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Risky Systems: Tactical Nuclear Weapons and Dispute Outcomes

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Author Note

Code and other replication materials available on demand.

Abstract

This study examines whether different types of nuclear weapons confer different bargaining advantages in international disputes. Existing theory holds that states elicit concessions from opponents by changing the expected costs and benefits of conflict. Nuclear powers accomplish this by taking escalatory steps to increase the risk of nuclear war. Given that tactical nuclear weapons (TNWs) are riskier than others, it seems likely that they will have a greater impact on disputes than strategic weapons. I test this hypothesis using quantitative data on nuclear weapons and militarized interstate disputes occurring between 1945-2010. In a multivariate logistic regression analysis, I found evidence that states with tactical nuclear weapons are more likely to win disputes compared to those without TNWs. This relationship remains significant even when controlling for conventional capabilities, system of government, and general nuclear capabilities.

Keywords: Tactical nuclear weapons, militarized interstate disputes, deterrence, escalation, quantitative analysis, coercive bargaining.

Risky Systems: Tactical Nuclear Weapons and Dispute Outcomes

Purpose

Adversaries of the United States continue to view nuclear weapons as central to their foreign policy objectives, including not just deterrence but also coercion and intimidation of other states. Recent policy documents, namely the Defense Department's Nuclear Posture Review and Missile Defense Review, reflect growing concern in Washington that adversaries will leverage their increasingly diverse and flexible nuclear arsenals for strategic advantage in disputes. American officials are particularly worried over Russia's doctrine of "escalate to de-escalate," which entails the limited use of nonstrategic nuclear weapons to force concessions from the United States early in a conflict. To prevent this, the Trump Administration has announced plans to develop a low-yield variant warhead for the Trident-III submarine-launched ballistic missile (SLBM). This response is based on the assumption that Moscow's tactical weapons confer some tangible, competitive edge over the United States. However, there is little empirical research on whether tactical nuclear weapons confer bargaining advantages in international disputes. This question is worth exploring; despite the destructive power of nuclear weapons, nuclear powers do not win every dispute, especially against states that also possess nuclear weapons. What explains this variation in outcomes? Do certain types of nuclear weapons (i.e. low yield, short-range) increase a state's chances of winning a dispute? This question will have important implications for the future of arms control in a new era of great power competition between the U.S. and its nuclear-armed adversaries. To help answer this question, this paper examines data on militarized international disputes to test whether tactical nuclear weapons impact dispute outcomes. Tactical nuclear weapons have a lower yield and shorter-range than strategic nuclear weapons, which may impact the dynamics of a conflict.

Literature Review and Theory

Existing Research

There is little empirical research exploring the impact of TNWs on international disputes. Previous quantitative studies on nuclear weapons have focused primarily on general warhead count without distinguishing between weapon systems or characteristics. For example, in their authoritative work on nuclear weapons and coercive bargaining, *Nuclear Weapons and Coercive Diplomacy*, Todd Sechser & Robert Fuhrmann measure nuclear capabilities in terms of absolute warhead count, and the ratio of warheads for disputes involving two nuclear powers.¹ Matthew Kroenig also measures the ratio of warheads in his analysis of 52 crises involving dyads of nuclear states.² These authors and others also use a dichotomous measure of nuclear possession to test the differences between nuclear and non-nuclear states.³ The problem with this existing research is that it does not distinguish between different types of nuclear weapons. As discussed below, certain characteristics of nuclear weapons, such as launch-time and range, may impact the dynamics of a conflict.

Theory: Nuclear Weapons and Risk

Nuclear weapons confer strategic advantages by raising the expected costs and risks of conflict with nuclear states. First and foremost, nuclear weapons are a powerful deterrent against existential threats. States will “be hesitant to act violently against a nuclear opponent because of the considerable risks of putting a nuclear state on the defensive...by increasing the potential of a

¹ Todd Sechser and Matthew Fuhrmann, *Nuclear Weapons and Coercive Diplomacy* (Cambridge: Cambridge University Press, 2017).

² Matthew Kroenig, “Nuclear Superiority and the Balance of Resolve: Explaining Nuclear Crisis Outcomes,” *International Organizations* 67, no. 1 (January 2013).

