Deterring Intervention: The Civil Origins of Nuclear Proliferation

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Abstract

Standard nuclear deterrence theory suggests that atomic weapons decrease the probability of conflict between states. We argue that nuclear weapons can have such a chilling effect on civil wars as well, even if their use against a domestic opposition is never credible. Potential rebel groups consider the likelihood of third-party intervention in the decision to revolt. In contrast to civil use, a government on the verge of defeat can credibly threaten to use nuclear weapons against international opponents. Thus, when (1) interventions occur in the absence of nuclear weapons, (2) interventions would not occur against a nuclear-armed state, and (3) rebel groups only wish to revolt with third-party assistance, nuclear weapons stop the onset of civil war. We use Libya’s long-lasting nuclear program and the 2011 uprising to illustrate the mechanism.

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1 Introduction

In the infancy of the atomic age, militarily powerful countries developed the first nuclear weapons. However, nuclear programs have recently expanded to weak, repressive, autocratic states. North Korea, for example, became the most recent addition to the nuclear club in 2006. By many accounts, failing the successful implementation of an agreement, the state most likely to join next is Iran. Meanwhile, Iraq, Romania, Egypt, Algeria, Syria, and Libya have all tried developing nuclear weapons over the past few decades (Levite 2002; Jo and Gartzke 2007; Sagan 2011).

What accounts for this trend? For one answer, we look inside—whereas standard accounts of nuclear proliferation generally focus on security concerns abroad (Sagan 1996; Paul 2000; Singh and Way 2004; Solingen 2007), we believe that potential domestic disturbances help explain the recent influx of autocratic nuclear programs.1 Perhaps the greatest security concern for such repressive regimes is the threat of a domestic uprising. Oftentimes unable to credibly commit to a settlement over the long term, such leaders face civil war, removal from office, and execution. These outcomes are especially likely when a strong third-party militarily backs the rebellion. Indeed, the expectation of intervention may prompt the rebellion in the first place.

Consequently, we argue that nuclear weapons act as regime insurance. More specifically, we develop a formal model of nuclear construction, potential civil uprisings, and third-party interventions. We find that third-parties only wish to intervene militarily when the costs of doing so are sufficiently low. However, a single nuclear weapon changes that calculus entirely—third-parties will stay out of some civil wars if and only if the regime under fire holds a nuclear deterrent. Thus, the government indirectly gains domestic coercive bargaining leverage by proliferating. In turn, despite their exorbitant price tag, nuclear weapons are sometimes worth the cost.

To illustrate the logic—and preview our case study below—consider the 2011 Libyan Civil War. The rebellion teetered on the edge of defeat early in the conflict, in desperate need of Western air support and resupply. A NATO offensive rescued the rebels and

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1Of course, we do not believe this is the only explanation. In particular, Brown, Fariss, and McMahon (2015) argue that regimes with related coup problems tend to pursue weapons of mass destruction. This is because leaders, in an attempt to coup-proof their regime, find development of weapons of mass destruction as a way to obtain power abroad without empowering potential internal challengers. We view our mechanism as complementary to theirs.
resulted in no allied casualties. However, in an alternate world where Libya had nuclear weapons, it is reasonable to conclude that NATO would have stayed out and perhaps the rebels never would have started the war. As such, and as our model predicts, Gaddafi pursued a nuclear weapon; the program only stopped after the international community shut down Libya’s cost-effective path to a bomb.

Our model generates a number of other important results that apply more broadly. First, the model shows that nuclear weapons can endogenously increase their possessors’ ability to win a war. Due to tactical limitations or international taboos (Sechser and Fuhrmann 2013; Tannenwald 1999), many scholars question whether nuclear weapons provide compellent power (Schelling 1960, 193-199). However, few doubt that nuclear weapons provide a deterrent threat when the state faces imminent demise (Sechser and Fuhrmann 2013, 177-178). We therefore assume that nuclear weapons do not directly influence a government’s ability to win a war. Rather, they only increase the cost of intervention for a third-party. Nevertheless, the additional cost indirectly increases the government’s probability of victory because it changes the alliance it will face in battle.

Second, and as hinted above, the increased cost has a third-order effect of decreasing the probability of civil wars. Rebels face a tradeoff in crisis negotiations. Successfully protesting against a government requires careful coordination (King, Pan, and Roberts 2013). Thus, although a government may offer substantial concessions in response to uprisings, rebel groups must be cognizant that those concessions will disappear once protestors return home. We show that one determinant of the rebels’ decision to take the temporary concessions is the likelihood they will win a war; the higher the probability, the more likely conflict occurs. But because the increased cost of intervention leaves the rebel group without a powerful ally, its likelihood of winning is lower. In turn, nuclear weapons can decrease the probability of civil wars even if they would never be directly used against the rebel group.

However, we only observe a reduction in the probability of war when the chances of coordination falls in a middle range. This is because governments do not build weapons when the probability of coordination is sufficiently low; the cost is not worth the expected benefit. Meanwhile, if the probability of coordination is sufficiently high, civil wars never begin; rebels have no need to engage in costly conflict when they expect to have bargaining power in the future. In between, nuclear weapons are worth the investment and convince potential dissidents to not rebel.
Finally, our model contributes to a growing literature on third-party intervention in civil wars. Scholars of civil conflict have increasingly recognized that the decision to begin a rebellion depends on expectations about how the international community will respond (Gleditsch and Beardsley 2004; Collier and Hoeffler 2004; Gent 2008; Carroll 2015). However, to our knowledge, no study investigates the role of nuclear weapons in this decision. Our results indicate that nuclear weapons limit rebel-biased interventions, which in turn affects the probability of civil war onset.

The paper proceeds as follows. In the next section, we develop a model of proliferation, civil war, and intervention. We show that when nuclear weapons are pivotal in the intervention decision and the cost of proliferation is low, nuclear development results. Using the model as a guide, the third section traces the mechanism with a case study of Libya under Gaddafi. We show that when the conditions for proliferation held, Gaddafi sought a nuclear weapon; but when the conditions failed—specifically, when the cost of weapons became too large—the proliferation process ended. We then conclude with further implications from the model.

2 Modeling Civil Wars, Nuclear Weapons, and Intervention

This infinite horizon game consists of three players: G(overnment), R(ebels), and T(hird-party). G and R have some bargaining good in contention standardized to value 1. This good could take many forms, but two intuitive motivations are extractive tax revenues and domestic policy. T sympathizes with R and thus earns R’s share of the good in every stage.

The game has two distinct segments: armed and unarmed. Play begins in the unarmed stage. Here, G chooses whether to develop a nuclear deterrent at cost $k > 0$. Doing so shifts the game into the armed state of the world, which we will address momentarily.\(^2\) If G does not arm, Nature chooses whether to recognize R with probability $q$ or not with probability $1 - q$. If Nature does not recognize R, G plays a dictator

\(^2\)Thus, we focus on cases where the “declining state” in this interaction (T) cannot adequately launch preventive war. While preventive motivation is a common modeling feature (Powell 1999; Powell 2006; Chadefaux 2011; Debs and Monteiro 2014), we focus our model on civil conflict. One might imagine that T’s effectiveness in war without the support of a coordinated rebel group is minimal.
game, choosing to give \( x_t \in [0, 1] \) to R and keep the remainder of the good for itself.\(^3\) The unarmed state of the world repeats in the next period.

