuclear capabilities or making direct threats against the United States and its allies.

And this strategy works. Despite having a comparative strategic advantage, the consequences of nuclear escalation on the Korean Peninsula are far too great for the United States to bear. As a result, credible North Korean signals of resolve are often sufficient for deterrence, despite its limited nuclear capabilities.

Though Pyongyang struggles with general deterrence, in that it cannot deter the United States from challenging its core interests, it is nonetheless able to achieve immediate deterrence when crises with the United States arise. Even a small nuclear arsenal would enable North Korea to impose severe consequences on the United States if a conflict broke out. This means, for the United States, fighting with North Korea is unwise. The United States can only push back so far, and North Korea can resist concessions on its core interests by demonstrating high levels of resolve once a crisis begins. This dynamic leads to stalemates in which the United States is rarely able to achieve its objectives.

For example, consider the 2009 US-North Korea crisis, which began with a North Korean underground nuclear test in May 2009, followed by the imposition of sanctions against North Korea via UN Security Council Resolution 1874. The costly sanctions and accompanying ratcheting up of tensions with the United States posed a direct threat to North Korea and its nuclear deterrent—the only thing, in many North Korean leaders' minds, keeping the country safe from US military intervention or efforts at regime change (though North Korea has substantial conventional capabilities and may be able to inflict heavy damage early, US and South Korean allied forces ultimately maintain conventional superiority and could limit a North Korean offensive).[76] Some scholars even argue that conventional forces are sufficient for deterrence by denial.[77] In exchange for North Korea dismantling its nuclear program, the United States could offer sanctions relief,

[76]Andrew Scobell and John M. Sanford, *North Korea's Military Threat: Pyongyang's Conventional Forces, Weapons of Mass Destruction, and Ballistic Missiles* (Carlisle, PA: US Army War College Press, 2007), 3.
[77]Vipin Narang and Ankit Panda, "North Korea: Risks of Escalation," *Survival* 62, no. 1 (2020): 47–54.

not an end to its regime-change policy. In fact, the United States would have been unable to credibly commit to reverse this policy even if it wanted to, given that dismantling Pyongyang's nuclear program would increase the United States' relative power and encourage a preventive regime change operation before North Korea could rearm. Scholars generally agree that North Korea's nuclear arsenal is essential to its ability to deter regime change and other adverse policies or actions.[78] This demonstrates how superior states face a significant commitment problem that makes it difficult for them to limit the stakes of a crisis with a vastly inferior opponent, even if they recognize the disadvantages associated with existential crisis stakes.

Thus, while the actual threat to North Korea appeared economic—from sanctions—the true threat was an existential risk to regime survival. This illustrates the entanglement of stakes with the balance of power and highlights why many crises between states with vastly different capabilities escalate. Concerned, North Korea was forced to take dramatic measures to demonstrate its resolve and deter the United States. North Korea responded with a satellite launch, which was a critical test of missile technology essential to the robustness of the North Korean nuclear deterrent. The launch successfully demonstrated North Korea's resolve, and although it was unable to coerce the United States into dropping the sanctions, it deterred any additional US efforts. Though the United States would have suffered less than North Korea if the situation escalated to nuclear war, the United States still would have endured significant costs to military assets and citizens in the Asia-Pacific region. It therefore acted in a risk-adverse manner. The costs North Korea threatened, although smaller than those from the United States, discouraged the latter from reciprocating North Korea's escalatory action. Because North Korea credibly demonstrated its resolve, the crisis ended in a stalemate and the status quo persisted.

The Korean War

We further illustrate our theory using the case of the Korean War. The Korean War is a difficult case because the Soviet role in the crisis is debated. There is also some disagreement about the outcome. The ICB dataset codes the Korean War as a victory for the inferior state, but Kroenig recodes it as a stalemate.[79] However, in either coding, the inferior state did not lose the crisis, in keeping with our predictions.

[78]Doug Bandow, "North Korea Needs the Bomb to Protect Itself from America," *Foreign Policy*, 7 July 2021, Terence Roehrig, "North Korea, Nuclear Weapons, and the Stability-Instability Paradox," *Korean Journal of Defense Analysis* 28, no. 2 (June 2016): 187–89; Vipin Narang, "Nuclear Strategies of Emerging Nuclear Powers: North Korea and Iran," *Washington Quarterly* 38, no. 1 (Spring 2015): 82–85.