³ Victor Asal and Kyle Beardsley, “Nuclear Weapons as Shields,” *Conflict Management and Peace Science* 26, no. 3 (July 2009).

nuclear response, the expected costs of aggression against a nuclear state can be quite high.”⁴ However, nuclear weapons are a core-value weapon. Nuclear first-use would likely have exceptionally high costs for the user, so states issuing nuclear threats face severe credibility problems when their vital interests are not at risk. Put simply, it is difficult for a state to convince adversaries that it would really use nuclear weapons.

There is a paradoxical gap between the military credibility of nuclear weapons themselves and the political credibility of nuclear threats. To overcome this credibility problem, states engage in a strategy of risk-manipulation.⁵ Rather than threaten an intentional first-use (which would not be credible), a nuclear power can take steps to increase the chances that the dispute spirals out of control, making accidental nuclear war more likely. In his seminal work on coercive diplomacy, *Arms and Influence*, Thomas Schelling outlines this strategy with a metaphor involving a dispute between two mountain-climbers:

It means exploiting the danger that somebody may inadvertently go over the brink, dragging the other with him...while either can deliberately jump off, he cannot credibly pretend that he is about to. Any attempt to intimidate or to deter the other climber depends on the threat of slipping or stumbling. With loose ground, gusty winds, and a propensity toward dizziness, there is some danger when a climber approaches the edge; one can credibly threaten to fall off *accidentally* by standing near the brink.⁶

In this manner, nuclear powers fight with “the substitution of crises for wars,” ramping up the risk of disaster until the adversary decides that the potential costs of remaining in the dispute outweigh the potential benefits of winning the contested issue.⁷ Herein lies the key theoretical link between nuclear weapons and dispute outcomes: the imposition of risk. Simply

⁴ Ibid., 261.

⁵ Thomas Schelling, *Arms and Influence* (New Haven, CT: Yale University Press, 1967).

⁶ Ibid., 99.

⁷ Kroenig, “Nuclear Superiority.”

counting the warheads in a state's arsenal does not adequately capture this causal mechanism, because it ignores the various contextual factors impacting risk-perception. For example, during the Cuban Missile Crisis, the United States' calculus was based not on a tally of warheads in the Soviet arsenal, but on the proximity and readiness of the weapons in Cuba.

Tactical Nuclear Weapons and Risk

Tactical nuclear weapons may have a greater impact on disputes because they are inherently more risky than strategic nuclear weapons. Tactical nuclear weapons have less-restrictive safety features (permissive action links) than strategic nuclear weapons and are often subject to relaxed command and control. At the same time, TNWs operate in an unstable and unpredictable environment - the field of battle. Because TNWs are vulnerable to conventional counterforce, under unpredictable battlefield conditions, commanders may face the decision to "use them or lose them."⁸ This combination of relaxed safety features and commanders' incentives to launch increases the chances of nuclear detonation due to accident or miscalculation.

Thus, there is greater risk of nuclear detonation with tactical nuclear weapons than with strategic nuclear weapons. This inherent and immediate risk could impact an adversary's decision-making more than the relatively vague notion that strategic weapons loom in the background of a crisis. In terms of Schelling's metaphor, deploying TNWs is similar to moving closer to the edge of the cliff. This leads to a hypothesis on the relationship between tactical nuclear weapons and dispute outcomes:

⁸ Brian Alexander and Alistair Millar, *Tactical Nuclear Weapons: Emergent Threats in an Evolving Security Environment* (Lincoln, NE: Potomac Books, 2003).

H₁: States with tactical nuclear weapons will be more likely to win disputes than states without tactical nuclear weapons

Methodology

Scope and Unit of Analysis

I test the hypothesis using conflict data from the Correlates of War Project's (COW) militarized interstate disputes (MID) database.⁹ Below, I estimate a logistic regression equation modeling the outcomes of 3,762 country-dispute observations spanning 1,601 disputes occurring between 1945 and 2010. Disputes are defined as "cases of conflict in which the threat, display, or use of military force short of war by one member state is explicitly directed towards the government, official representatives, official forces, property, or territory of another state."¹⁰ Cases before 1945 were dropped to account for the systemic changes that occurred after World War II and the advent of nuclear weapons. The sample still contains a representative range of disputes involving nuclear and non-nuclear states, with varying levels of intensity and duration.