If Nature recognizes R, G and R play a crisis bargaining game. G offers a division \( x_t \) to R, where \( t \) denotes the period. If R accepts, R receives \( x_t \) for the period, G receives \( 1 - x_t \) for the period, the period ends, and the players begin a new period still in the unarmed state of the world. If R rejects, the parties begin a war. T must now decide whether to intervene. If it does not, R wins with probability \( p \), G wins with complementary probability, and both pay respective costs \( c_G, c_R > 0 \).\(^4\) If T intervenes, the coalition of R and T wins with probability \( p' > p \), G wins with complementary probability, and all three pay respective costs \( c_G, c_R, c_T > 0 \).\(^5\) The game ends regardless. Consequently, the strategic dilemma for T is choosing whether to exert effort to win the war or free ride off of R. Meanwhile, R always prefers T to intervene, as it maximizes its probability of winning under those circumstances.\(^6\)

The armed state of the world operates similarly. Here, Nature still recognizes R with probability \( q \), leading to the same crisis bargaining process, this time involving an offer \( y_t \in [0, 1] \) from G. The only difference is that G’s nuclear weapons mean that T pays a higher cost if it intervenes. Specifically, T’s cost becomes \( c'_T > c_T \). The probability that R wins the war remains the same as before, though. If R accepts the offer or Nature does not recognize R, the period ends either with the appropriate division, and the armed stage repeats with Nature’s decision. If R rejects, the game ends after T decides whether to intervene.

To incorporate time preferences, the players share a common discount factor \( \delta \in (0, 1) \).

\(^3\)Identical results would follow if we permitted R an opportunity to accept or reject in these un-coordinated stages provided that R’s power is significantly lower when Nature does not recognize it.

\(^4\)To rule out corner solutions that do not add to the theoretical results, we assume \( p - c_R > 0 \).

\(^5\)Thus, R pays the same cost regardless of whether T intervenes. Relaxing this assumption would not fundamentally alter the results.

\(^6\)As Crawford (2005) and Kuperman (2005; 2008) identify, T’s willingness to intervene leads to wars that would not have occurred in T’s absence.
2.1 Properties of the Model and Conditions on the Parameter Space

Before deriving the model’s equilibria, it is worth further motivating the assumptions substantively. One prominent assumption is that R’s bargaining power fluctuates; sometimes it can exercise an outside option, sometimes it cannot. This is a common modeling feature in the civil war literature (Fearon 2004; Paine 2015), and it is especially compelling for the coordination issues we have in mind. Many prominent instances of civil unrest have occurred without foresight, ranging from the countries involved in the Arab Spring to the Color Revolutions in the former Soviet bloc. For simplicity—and because our research question focuses on the decision to proliferate—we assume that the probability Nature recognizes R is exogenous. However, one could imagine this as a reduced-form description of a global game in which potential rebels resolve their coordination problem with probability $q$ in equilibrium.

Regardless, recognition leads to a significant if fleeting power shift. This corresponds to the idea that protestors enjoy safety in numbers. A lone dissenter in an autocratic state faces beatings, imprisonment, or even death; thousands of protestors, on the other hand, can effectively resist police and military forces. In the extreme, such mass movements can bring down regimes (Ash 2002; Lohmann 1994; Prezworski et al 2000), with Egypt, Ukraine, and Romania as recent examples. Resolved coordination problems are especially troubling for autocratic governments, as the inability to credibly commit to concessions over the long-term leaves protestors skeptical of attempts to negotiate. Further, we know that autocratic governments recognize the perils of collective action and preempt coordination (King et al 2013).

We also assume that nuclear weapons do not directly influence G’s probability of victory in a conflict in the model. Indeed, such armaments do not even directly change G’s expected payoff; it receives $1 - p - c_G$ if T does not intervene and $1 - p' - c_G$ if T does. This incorporates a commonly-held belief in the literature that nuclear arms make poor offensive weapons, whether due to credibility problems or a norm against their use. In turn, proliferation will not directly allow G to increase its compellent demands against R. Nevertheless, nuclear weapons have a second-order effect that can lead to massive changes in the game’s outcome. Still consistent with existing theory, nuclear weapons simply increase T’s cost to intervene. This is consistent with the notion that states
facing complete defeat can credibly detonate a nuclear weapon (Sechser and Fuhrmann 2013, 177-178).

As Lemma 1 details, the costs associated with challenging a nuclear deterrent alters T’s intervention behavior:

**Lemma 1.** In all SPE, if G has not build, T intervenes if $c_T < p' - p$. In all SPE, if G has built, T intervenes if $c'_T < p' - p$.

The proof is straightforward. T’s move is the final strategic decision in the game. If G has not built, T earns $p' - c_T$ if it joins and $p$ otherwise. As such, it strictly prefers joining if $c_T < p' - p$. On the other hand, if G has built, T earns $p' - c'_T$ if it joins and still receives $p$ otherwise. Thus, it strictly prefers joining if $c'_T < p' - p$.

Note that because $c'_T > c_T$—that is, the cost of intervention is greater when the G has nuclear weapons—the circumstances under which T would want to intervene after G has built is a subset of the circumstances if G has not built. Indeed, if $c_T > p' - p$, then T would not intervene in either case. Similarly, if $c'_T < p' - p$, T would intervene regardless of G’s nuclear weapons status. Going forward, we therefore focus on the following conditions on the parameter space:

**Condition 1.** Suppose T would intervene if G has not build nuclear weapons (i.e., $c_T < p' - p$).

**Condition 2.** Suppose T would not intervene if G has build nuclear weapons (i.e., $c'_T > p' - p$).

We do this because all other cases are not of theoretical interest. If Condition 1 does not hold, G has no incentive to pay the cost to proliferate because it leads to no behavioral change from T—it intervenes regardless of the history of the game. If Condition 2 holds, G again has no incentive to build—T does not intervene regardless of the history. Put differently, to justify their expense, nuclear weapons must be pivotal to some degree.\(^7\) Together, Conditions 1 and 2 ensure a change in T’s behavior.

Conditions 1 and 2 also indicate that nuclear weapons are most useful when the state faces a potential centrist civil war rather than a war for regional autonomy. This

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\(^7\)In our model, nuclear weapons are either pivotal or they are not. One could imagine a richer model in which $p$ and $p'$ are drawn each period from a joint distribution, so that nuclear weapons are pivotal some portion of the time. For tractability, we focus on the case where nuclear weapons are always pivotal.
falls back to Sechser and Fuhrmann’s point that states cannot credibly threaten nuclear retaliation if an opponent captures an outlying region but certainly could if the regime were on the line. To make this more concrete, a nuclear weapon likely would not have deterred Russian intervention into Georgia’s 2008 civil war. After all, the stakes were limited to South Ossetia and Abkhazia; the Georgian capital of Tbilisi was never in danger. In contrast, a hypothetical civil war in North Korea would not involve outlying regions—capturing Pyongyang would undoubtedly be a war aim. As such, and as we detail further in the case study below, the model indicates that states expecting centrist civil wars to be more likely to proliferate.