[79]Kroenig, "Nuclear Superiority and the Balance of Resolve," 154; Online Appendix C.

The Soviet Union had high stakes in the Korean War. The conflict occurred in the Soviet Union's backyard, whereas the Korean Peninsula is far from the United States. The Soviet government's investment in Korea was long-standing, and Korea was seen as important for protecting Soviet territory. A report sent to negotiators at the Potsdam Conference noted:

> Korean independence must be effective enough to prevent Korea from being turned into a staging ground for future aggression against the U.S.S.R. not only from Japan, but also from any other power that would attempt to put pressure on the U.S.S.R. from the east. The surest guarantee of the independence of Korea and the security of the U.S.S.R. in the Far East would be the establishment of friendly and close relations between the U.S.S.R. and Korea.[80]

Access to Korea also meant access to the Pacific, which Joseph Stalin considered vital. The Soviet Union had relied on its 1945 agreement with China for access to a warm-water port in Manchuria, which the Soviets viewed as strategically valuable. After the Chinese Communist Party's victory, the treaty was renegotiated, and negotiations over the 1950 version of the treaty resulted in a Soviet agreement to withdraw from its port at Lushun. With access to Lushun in jeopardy, continued access to Korea became even more valuable. Evidence suggests Stalin was worried that if the Soviet Union did not support North Korea, the relationship with China would sour, posing a great risk to Soviet stability.[81] These motives meant Korea was a vital Soviet security interest. In comparison, the US objective, driven by the "domino theory" of politics, was primarily to prevent communist influence in South Korea, which at the time was a dictatorial state with which the United States had a strategic but nascent relationship. Thus the stakes were imbalanced.

The Soviet Union's high stakes contributed to its ability to demonstrate resolve. When the Soviets intervened, China and North Korea claimed Moscow would be willing to use nuclear weapons to protect their regional interests—and the United States seemed wary that this might be the case.[82] This belief deterred the United States from escalating in Korea, although the option was repeatedly considered. Conrad C. Crane writes that the Joint Chiefs of Staff resisted plans to bomb Manchuria "because of fears such action might bring in the Russians," that Far East Air Forces Bomber Command believed nuclear use risked "bringing the Russians into the

[80]Shen Zhihua, "Sino-Soviet Relations and the Origins of the Korean War: Stalin's Strategic Goals in the Far East," *Journal of Cold War Studies* 2, no. 2 (Spring 2000): 60.

[81]Kathryn Weathersby, "Soviet Aims in Korea and the Origins of the Korean War, 1945–1950: New Evidence from Russian Archives (Cold War International History Project Working Paper no. 8, Woodrow Wilson International Center for Scholars, 1993), 28–32.

[82]Edward Friedman, "Nuclear Blackmail and the End of the Korean War," *Modern China* 1, no. 1 (January 1975): 82, 87–88; Jonathan D. Pollack, *No Exit: North Korea, Nuclear Weapons, and International Security* (New York: Routledge, 2017), 43–45; John Lewis Gaddis, *The Cold War: A New History* (New York: Penguin, 2006), 83–119.

conflict," and that President Dwight Eisenhower "remained worried about the Soviet response" to plans drawn up in May 1953 to expand the war that included designs for tactical and strategic nuclear use.[83]

Although some scholars have argued that the settlement of the war resulted from US nuclear threats, other scholars have demonstrated that both the Soviets and Chinese viewed these threats with skepticism and resisted them.[84] Nuclear escalation in Korea would have had devastating consequences for the United States, despite the fact that the Soviet arsenal was, at the time, smaller than the US one.

This case illustrates how, in high-stakes, asymmetric crisis dyads, inferior states can successfully leverage nuclear arsenals against superior opponents. Asymmetrically inferior states can credibly demonstrate resolve and bid up the risk of nuclear conflict. This can deter superior adversaries, allowing inferior states to avoid losing. We have additionally demonstrated this phenomenon with descriptive data on nuclear crises and statistical analyses showing superiority does not provide an advantage in asymmetric crises.

Rethinking Nuclear Superiority

Previous scholarship focuses on the relationship between nuclear superiority and advantages in deterrence or compellence. It does not address how varying degrees of superiority may affect these factors. We introduce important nuance by showing the relationship between nuclear superiority and crisis outcomes depends on the size of the disparity between states' nuclear arsenals.