Variables¹¹

Dependent Variables

Dispute outcome is measured with the variable *WinLose*, a dichotomous variable indicating whether the country won the MID in question. This variable is adapted from the COW variable outcome. *WinLose* takes on a value of 1 indicating *Win* if the opposing side yields, or if the state achieves at least some of its objectives. *WinLose* is coded as 0 indicating *Lose* if the state yields in a conflict or fails to achieve any of its objectives. To test for robustness, I also

⁹ Daniel Jones, Stuart Bremer, and J. David Singer, "Militarized Interstate Disputes, 1816-1992: Rationale, Coding Rules, and Empirical Patterns," *Journal of Conflict Resolution* 15, no. 2 (September 1996).

¹⁰ *Ibid.*, 163.

¹¹ Descriptive statistics for all variables can be found in the appended Codebook.

include an alternative coding of the dependent variable, *WinAll*, indicating whether a state achieved all its objectives in the conflict. Any other outcome is coded a 0 indicating *Lose*.

Independent Variables

Nuclear status is measured categorically by the variable *NukeStatus*. 0 indicates non-nuclear powers, while 1 indicates states that have achieved a secure second strike but do not possess tactical nuclear weapons. States with strategic and tactical nuclear weapons are coded as 2. Information on tactical nuclear weapons is taken from the Bulletin of Atomic Scientists Nuclear Notebook.¹² It is worth noting that, for the purposes of this paper, tactical nuclear weapons are defined as those weapons which were not subject to Cold War treaties governing the superpowers' strategic forces. This legal - rather than functional - definition is imperfect, but it does capture the general characteristics (relaxed safety features, designed for battlefield use) which would make the weapons riskier, as required by the theory underpinning this study. The weapons in question were considered nonstrategic because they were generally of shorter range and lower yield.¹³ Thus, the legal definition is a valid measure of the independent variable, because it captures the "riskiness" that distinguishes TNWs.

Control Variables

I also control for several other factors identified in the scholarly literature as affecting dispute outcomes. Conventional military capabilities may also affect an adversary's decision-making calculus, and by extension the outcome of a dispute. I therefore include the variable *cinc*,

¹² Hans Kristensen, *Nuclear Notebook* (2019), https://thebulletin.org/feature_type/nuclear-notebook/.

¹³ Amy F. Woolf, *Nonstrategic Nuclear Weapons* (Washington, DC: Congressional Research Service, 2019), <https://fas.org/sgp/crs/nuke/RL32572.pdf>.

for the Composite Index of National Capabilities from the Correlates of War Project.¹⁴ This variable is a continuous measure between 0 and 1 of the aggregate of 6 indices which together provide an accurate measure of a state's military capabilities. These 6 factors are: iron and steel production, military expenditures, military personnel, energy consumption, total population, and urban population. The CINC score is widely recognized as a valid and accurate measure of conventional military capabilities and has been used in a variety of studies on conflict and war.

Furthermore, there is some evidence that democracies win disputes more frequently than non-democracies.¹⁵ While the issue is still debated among scholars, it is possible that democracies self-select into conflicts that they are more likely to win.¹⁶ This could impact the results by making democracies more likely to win disputes, regardless of nuclear weapons. To avoid this inherent selection bias, I include a dichotomous variable from the Quality of Governance project indicating whether the state is a *democracy*.¹⁷

Finally, it is necessary to control for the total number of nuclear weapons that a state possesses. This is because sheer numbers of nuclear weapons could be what really intimidates the adversary, rather than the type of weapon. I therefore include *NukeCount*, a continuous variable measuring the total number of operational nuclear warheads for each country in a

¹⁴ 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 (Beverly Hills: Sage, 1972).

¹⁵ Dan Reiter and Erik R. Tillman, "Public, Legislative, and Executive Constraints on the Democratic Initiation of Conflict," *Journal of Politics* 64, no. 3 (August 2002).

¹⁶ Dan Reiter and Allan C. Stam III, "Democracy, War Initiation, and Victory," *The American Political Science Review* 92, no. 2 (June 1998).