Types of civil war aside, these conditions do not only influence T’s behavior. Indeed, T’s varying decision to intervene changes R’s outside option in negotiations. If G has proliferated, R ultimately receives \( p - c_R \) if it rejects the offer; if G has not not proliferated, R ultimately receives \( p' - c_R \) by rejecting. Thus, even though nuclear weapons do not directly increase power, they do so as a second-order effect. Furthermore, this second-order effect has a third-order effect of influencing how G negotiates with R. We tackle the post-proliferation bargaining environment first.

2.2 Bargaining after Proliferation

The following lemma describes equilibrium play in post-proliferation periods:

**Lemma 2.** Let \( y^* = \frac{(1 - \delta q)(p - c_R)}{1 - \delta} \). In periods where Nature recognizes R, if \( y^* < 1 \), there is a unique equilibrium. G offers \( y_t = y^* \) and R accepts iff \( y_t \geq y^* \). G offers 0 in periods in which Nature does not recognize R. Peace prevails. If \( y^* > 1 \), non-peaceful equilibria exist in which R rejects all offers G makes in periods that Nature recognizes it. G can offer any amount in equilibrium. R rejects regardless of the offer. War occurs in every period that Nature recognizes R. In all periods in which Nature does not recognize R, G chooses \( y_t = 0 \).

See the appendix for proof. Intuitively, the central tension of the model is that R can only coordinate to fight a war some portion of the time. In other periods, G cannot credibly commit to offer concessions; instead, it keeps the entire good for itself. Thus, in a period where Nature recognizes R, R knows that it might not receive concessions again for a while. In turn, to be willing to accept, G must compensate for the future
losses R expects to incur; otherwise, R would prefer fighting a costly war (even without the support of T) and secure a share of the good for all future periods.

The appendix shows that the minimal amount R needs to receive in a period is \( y^* \). However, G can only give so many concessions in any particular period. If \( y^* \) exceeds that amount (i.e., \( y^* > 1 \)), then no offer in recognized periods can lead to peace without concessions in unrecognized periods. For some equilibria, this does not happen. For example, G may demand the whole good in unrecognized periods and have its offer (regardless of the amount) be rejected in recognized periods.\(^8\) War eventually occurs in equilibrium.

Note that T’s inability to credibly threaten intervention alters the bargaining dynamics between G and R. To see this, consider a hypothetical world in which G never had the opportunity to proliferate. Then the interaction would take the same form as the armed state of the world. The only difference is that, by Condition 1, T would intervene should R start a war. In turn, R’s functional power is \( p' \) under those conditions, not \( p \). Therefore, the minimum amount R would need to accept would change to \( \frac{(1-\delta_q)(p'-c_R)}{1-\delta} \), which is greater than \( y^* = \frac{(1-\delta_q)(p-c_R)}{1-\delta} \). This means that the non-peaceful equilibria cover a greater parameter range when T has a credible threat to intervene.

### 2.3 The Decision to Proliferate

The question remains how G would respond to these incentives given that it can proliferate beforehand. This section answers that question. The inclusion of the build/not build decision allows for “no deal” types of equilibria to form in the unarmed periods in which G always builds, G offers \( x_t = 0 \) in periods that Nature recognizes R, and R rejects all offers. These decisions are self-reinforcing and inefficient, allowing them to form reversion strategies. In turn, the folk theorem dictates that the game can support many equilibria overall, with the reversion strategies used to enforce any particular outcome.

Ordinarily, the folk theorem presents a significant predictive barrier. However, under certain circumstances, G must build in every SPE; in others, G must never build. Either way, the model generates a unique equilibrium outcome. This gives our infinite horizon

\(^8\)These strategies describe all of the Markov perfect equilibria. For sufficiently high values of \( q \), other SPE exist where G makes concessions in unrecognized periods that convince R to accept in recognized periods. These rely on the “no deal” equilibrium as the reversion strategies.
model predictive power despite the standard issues with the folk theorem. As such, we focus on those situations below.

Per Lemma 2, G can face one of two types of continuation values should it arm. Although there are substantive differences between cases where \( y^* > 1 \) and \( y^* < 1 \), the overall effect on the build decision remains similar. This is because G sees better outcomes by having proliferated, either because it stops the civil war from starting or because it deters T from intervening if the war starts. To avoid redundant theoretical results, we restrict attention to situations where \( y^* < 1 \). Thus, G and R will maintain the peace should R proliferate.\(^9\)

**Proposition 1.** If the cost to proliferate \( k \) is sufficiently low, G builds in every period in every SPE.

The proof is simple and instructive. For simplicity, in all our proofs, we normalize measures of utility by \( 1 - \delta \). Note that if G builds, it receives a fixed payoff of \( 1 - qy^* - (1 - \delta)k \).\(^10\) Thus, if G does not build in some period in equilibrium, it must receive at least that amount by not doing so. However, G must deal with another equilibrium constraint. In any period that G did not build, Nature recognizes R with probability \( q \), and R can secure at least \( p' - c_R \) by rejecting. Thus, R’s value for the subgame beginning with G not building is at least \( q(p' - c_R) \). Because the value of the bargaining good equals 1, this caps G’s payoff for the subgame at \( 1 - q(p' - c_R) \). Building therefore generates a higher payoff for G if:

\[
1 - q \left( \frac{(1 - \delta q)(p - c_R)}{1 - \delta} \right) - (1 - \delta)k > 1 - q(p' + c_R)
\]

\[
k < q \left( \frac{p'}{1 - \delta} + \frac{\delta c_R(1 - q) - p(1 - \delta q)}{(1 - \delta)^2} \right)
\]

This defines “sufficiently low” for Proposition 1.\(^\Box\)

Put differently, proliferating guarantees a peaceful outcome that is advantageous to G. In contrast, not building a nuclear deterrent means that R can use T’s credible threat to intervene (or an actual intervention) to coerce more out of G. If these extra

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\(^9\)For transparency, the only substantive difference here is that arming (if optimal) leads to a decrease in the probability of war. However, the central mechanism that drives G to build—a difference in war outcomes with nuclear weapons—results in construction regardless.

\(^10\)Recall that \( q \) is the probability Nature recognizes R, and \( y^* \) is the amount G gives. Thus, the expected remainder G keeps equals \( 1 - qy^* \). The \( k \) value, of course, is the cost G pays to build.
concessions are too great, then it is worth paying the inefficient cost to proliferate to shut out T. Thus, the phrase “sufficiently low” from Proposition 1 refers to the expected difference in concessions G must give. Weapons programs are an investment in coercive power. In turn, even expensive weapons programs may prove worthwhile if the effect of the third party intervener is sufficiently large and Nature recognizes R frequently.

Note that one determinant of whether $k$ is “sufficiently low” is the difference between $p'$ and $p$. As this difference increases, G obtains progressively more coercive power by developing the nuclear weapon. Correspondingly, G can extract greater concessions in negotiations with R and is therefore willing to pay a greater price to proliferate. Perhaps surprisingly, this suggests that G is most likely to pursue nuclear weapons when the potential rebel groups are relatively weak because such groups would receive the largest jump in power through an intervention (Gent 2008).

At the other extreme, the model predicts no building when costs are high:

**Proposition 2.** If the cost to proliferate is sufficiently great, G never builds in every SPE.

See the appendix for a complete proof and the exact cutpoint on $k$. Intuitively, G prefers building nuclear weapons if they cover the cost of investment. Not proliferating guarantees G at least its payoff through war, while proliferating gives G its armed value minus the construction cost. Thus, holding these first two values constant, increasing the cost $k$ to sufficiently great levels guarantees that G would never want to build.