Specifically, we argue brinksmanship and crisis escalation operate differently in symmetric and asymmetric dyads. The low-level and low-stakes nature of symmetric crises makes it difficult for either side to credibly signal resolve to escalate to the nuclear level, making stalemates likely. But inferior states have an advantage in asymmetric crises. In these cases, threats to inferior states' core interests are credible, and superior states cannot credibly commit to exercise restraint. An asymmetrically inferior state would not allow a disagreement to escalate to a crisis if acquiescing to the superior state's demands did not pose a severe threat. Because they face significant consequences should they back down, inferior states in asymmetric dyads must risk escalating to demonstrate resolve and deter more powerful opponents. The significant consequences associated with acquiescing to threats lends credibility to these demonstrations of resolve.

[83]Conrad C. Crane, "To Avert Impending Disaster: American Military Plans to Use Atomic Weapons during the Korean War," *Journal of Strategic Studies* 23, no. 2 (2000): 75–83.

[84]Friedman, "Nuclear Blackmail and the End of the Korean War," 81, 84–85. Rosemary J. Foot, "Nuclear Coercion and the Ending of the Korean Conflict," *International Security* 13, no. 3 (Winter 1988/89): 94–95, 111–12. Robert J. Art, "To What Ends Military Power?" *International Security* 4, no. 4 (1980): 8.

We evidence this theory in three ways. First, descriptive statistics show our main hypotheses hold in nearly all nuclear crises in the ICB data. Second, quantitative analyses show the probability of superior states' victory decreases as the arsenal disparity relative to inferior states increases. Third, case illustrations demonstrate that the asymmetrically inferior state in several crises—including recent flare-ups between the United States and North Korea and the Korean War of the early 1950s—have been able to resist their superior opponents.

These findings have important policy implications. We find an upper limit to the potential benefits of nuclear superiority. This poses a dilemma for the United States, which has significant concerns about asymmetric nuclear opponents. For example, the United States' current major nuclear security concerns are North Korea, a highly asymmetric opponent, and a potential Iranian nuclear arsenal, which would also be vastly inferior to US nuclear assets. Even China's nuclear arsenal is nearly nineteen times smaller than the United States'. Although China is currently strengthening its nuclear arsenal, these developments will still not allow China to approach parity in the short term. Nevertheless, this increase in nuclear arsenal size will improve China's ability to inflict significant damage on US forces—and thus its capabilities for immediate deterrence. Our theory could also help explain China's buildup, since if it were able to achieve parity, then it may be able to also achieve general deterrence, preventing the United States from threatening its core interests in East Asia.

Although the United States often approaches these adversaries as if it had a clear deterrent advantage, our findings suggest that a "big stick" may not be sufficient. Our results indicate US nuclear superiority will provide no advantage if disagreements with these highly asymmetric adversaries escalate to full crises. Therefore, policies meant to contribute to a larger nuclear arsenal—like perennial propositions on the resumption of nuclear testing—may be the wrong strategy with respect to many pressing and ongoing security concerns.

Nevertheless, there are other areas for which nuclear superiority could matter, such as nuclear warfighting or, as our theory elucidates, in the precrisis stage—when superiority can interact with the stakes at hand to determine if crises escalate. States focused on these outcomes may value nuclear superiority despite its ineffectiveness in achieving crisis victories. States may also choose to increase their nuclear arsenals for reasons unrelated to the strategic outcomes of crises or wars; for example, bureaucratic actors may push for nuclear investments, politicians may expand nuclear arsenals in response to public concerns about security, or states may upgrade their nuclear arsenals primarily to increase their international prestige.

Our findings show that seeking nuclear superiority will not help states achieve better crisis outcomes. In a Cold War world, where it was essential for the United States to maintain parity with the Soviet Union to achieve general deterrence, the pursuit of nuclear superiority may have been strategic. But today, immediate deterrence takes precedence. Parity with Russia has already been achieved, and the United States boasts a far superior nuclear arsenal than all remaining nuclear states. Yet, despite its immense nuclear capabilities, the United States is struggling to curb North Korean and Chinese threats. Nuclear superiority provides few benefits in these settings. Further pursuit of superiority may even be counterproductive, harming the United States' ability to achieve its objectives in this increasingly important geopolitical sphere.

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Data Availability Statement

The data and materials that support the findings of this study are available in the Security Studies Dataverse at https://doi.org/10.7910/DVN/9RBEPV.

The online appendix is also available in the Security Studies Dataverse at https://doi.org/10.7910/DVN/SZPAM7.