¹⁷ Jan Teorell et al, "The Quality of Government Dataset," *The Quality of Government Institute* (University of Gothenberg, 2019), <http://www.qog.pol.gu.se> doi:10.18157/qogstdjan19.

dispute. This data is compiled by Max Roser and Mohamed Nagdy using multiple sources including the Federation of American Scientists.¹⁸

Thus, the probability of winning an international dispute is a function of a state's nuclear status, democracy status, warhead count, and conventional capabilities. This is expressed as a logistic regression equation below:

$$\rho(\text{Win}) = \frac{e^{\beta_0 + \beta_1 \text{NuclearStatus} + \beta_2 \text{Democracy} + \beta_3 \text{Warhead Count} + \beta_4 \text{Cinc}}}{1 + e^{\beta_0 + \beta_1 \text{NuclearStatus} + \beta_2 \text{Democracy} + \beta_3 \text{Warhead Count} + \beta_4 \text{Cinc}}}$$

¹⁸ Max Roser and Mohamed Nagdy, "Nuclear Weapons," *Our World in Data*, <https://ourworldindata.org/nuclear-weapons>, (April 2019).

Results

As a preliminary check, I conduct Pearson's chi-squared test to evaluate the observed dispute outcomes between the 3 categories of nuclear status. The results of the cross-tabular analysis are shown in **Table 1**. The test provides initial evidence for the hypothesis. States with tactical nuclear weapons won more disputes, and lost fewer disputes, than would be expected in a random sample. The p-value (.001) indicates that it is highly unlikely that the relationship is due to random chance, supporting the rejection of the null hypothesis that nuclear status has no impact on dispute outcomes.

	Non-Nuclear	Nuclear	TNW Nuclear
Lose (Expected)	2,582 (2,549)	276 (293)	289 (304)
Win (Expected)	435 (467.5)	71 (54)	71 (56)
Total	3017	347	360
χ^2	14.12		
p-value	.001		

Next, I run a multivariate logistic regression model to evaluate the impact of nuclear status on the likelihood of winning a dispute. As shown in *Model 3*, there is a positive, statistically significant relationship between nuclear status and the probability of winning a dispute. This is consistent with the hypothesis that states with TNWs are more likely to win a dispute than are states without TNWs. This is true even when controlling for conventional capabilities, democracy, and general warhead count.

	Model 1	Model 2	Model 3	Model 4
TNW Nuclear State β (SE)	1.096*** (.255)	1.06*** (.269)	.875*** (.43)	1.533** (.637)
Nuclear State β (SE)	.689*** (.161)	.587*** (.164)	.579*** (.165)	.693** (.219)
CINC Score β (SE)	-5.01*** (1.52)	-5.31*** (1.6)	-5.39*** (1.62)	-8.453*** (2.59)
Democracy β (SE)		.317** (.103)	.315** (.103)	.795*** (.151)
Warhead Count β (SE)			.00001 (.000)	-.00002 (.000)
<i>N</i>	3,724	3,398	3,398	3,427

***p <.001 **p <.05 *p <.1

As expected, democratic governance increases the likelihood of winning a dispute, as does general warhead count. However, it is worth noting that the direction of the relationship between conventional capabilities and outcome is negative, contrary to the prediction outlined in the theory section. This may be the result of self-selection. Perhaps weaker states would avoid conflicts unless the stakes were particularly high. If this were the case, then relatively weak states involved in a conflict would have higher expected benefits of remaining in a dispute and would therefore have higher resolve (greater risk-proneness). On the other hand, the negative relationship could be due to methodological problems, as will be discussed in greater detail in the conclusion section.

Although the coefficients for the logistic model indicate the direction and statistical significance of the relationship, it is more difficult to interpret their substantive significance. **Table 3** displays the predicted probabilities of winning a dispute given specific values of each independent variable. Regardless of the measure of the control variables, possessing tactical nuclear weapons increases the likelihood of winning a dispute. However, the substantive significance is only moderate, increasing the probability by only 5-7%. The probability of winning is highest for TNW states with high warhead counts. This makes sense, as a larger number of warheads, at least some of which are tactical, would increase an adversary's expected costs for remaining in a dispute.

TABLE 3. Margins						
Probability of Winning Dispute						
	CINC		Democracy		Warhead Count	
	<i>Low</i>	<i>High</i>	<i>Yes</i>	<i>No</i>	<i>Low</i>	<i>High</i>
Nuclear	28%	27%	28%	22%	28%	34%
TNW	34%	33%	34%	27%	34%	41%

Robustness Test

Returning to **Table 2**, *Model 4* shows the results of the same logistic regression model using *WinLoseAll*, the alternative coding for dispute outcomes, which indicates *Win* only if the state achieved all of its objectives in the dispute. Under this new dependent variable, the relationship is still statistically significant. This extra step provides additional support for the hypothesis by showing that the observed relationship is consistent even under a more stringent definition of winning.