While Propositions 1 and 2 explain whether we observe nuclearization, they fail to explicate the likelihood of war. We address this now:

**Remark 1.** The parameters for which war is supported in equilibrium are greater under the conditions of Proposition 2 than the conditions of Proposition 1.

The intuition follows from Lemma 2. When R’s effective power is greater (because T will intervene), G must offer a larger amount to appease it. But because G can only concede so much per period, R is willing to fight under a larger set of circumstances here.$^{11}$ Thus, in circumstances where G has a nuclear weapon to deter T from interven-

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$^{11}$More technically, this is because the analogous $y^*$ when T will intervene equals $\frac{(1-\delta p)(p'-c_R)}{1-\delta}$. This value is strictly greater than $y^*$, meaning there is a larger parameter space here where G cannot fulfill R’s minimal demands than when T would not intervene.
ing, war is less likely. But when G lacks that deterrent, peace is more likely to prevail because R lacks an attractive war option.

This result is worth interpreting further. Although scholars recognize that nuclear weapons can have a pacifying effect on interstate war, our model indicates that the same is true for some types of civil wars. With the support of an alliance partner, R is willing to take risks it would avoid on its own (Crawford 2005; Kuperman 2005; Kuperman 2008). These additional risks lead to more civil wars. Proliferation, however, functionally eliminates the alliance partner and thereby leads to fewer intrastate conflicts.

As a final note, the model predicts that nuclear weapons only affect the probability of civil war when the likelihood of rebels coordinating in any period falls in a middle range. The logic fails on the extremes for two separate reasons. When $q$ is sufficiently low, the cutpoint for Proposition 1 shows that G does not build—the probability of civil war is too low to justify the costs of a weapons program. Because G never proliferates, it cannot alter T’s decision to intervene, which in turn does not change R’s willingness to rebel. Meanwhile, when $q$ is sufficiently high, G and R always negotiate an agreement. With peace always assured, nuclear weapons can only alter the distributional consequences of an agreement, not the likelihood of war.

3 Tracing the Mechanism: Libya, 1969-2011

Formal models derive causal relationships and show how certain inputs correspond to outputs. In particular, our model shows the conditions under which a state would proliferate in the shadow of civil war. More precisely, Condition 1, Condition 2, and Proposition 1 give the precise premises that translate to nuclearization: (1) a third party would intervene in the absence of nuclear weapons, (2) that third party would not intervene if the government controlled nuclear weapons, and (3) the cost of proliferation is sufficiently cheap.

To provide empirical evidence for the mechanism, we must therefore find a case that matches these inputs and check whether attempts to proliferate resulted. While we believe that the mechanism plausibly helps explain a number of cases—North Korea, 12 This is easy to see in the extreme—when $q = 1$, the game converges to an iterated version of Fearon’s seminal model.
Iraq, and Syria—this section focuses on Libya. Despite Libya’s unsuccessful attempt to nuclearize, Muammar Gaddafi’s regime is an ideal case study. Proving that a case meets the above criteria requires approaching the problem from many angles. To wit, the cost restriction in Proposition 1 relies on nuclearization to be cheap relative to the stakes at hand. It would therefore be useful to observe whether proliferation decisions changed as that cost fluctuated. Likewise, (1) and (2) require substantial counterfactual thinking, as revolutions and wars are rare. Although scholars have recommendations on how to construct the counterfactual, each step deeper is another layer removed from reality. Consequently, the ideal case to study would have variance in its independent variables, essentially allowing it to be its own counterfactual.

Libya provides just such an opportunity. In brief, when the costs of proliferation were low, Gaddafi invested in nuclear arms; when the cost increased due to factors exogenous to civil war, he terminated the program. We trace the mechanism in four steps. First, we provide a brief background in the conflict between the United States and Libya. The following subsection explains the United States’ intervention calculation in 2011 to motivate Condition 1. After, we address a counterfactual world with a nuclear-armed Libya to motivate Condition 2. The final subsection discusses Libya’s cost to proliferate, which differentiates the parameters of Propositions 1 and 2.

3.1 Background: Gaddafi versus the United States

Muammar Gaddafi came to power in the wake of a 1969 coup that displaced the relatively pro-Western Sanussi monarchy. Gaddafi was an avid believer in Gamal Abdel Nasser’s confrontational version of Arab nationalism, openly advocating the use of Libyan resources to promote Arab unity and confront the West outside of Libya’s borders (Vandewalle 2012, 79). Although this confrontation began with the expulsion of American and European military bases shortly after the revolution, it waxed with a series of terrorist attacks and military confrontations in the 1980s. In 2003, negotiations between Libya and the United States and United Kingdom led to a resumption of diplomatic relations, the removal of sanctions, and the dismantlement of Libyan

\footnote{We do not focus on credible commitment issues that Gaddafi and the rebels faced. While this is central to our theory, the mechanism is well-understood (Fearon 2004; Walter 1997). We also do not focus on the source of the disagreement—the fact that the parties came to blows is enough to illustrate the disagreement between them. For more on Gaddafi’s rentier state, see Vandewalle 1986, Vandewalle 2012, Pack 2013, and Wright 2012.}
chemical, nuclear, and missile programs. Nonetheless, during the Arab Spring revolt of 2011, the U.S. supported a NATO-led, U.N.-authorized peacekeeping operation in Libya. Washington justified it on the grounds of protecting civilians but clearly aimed to remove Gaddafi from power.

Of course, conflict between the United States and Gaddafi did not begin in 2011. Although the primary grievances behind the 1969 coup were economic, Gaddafi and the other officers who overthrew King Idris cited the king’s pro-Western stance to legitimize their stroke (Vandewalle 1986). In one of its first moves, the new regime removed American and other NATO airbases from Libya, which involved a personal armed confrontation between Colonel Gaddafi and an American four-star general (Lobhan and Dalton 2014, 59-60).

These issues did not stop at the border. Throughout Gaddafi’s rule, Libya expended significant resources funding anti-Western separatist organizations (Lobhan and Dalton 2014, 13-16 and 65-73; Vandewalle 2012, 128-133; Wright 2012, 211-214). These projects began with arms shipments to the Irish Republican Army (Lobban and Dalton 2014, 71). By the end, Libya’s reach extended to thirty different groups, from Venezuela to the Philippines (Lobban and Dalton 2014, 71; Vandewalle 2012, 130).

The United States responded by closing its embassy in 1980 and applying various economic sanctions. In 1981, the U.S. Navy shot down two Libyan fighters over disputed waters. The United States famously bombed Tripoli in the wake of a 1986 attack on American troops in Germany, but this failed to deter further attacks such as the infamous bombing of Pan Am 103 over Lockerbie in 1988. Lockerbie and other brazen Libyan actions eventually triggered multilateral sanctions which had a far greater effect than unilateral American sanctions or American military action (Vandewalle 2012, 150-151). Libya began to distance itself from terrorism during the 1990s, admitting responsibility for the Lockerbie bombing and allowing two suspects to face prosecution in an international court. Gaddafi eventually agreed to compensate victims for the Lockerbie bombing and settled other diplomatic issues. But his decision did not reflect a change in ideology—rather, he buckled to the tightening screw of economic restrictions.14

By 2002, Libya’s WMD program was the only major concern standing in the way of sanctions relief and the restoration of normal diplomatic relations (Vandewalle 2012, 128-133 and 166-170).

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14For a full discussion, see Vandewalle 2012, 128-133 and 166-170.
180). After Western intelligence agencies intercepted a shipment of nuclear technology from the A.Q. Khan network—an event that proves critical later—Libya reached an agreement with the United States to terminate its WMD programs in December 2003. The detente with the United States concluded in 2006, when Libya was finally de-listed by the State Department as a sponsor of terrorism. Yet even before the process was complete, American diplomats began to feel that “both sides ... were somehow not quite getting what they had bargained for” (Chorin 2012, 99). Presciently, a running joke in the embassy was that Gaddafi’s country was “Iraq, but without the shooting—for now” (Chorin 2012, 100).

Tensions arose in multiple places. Libya backtracked on promised economic reforms and attempted to cancel Lockerbie payments using a legal loophole. Tempers flared over the fate of five Bulgarian nurses and a Palestinian doctor who had been arrested in 1999 and sentenced to death in 2004 for allegedly spreading AIDS to Libyan children. By 2009, Gaddafi accused Washington of terrorism and “dictatorship” (Chorin 2012, 160-161). That same year, Libya demanded that Abdelbasset al Megrahi, the convicted Lockerbie bomber serving a life sentence in Scotland, be released on compassionate grounds so that he could succumb to cancer in Libya. Gaddafi greeted Megrahi with a publicly-organized hero’s welcome. At one point, Gaddafi even reneged on part of his nuclear disposal agreement—not to restart Libya’s program, but merely as petty retaliation for an incident involving his accommodations during a 2007 U.N. visit (Chorin 2012, 161).

Thus, despite the appearance of detente, the United States was ready to topple Gaddafi. For the moment, though, Washington lacked a feasible plan to accomplish that goal.

3.2 The Calculus of Intervention

Recall that one necessary condition for our mechanism is that the third-party is willing to intervene in the absence of nuclear weapons; that is, Condition 1 states that $c_T$ must be less than $p’ - p$. While clearly the United States was willing to intervene—Washington did just that—the reasons the intervention occurred are informative for what would have occurred in a world with a nuclear-armed Libya. We thus detail the motivation here, focusing on the low costs but pivotal effects of the intervention.
On February 15, 2011, the arrest of a prominent human rights lawyer sparked a revolt that quickly engulfed Eastern Libya. A month later, United Nations Security Council Resolution 1973 authorized the enforcement of a no-fly zone, ostensibly to prevent a humanitarian catastrophe. Aside from a no-fly zone, the resolution authorized “all necessary measures,” short of an “occupying force,” to protect civilians. The United States, United Kingdom, and France correspondingly began neutralizing Libyan air defenses and ground forces while negotiating the best way to organize the international intervention (Chivvis 2014, 79-80). Eventually, they settled on NATO. Over the next few months, NATO’s mission evolved into an explicit attempt to implement regime change, with the aid of Arab League allies. Although the revolution originated in the east and the Cyrenaican National Transition Council (NTC) gained international recognition as Libya’s new government, rebels in the West that took Tripoli on August 15 and led Gaddafi to his infamously gruesome demise near his hometown of Sirte on October 20.

The foreign intervention was pivotal. Pro-Gaddafi forces were on track to take Benghazi prior to the bombing campaign, and whatever the humanitarian result would have been, the city is the capital of Cyrenaica and was the heart of the rebellion (Vandewalle 2012, 204; Wright 2012, 237). During the stalemate following the defense of Benghazi, the no-fly zone preserved anti-Gaddafi forces in strategic locations outside of Cyrenaica, who required resupply via air and sea (Pack 2013, 7-8). NATO forces cleared a path for one group of these forces to take Tripoli, and an American drone enabled Gaddafi’s capture by bombing his convoy (Chivvis 2014, 161 and 175; Vandewalle 2012, 206). In terms of our model, this tells us that the difference in the rebels’ power with and without support \((p' - p)\) was large.

However, Condition 1 states that intervention only occurs if the shift in power is relatively great compared to the costs of participation \((c_T < p' - p)\). The historical record is unambiguous here: the Libyan intervention was one of the cheapest wars the United States has ever fought. Of the nineteen nations participating in the intervention, Washington paid the highest cost at $1.1 billion, less than half the cost of similar operations in Kosovo and a paltry sum compared to major ground wars (Chivis 2014, 176 and 207-208).\(^\text{15}\) The United States paid potentially larger political costs in the

\(^\text{15}\)This includes one aircraft lost in an accident and some very expensive cruise missile and B-2 strikes that critics contend were really intended for audiences outside of Libya (Chivvis 2014, 81-82).
wake of post-Gaddafi anarchy. There was serious concern over weapons caches, such as portable surface-to-air missiles, that ended up on the international black market. Nonetheless, some of these costs may have occurred absent intervention, and Defense Secretary Robert Gates ensured that the White House considered the risks of a post-Gaddafi Libya (Chivvis 2014, 40).

The only other pitfall Washington faced is that the United States and Libyan rebels did not share identical interests. Indeed, the international intervention started before the United States had even recognized the NTC. Nonetheless, lack of economic opportunity was a common grievance for everyone outside Gaddafi’s political elite. Thus, American policymakers and most Libyan rebels had a common cause, as Gaddafi’s political and economic systems were “intrinsically linked” (Vandewalle 2012, 160). Put bluntly, this was better than the alternative for the United States. Libyan citizens wanted economic opportunities, and the United States wanted a Libya peacefully integrated into the neoliberal international order. The United States was willing to gamble on regime change.

With that in mind, we can confidently conclude that the United States’ costs were lower than America’s effect on the outcome of the civil war. In terms of our model, Condition 1 held.

3.3 The Deterrent Effect of a Nuclear Weapon

Before we can address the feasibility of a Libyan nuclear weapon, we must first ask whether it would have any coercive consequences. In terms of the model, the question is whether Condition 2 holds—that is, if the cost of intervention against a nuclear-armed state \( c' \) outweighs the benefits \( p' - p \). If so, we would expect the target government to pursue nuclear weapons provided that they are sufficiently cheap.

As a practical matter, had Libya possessed a nuclear device in 2011, Gaddafi could have used two different delivery mechanisms. First, he could have outsourced. So far, the biggest obstacle to nuclear terrorism has been states’ unwillingness to let terrorists acquire nuclear weapons, rather than the logistical difficulties of planning a covert attack. Gaddafi’s nearly unparalleled sponsorship of diverse terrorist organizations

\[16\text{In fact, the Libyan revolution initially consisted of numerous revolts all over the country, some of them by specific ethnic groups with historical grievances (Wright 2012, 223).}\]
would have put Libya in a position to strike targets essentially anywhere.\textsuperscript{17} Although designing efficient nuclear warheads that can be delivered by missiles or aircraft is a significant technical challenge, building a crude nuclear weapon is not. As early as 1977, a U.S. government report determined that “\textquoteleft[\textquoteleft[g]iven the weapons material and a fraction of a million dollars, a small group of people, none of whom have ever had access to the classified literature, could possibly design and build a crude nuclear explosive device ... .\textquoteright\textquoteright” (Bunn 2008).