Analysis of Findings

Limitations

Although the model does support the hypothesis that tactical nuclear weapons increase the likelihood of winning disputes, the findings presented here are not definitive. There are some methodological limitations that need to be addressed in future research. First, due to a lack of available data, the model does not control for the stakes involved in each dispute. The interests at stake are important determinants of dispute outcomes, because states with more to lose will perceive a greater benefit of remaining in a dispute and may therefore be willing to tolerate greater risk. States whose genuine interests are at risk will also issue more credible threats. Second, the model did not control for relative military power between adversaries, which would also impact the outcome of the dispute, since it is a better indicator of the costs one state can inflict on another. Finally, future research should include variables measuring specific functional characteristics of weapons rather than legal definitions. This would allow for more nuanced examination of “riskiness,” as some weapons not included in this study may have similar characteristics. For example, there is evidence that Pakistan’s nuclear weapons are subject to

particularly relaxed command and control, which could confer bargaining advantages consistent with the risk-manipulation theory outlined above.

The Trump Administration's nuclear strategy of "tailored deterrence" reflects an understanding that the United States faces a complex array of nuclear threats, from near-peer competitors to rogue states. As this security environment continues to evolve, it is vital that U.S. nuclear strategy be based on a firm foundation of research into the dynamics of nuclearized disputes. To that end, this study represents a preliminary effort to develop more nuanced understanding of how different types of nuclear weapons can impact the outcome of a dispute. The study's findings suggest that nonstrategic weapons confer unique advantages in disputes. While further research is needed, these findings could have implications for U.S. nuclear strategy in an era of great power competition – from arms control to nuclear modernization.

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Appendix: Descriptive Statistics of Variables

Dependent Variables

WinLose

Dichotomous variable indicating whether the country won the dispute in question. Coded as 0 if the state achieved none of its objectives in the dispute. Coded as 1 if the state achieved some of its objectives in the dispute. This variable is coded from the COW Project's outcome variable. For outcomes 1-4, the coding is straightforward. If the outcome was a stalemate, the country that initiated the conflict receives a value of Lose, because they did not manage to elicit a compromise. If the outcome was a compromise, the country that initiated the conflict receives a value of Win, because they managed to achieve at least some of their goals. Outcomes 7-9 are coded as missing.

	Frequency	Percent
Lose	3,151	84.45
Win	580	15.55
Total	3,731	

WinAll

Dichotomous variable indicating whether the country won the dispute in question. Coded as 1 if the state achieved all its objectives in the dispute (i.e outcome was 1-4). Otherwise, coded as 0.

	Frequency	Percent
Lose	3,524	93.67
Win	238	6.33
Total	3,762	

Independent Variables

Source: Bulletin of the Atomic Scientists

NukeStatus012

Categorical variable indicating a state's nuclear status.

- 0 Non-nuclear state
- 1 Nuclear state, no tactical nuclear weapons
- 2 Nuclear state with tactical nuclear weapons

	Frequency	Percent
Non-Nuclear 0	3,040	80.96
Nuclear 1	354	9.43
TNW-Nuclear 2	361	9.61
Total	3,755	

Control Variables

Democracy

Dichotomous variable indicating whether the country in the country-dispute observation was a democracy. 0 indicates non-democracy, 1 indicates democracy.

Source: QoG Dataset

	Frequency	Percent
Non Democracy	2,183	63.57
Democracy	1,251	36.43
Total	3,434	

NukeCount

Continuous variable measuring the number of operational nuclear warheads in a state's arsenal.

Source: Our World in Data

N	Min	Max	Mean	Std. Dev.
3,762	0	40,159	1,719	6,021.387

Cinc

Continuous index variable measuring the aggregate scores from 6 metrics of national power: total population, urban population, iron and steel production, energy consumption, military personnel, and military expenditure.

Source: Correlates of War Project

N	Min	Max	Mean	Std. Dev.
3,762	6.90e-7	.3640	.0296	.055