Such an attack on mainland American would be devastating. Indeed, a 10 kiloton nuclear explosion during the workday in Manhattan would kill about 500,000 people and cause a trillion dollars in damage (Bunn 2010, 3).\textsuperscript{18} Even the moderate likelihood of one successful nuclear retaliation by Libya would have deterred NATO’s intervention.

Second, in a counterfactual world where Libya proliferated, Gaddafi could have used domestic forces to hit a regional target. While the Libyan Air Force had negligible bomber capabilities, Gaddafi began development of the Al-Fatah ballistic missile system in the 1980s. This program was never completed because it was superfluous—the 2003 agreement halted development of the payload. Had development continued, the missiles had an intended range of 1300-1500 kilometers (Nuclear Threat Initiative 2015). This would have put most of Italy, southern France, all of Israel, and the large American airbase at Incirlik, Turkey in range. Libya also possessed Scud-B and C missiles that could threaten Malta, parts of Sicily, parts of Egypt (such as Alexandria) and much of Chad (Nuclear Threat Initiative 2015).

Further, using a nuclear weapon would have been credible had the intervention succeeded. This was a centrist civil war after all\textsuperscript{19}—it jeopardized the survival of Gaddafi’s regime and person.\textsuperscript{20} With nothing to lose, all options would have been on

\textsuperscript{17}A simple plutonium bomb could easily fit in a shipping container and be nearly undetectable (Defense Science Board Task Force 2001, 28).

\textsuperscript{18}In comparison, the Hiroshima bomb had a 15 kiloton capacity.

\textsuperscript{19}Although regional grievances inspired much of the initial rebellion, Libya’s civil war was not separatist for at least two reasons. First, the rebellion was not exclusive to Cyrenaica. Second, no state was willing provide a long-term peacekeeping force to protect the NTC, which had no regular military forces and would have been vulnerable to Libya’s military after demobilization (Vandewalle 2012, 206).

\textsuperscript{20}Negotiations between the NTC and Gaddafi included proposals in which Gaddafi would be exiled but elements of the Libyan regime would stay in power, a position publicly supported by Russia. These fell apart because few countries were willing to accept Gaddafi, especially the ICC issued a warrant (Chivvis 2014, 150).
the table. Even if Gaddafi’s missile systems were underdeveloped or eliminated, the terrorism option would have remained. Nuclear states are reluctant to provide nuclear weapons to terrorist organizations because terrorists are hard to control. Further, nuclear forensics would allow the source of such a strike to be traced, causing the usual deterrence logic to apply (Bunn 2010, 20). Even proponents of this argument acknowledge exceptions if the survival of the regime was at stake or “as a last act of vengeance as a regime is collapsing” (Bunn 2010, 20).

Indeed, statements by former Libyan leaders indicate that deterrence motivated Libya’s proliferation attempts. In the wake of the 1986 bombing of Tripoli, Gaddafi argued “if we had possessed a deterrent—missiles that could reach New York—we would have hit it at the same moment. Consequently, we should build this force so that they and others will no longer think about an attack ... the world has a nuclear bomb, we should have a nuclear bomb” (Braut-Hegghammer 2009, 4). According to an anonymous Libyan official, the regime worried about an American intervention and “there was a renewed purchasing campaign ... driven less by status than a desire to ensure Libya’s survival” (Braut-Hegghammer 2009, 4). Mohamed Azwai, former Libyan ambassador to London, claims that they “thought of obtaining WMDs at the beginning when problems with the West started ... . When Lockerbie came it made [them] convinced that this decision was right” (Corera 2006, 178). Moreover, sometime in the 1990s, the Libyan military concluded that nuclear weapons were no substitute for conventional forces, as demonstrated by the Falklands War and the Israeli invasion of Lebanon (Braut-Hegghammer 2009, 5).

During the 2011 invasion, Saif Gaddafi even suggested that nukes would be an effective deterrent:

It’s a good lesson for everybody, for us and for others ... . We heard many news from Iran, North Korea, saying: 'This is your mistake, Libyans. You give up your weapons of mass destruction. You’ll stop [sic] developing long-range missiles, you became very friendly with the West, and this is the result.' So, what does this mean? It means this is a message to everybody that you have to be strong, you never trust them, and you have to be always on alert. Because those people don’t have friends. Over one night, they change their mind and start bombing us. And the same thing could happen to any other country. (Gaddafi 2011)
Thus, what was a cost-effective exercise would have been exceedingly burdensome had Libya possessed a nuclear weapon. In terms of the model, this indicates that Condition 2 would have held in a counterfactual world with a Libyan deterrent even if we assume that nuclear weapons would have had no direct effect on the outcome of the conflict. Put formally, \( c_T' > p' - p \).

Further, because the rebels needed air support to avoid complete eradication, we can reasonably believe that \( p \) (the probability of victory absent intervention) met the condition in Remark 1. That is, the status quo was preferable to near-certain death plus the associated costs. In turn, it seems that a nuclear-armed Gaddafi might have avoided a civil war entirely in 2011.

3.4 Nuclear Options With and Without the Khan Network

While we have shown that two of the conditions for proliferation held, we are still missing a third: Proposition 1’s restriction on \( k \), which requires the costs of proliferation to be relatively low. If this were to hold, we would expect the state in question to develop nuclear weapons. In contrast, if the cost of proliferation were too expensive, the parameters of Proposition 2 would hold, and we would expect the state to forgo nuclear weapons despite their attractiveness.

Libya’s case is especially interesting to consider because there was substantial variation in its proliferation costs over Gaddafi’s tenure. Unlike many states with atomic weapons programs, Libya had little domestic know-how. Thus, proliferating at a reasonable cost required technical assistance from elsewhere. After its attempts to buy weapons directly from China and India failed (Sollingen 2007, 213; Nuclear Threat Initiative 2015) and its deal to fund Pakistan’s nuclear program in exchange for the resulting technology broke down (Corera 2006, 12), Libya developed different parts of the nuclear pipeline as opportunities arose. By 2002, Libya possessed a nuclear weapons design based on a weapon that China had tested in the late 1960s (Nuclear Threat Initiative 2015, Associated Press 2004.) and had purchased enough centrifuges to produce 10 bombs a year, (Corera 2006, 109). The IAEA now believes Libya had

\[21\] Note that \( c_T' \) implicitly refers to the expected cost of intervention for the third-party. Given the enormous cost of a successful nuclear detonation, it is reasonable to believe that \( c_T' \) would have exceeded \( p' - p \) even if there were a very low chance that a nuclear strike would have been successful.

\[22\] The smallest known Chinese test in the 1960s had an estimated yield of 12-30 kilotons (Center for Nonproliferation Studies 1998).
stockpiled 2,263 metric tons of yellowcake uranium ore, only 1,000 tons of which were
declared to the IAEA.

However, a finalized weapon in the absence of a native program required the as-
sistance of A.Q. Khan’s black market network.\footnote{Libya’s pre-Khan purchases included an entire uranium hexafluoride production facility, which it failed to assemble despite over a decade of trying. This illustrates Libya’s need for an integrated network that could provide technical assistance as well as physical parts. (Corera 2006, 108)} Libya never succeeded in converting the yellowcake into gaseous uranium hexafluoride (UF$_6$) for the centrifuges. Rather, it acquired about two metric tons of UF$_6$ from either Pakistan or North Korea through Khan’s network. The purpose of this UF$_6$ was to allow Libya to test its centrifuges while establishing its own conversion facility. However, the delivered gas alone would have been enough for one bomb, had Libya made the centrifuges operational and developed the capability to produce weapon components (Corera, 120; Nuclear Threat Initiative 2015). Libya had ordered 20 metric tons of UF$_6$ from the Khan network, enough for a small arsenal even if it never finished its uranium conversion facility (Corera 2006, 109). The feasibility of such purchases—and Khan’s desire to find buyers at reasonable rates—made the price right for Libya.

The above indicates that the cost condition from Proposition 1 held. And just as Proposition 1 predicts, Gaddafi pursued nuclear weapons.\footnote{Of course, Gaddafi did not actually obtain a weapon. The model makes the simplifying assumption that building immediately produces a bomb. However, we could obtain theoretically equivalent results if the proliferation process took multiple periods or had some probability of failure.} But the parameters of the interaction were about to change. Between 1995 and 2000, Libya negotiated a deal with Khan including the aforementioned components and enough advanced P-2 centrifuges to enrich material for ten bombs a year. Critically, the deal included extensive training for Libyan scientists and engineers, something only the Khan network could provide (Corera 2006, 109-120; Nuclear Threat Initiative 2015).

By March 2003, Libya had initiated secret talks on disarmament with the United States and United Kingdom (ElBaradei 2011, 150). However, such communications were typical and never amounted to anything. Indeed, as standard, Gaddafi expanded his nuclear program, continued to work with the Khan network, and stonewalled inspections of nuclear sites after suggesting a compromise (Corera 2006, 185-186). Libya had the motivation to talk about such deals but still lacked the incentive to follow through.

British intelligence provided the impetus. Working closely with the CIA, authorities
began tracking the Khan network’s exports in 2000. By 2002, unbeknownst to Libya, the British Joint Intelligence Commission identified that the Khan network was “central to all aspects of the Libyan nuclear weapons program” (Corera 2006, 168). The agencies successfully infiltrated it. On October 4, 2003, a joint CIA-MI6 team intercepted the BBC China carrying thousands of nuclear components from Khan’s network in Malaysia to Libya (Corera 2006, ix-x and 186-187). Libyan authorities were informed that the ship was intercepted and reversed their policy of non-cooperation less than two weeks later (Corera 2006, 187).

Without the Khan network, Libya had no affordable nuclear path in sight. Rather than proliferate on the cheap, Gaddafi would have had to produce a native program with neither the expertise nor the industry at the ready. Put simply, Libya had “a nuclear program that did not know what it was doing” (Hymans 2012, 242). In terms of the model, $k$ increased dramatically. Proposition 2 correspondingly predicts that attempts to proliferate will end, and that is exactly what occurred. On December 19, 2003, Libya terminated its program in exchange for modest concessions from the West. Although Gaddafi dragged his feet on a number of the terms, he never backtracked on the termination of the nuclear program—even as the United States was sidetracked with insurgencies in Afghanistan and Iraq.

### 3.5 Additional Cases

Although Libya makes for an ideal case study due to the information and variation in nuclear costs over time, we believe our mechanism applies to other cases as well. We quickly establish a couple here.

**Israel.** Most of the existing literature on Israel’s security policy ignores Israel’s Palestinian/Arab minority, and likewise most of the literature on Israel’s Arab minority ignores Israel’s security policy. This overlooks the statements of Arab, Israeli, and Palestinian leaders who saw the issues as very much linked. Corresponding to Condition 1, we argue that in fact Israel feared an intervention from Egypt and its allies would had an internal rebellion began.

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25See ElBaradei 2011 (154-155) for a detailed rundown of the state of Libya’s program at the time of the agreement.
At the end of the 1948 war, Israel was left with an Arab population of 150,000 out of a total population of 850,000 to 900,000 (Morris 1999, 259). The distribution of the population made Israeli leaders feel vulnerable, as a large portion of the Arab population occupied a strategically important stretch of Israel less than 10 miles thick, abutting Arab villages on the other side of the Green Line (Frisch 2011, 19). The rural Arab population roughly equaled the rural Jewish population, making Israeli leaders uncertain of their ability to hold large swaths of territory in the Galilee and elsewhere (Frisch 2011, 20).

Israel’s security fears went beyond the concern that Arab villages would aid enemy infiltrators like the Fedayeen who killed hundreds of Israelis in the 1950s. At the time, the Arab population was seen as an existential threat, comparable to the German minority in pre-WWII Czechoslovakia (Dowty 1998, 190). No Arab revolt ever materialized inside Israel proper, possibly because Israel kept its internal Arab population under a system of military rule. Yet Israel abolished that military rule in 1966, the same year Israel developed the capability to assemble a nuclear weapon (Cohen 2010, 54). One year later, Israel captured the West Bank and Gaza, substantially increasing the Arab population under its control.

History suggests how the Arab League would have responded to an Arab uprising. In 1947, a civil war broke out in Palestine after the passage of a UN plan to partition Palestine into Jewish and Arab states. In 1948, following the official termination of the British Mandate and the declaration of Israel’s independence, an Arab League coalition intervened, turning the civil war into an interstate conflict. In the wake of Israel’s victory in 1949 and the Palestinian refugee crisis, the Arab League and most of its members made the Israeli-Palestinian conflict the focal point of pan-Arab nationalism (Ghanem 2001, 17). Military regimes in Egypt, Syria, and Iraq repeatedly used their involvement with the Palestinians as a source of legitimacy, while Jordan used the Palestinian problem as an excuse to nationalize the West Bank (Ghanem 2001, 17). A Palestinian revolt in the absence of an Israeli nuclear deterrent would have given the Arab League a temporary military advantage, on top of domestic political pressure driven by pro-Palestinian sentiment. Given how frequently Israel and its neighbors fought for other reasons, it is hard to imagine a scenario in which Israel’s neighbors would let such an opportunity go to waste—if Israel could not implicitly threaten nuclear retaliation.
North Korea. Acts of rebellion in the Hermit Kingdom are more common than frequently believed. Although South Korea and the United States have not publicized how they would respond to a regime-threatening uprising in North Korea, the countries have military plans for regime change in the case of an attack by the North, as well as contingency plans should the regime fall on its own (Ryall 2015; Scarborough 2013). North Korea kills South Korean military and civilian personnel on a semi-regular basis, and the United States frequently portrays North Korea as a major national security threat. Corresponding to Condition 1, it is reasonable to infer that if the North temporarily lost its ability to retaliate against South Korean cities, South Korea and the United States might not let the opportunity go to waste.

Absent nuclear weapons, North Korea has conventional means of deterrence, particularly artillery that is pre-aimed at Seoul (Choi and Bae 2014, 56). Nonetheless, these static emplacements are vulnerable to well-timed air strikes and may be unreliable in the event of military defections or large-scale revolt. Although North Korea currently has limited delivery options, an improvement in its arsenal size and delivery systems would allow it to strike a US naval force or cities in South Korea and Japan, either via a missile, a ship, or by smuggling. Thus, our model predicts that North Korea has strong incentives to continue developing its nuclear arsenal and delivery systems.

4 Conclusion

While standard models of deterrence focus on how nuclear weapons pacify international relations, our paper showed that this effect extends to civil wars as well. Regimes at risk for popular uprisings have incentive to develop nuclear weapons to deter third-parties from intervening. This has a first-order effect of reducing the probability of interstate war (foreign intervention into civil conflict). Yet it also has a second-order effect of reducing the probability of civil war—knowing that the third-party will stay out, rebel groups are less likely to initiate a conflict in the first place. We illustrated the mechanism using Libya, though other cases—particularly North Korea—fit similarly.

26Stanton 2007 summarizes a list of incidents detailed in Jasper 2006 and other sources. These include camp rebellions, food riots, organized demonstrations, and military plots. Stanton also argues that North Korea’s geography and infrastructure make it vulnerable to a potential insurgency, though he records no such attempts.
Our work has a couple of natural implications, which we conclude with. First, negotiations are not a silver bullet toward nonproliferation. While such deals can be credible between states, civil issues such as the one we outlined may force governments to eschew an agreement. This does not mean that the international community should stop negotiating with states like Iran. Rather, it means that the international community should not believe that nuclear bargaining can solve all proliferation problems. Instead, the community may need to rely on erecting nuclear barriers—such as eliminating black markets—to increase the cost of proliferation to intolerably high levels.

Second, the incentives for autocratic regimes to develop a nuclear deterrent increase in the presence of a hyperpower. Put differently, the United States is a victim of its own strength. Washington’s ability to project power is historically unparalleled. Using this reach, one of its goals has been to minimize the number of nuclear states through targeted coercion. Yet the ability to coerce in this manner correlates with the ability to successfully intervene in civil wars. We would thus expect fewer autocracies to seek nuclear weapons when states in the system cannot project its power so effectively.

5 Appendix

This appendix gives complete proofs for the claims in the paper. Note that as a convenient normalization, we multiply all utilities by $1 - \delta$.

5.1 Proof of Lemma 2

Let $V_R$ be R’s continuation value for any given period. First, we show that $V_R \geq q(p - c_R)$ in all SPE for every history of the game. The proof is as simple as noting that in the following period, Nature recognizes R with probability $q$, and R can guarantee itself at least $p - c_R$ by rejecting. Doing so in expectation generates a payoff of $q(p - c_R)$.

Second, in all SPE for all histories of the game, R must accept $y_t > \frac{(1-\delta)q(p - c_R)}{1-\delta}$ in periods that Nature recognize it. To see this, note that the first step ensures that R’s value for accepting is no less than $(1 - \delta)y_t + \delta q(p - c_R)$. Meanwhile, rejecting assuredly delivers $p' - c_R$. Thus, R must accept if:

$$(1 - \delta)y_t + \delta q(p - c_R) > p - c_R$$
\[ y_t > \frac{(1 - \delta q)(p - c_R)}{1 - \delta} \]

Note that if \( \frac{(1 - \delta q)(p - c_R)}{1 - \delta} > 1 \), no such offer can satisfy R if G gives nothing during unrecognized periods. We continue the proof for \( \frac{(1 - \delta q)(p - c_R)}{1 - \delta} < 1 \).

Third, in all SPE for all histories of the game, G never offers \( y_t > \frac{(1 - \delta q)(p - c_R)}{1 - \delta} \) in periods where Nature recognizes R. Note that if G were to adopt such a strategy, there would be a period in which R accepted G’s offer. However, consider a deviation to offering some \( y_t > \frac{(1 - \delta q)(p - c_R)}{1 - \delta} + \epsilon \) in periods where Nature recognizes R and \( y_t = 0 \) in periods where Nature does not recognize R. From the second step, R must accept these offers. However, for sufficiently small \( \epsilon \), this leaves more for G either because it does not make an unnecessary concession or because it avoids war. Thus, G can never offer \( y_t > \frac{(1 - \delta q)(p - c_R)}{1 - \delta} \) in SPE.

Fourth, in all SPE for all histories of the game, R rejects \( y_t < \frac{(1 - \delta q)(p - c_R)}{1 - \delta} \). The above three steps imply that R will never receive an offer greater than \( y^* \) in periods where Nature recognizes R. In turn, R’s continuation value cannot exceed \( q(p' - c_R) \) unless G offers more than 0 in periods where Nature does not recognize R. The third step shows that G could profitably deviate from that, though. Using these facts to establish an upper limit on R’s continuation value, R must reject if:

\[ (1 - \delta) y_t + \delta q(p - c_R) < p - c_R \]
\[ y_t < \frac{(1 - \delta q)(p - c_R)}{1 - \delta} \]

Finally, the above four steps imply that R’s subgame perfect continuation value for every history of the game equals exactly \( \frac{(1 - \delta q)(p - c_R)}{1 - \delta} \). Given the above constraints, the only way this can occur is if G offers \( y^* \) in each period where Nature recognizes R, R accepts all offers at least as great as \( y^* \) in those periods, and G offers \( y_t = 0 \) in all periods where Nature does not recognize R.

If \( \frac{(1 - \delta q)(p - c_R)}{1 - \delta} > 1 \), multiple equilibria exist. This is because G giving nothing in unrecognized periods and any amount in recognized periods with R always rejecting minmaxes each player. Consequently, these are reversion strategies. In turn, the folk theorem applies, allowing any division of the surplus to be supported by an equilibrium.

\[\square\]
5.2 Proof of Proposition 2

By Lemma 2, arming secures $G 1 - \frac{q(1-\delta q)(p-c_R)}{1-\delta} - (1-\delta)k$. If $G$ does not build, $R$ can minmax $G$ by rejecting in every period Nature recognizes it. This leads to a complicated expression because $R$ can only reject with probability $q$ in each period (locking in $1 - p' - c_G$ for the rest of time), leaving $G$ to capture the entire good the remaining $1 - q$ portion of the time for just that period. Furthermore, each period that Nature does not recognize $R$ leads to a repetition of this process discounted by $\delta$. All told, this gives $G$ a payoff of:

$$q(1 - p' - c_G) + (1 - q)(1 - \delta)(1)$$

$$+ (1 - q)(\delta)[q(1 - p' - c_G) + (1 - q)(1 - \delta)(1)]$$

$$+ (1 - q)^2(\delta^2)[q(1 - p' - c_G) + (1 - q)(1 - \delta)(1)]$$

$$+ ...$$

Fortunately, this is a geometric series with finite sum:

$$\frac{q(1 - p' - c_G) + (1 - q)(1 - \delta)(1)}{1 - (1 - q)(\delta)}$$

Thus, $G$ must not build in every SPE if:

$$1 - \frac{q(1 - \delta q)(p - c_R)}{1 - \delta} - (1 - \delta)k > \frac{q(1 - p' - c_G) + (1 - q)(1 - \delta)(1)}{1 - (1 - q)(\delta)}$$

$$k > q \frac{(1 + \frac{p' + c_G}{1-\delta(1-q)} - \frac{q(p_R - c_R)(1-\delta q)}{1-\delta})}{1-\delta}$$

Therefore, for sufficiently large $k$, $G$ does not arm in every SPE.  

As a final point, note that if this does not hold, $G$’s minmax is not preferable to building. In turn, the folk theorem applies if $\delta$ and $q$ meet certain thresholds. However, because $\delta$ and $q$ are bounded, sufficiently great $k$ always exist to ensure that arming never occurs.  

26
Works Cited


