U.S. Foreign Policy and Nuclear “Red Lines”

Please note, this paper is only at the beginning stages of development. We would appreciate feedback on the underlying logic of the theory section, and any advice on the research design section that you might provide. As of right now, we are planning on a series of short vignettes focusing on cases where the US has used red lines, focusing more on explanation, with a second paper focusing more on prediction coming in the future.

Introduction

On September 27, 2012, Israeli Prime Minister Benjamin Netanyahu, in an address to the United Nations General Assembly, identified a nuclear red line for the Islamic Republic of Iran that, if crossed, may lead to the use of military force to prevent Iran’s acquisition of nuclear weapons. Israel’s red line for Iran, illustrated somewhat comically through the use of a cartoonish diagram of an atomic bomb, would be the enrichment of uranium beyond the 90% threshold typically considered necessary for the production of uranium-based nuclear weapons. Shortly before this pronouncement, the Obama administration stated that they, too, would not allow Iran to manufacture nuclear weapons, a position that has been reiterated in the months following, but stopped short, and continues to do so, of publicly stating a threshold beyond which Iran would not be allowed to cross.

Preventing Iran’s acquisition of nuclear weapons may be the single greatest foreign policy challenge of President Obama’s second term in office, yet the extent to which the United States, or anyone else for that matter, is able to influence Iran’s decision to develop nuclear weapons or not remains unclear.
Significantly complicating the situation is that, under the terms of the Nuclear Non-Proliferation Treaty (NPT), Iran is guaranteed the right to enrich uranium to whatever level they desire, as long as it is not used in the production of nuclear weapons. The difficulty lies in the fact that once a state produces weapons-grade uranium, few technical barriers remain to prevent them from assembling a nuclear weapon. A similar difficulty exists with the production of plutonium-based weapons. Thus, if the Obama administration wishes to prevent Iran from acquiring nuclear weapons, they may have to adopt an Israeli-like approach and publicly state that Iran will not be allowed to enrich beyond the critical 20% threshold without risking military intervention, and, perhaps more importantly, be willing to respond if and when Iran proceeds beyond the stated red line. Doing so, however, does in no way guarantee that Iran will be incentivized into giving up their weapons ambitions, nor does it guarantee that their ability to develop said weapons will be affected to such an extent that the production of nuclear weapons, at least in the short term, becomes difficult, if not impossible. Further, placing such a red line, or even engaging in military action against suspected nuclear facilities may, in fact, strengthen Iran’s resolve to actually produce nuclear weapons.

Research Motivation

While there is a substantial literature exploring why states engage in threat-making and various forms of coercive diplomacy, and, relatedly, what kinds of threats and coercive strategies are more or less likely to achieve success, the
uniqueness of the nuclear issue points towards a need to develop a specific, nuanced understanding of the phenomenon. Thus, this analysis will attempt to develop an understanding of why states pronounce *red lines* generally, as well as why they choose the specific type of red line when they are employed.

We argue that, because of the dual-use problem, a bargaining/negotiation process occurs between countries who develop nuclear technologies and the rest of the international community. This process has both formal and informal components. One tool that certain states employ in this negotiation process is the use of so-called “red lines.” These red lines serve dual purposes. First, they act as a mechanism for states to signal to potential or suspected proliferators of what actions or behavior the issuing state may or may not be willing to accept, without risking intervention or punishment. Second, and perhaps more importantly, they serve as a means to test both the intentions and resolve of a suspected or potential proliferator. Whether states issue red lines, and what form they take, we argue is largely determined by the geo-political context in which the activities or behavior takes place, the relationship between the issuer and target state, whether the target is a member in good standing with the existing non-proliferation-related treaties and institutions, and whether there are identifiable motivations for the state to actually engage in nuclear proliferation.

This article thus proceeds as follows. First, we start with a review of the extant literature on bargaining, international negotiations, and nuclear proliferation. We then turn to a brief review of the literature on red lines before
moving on to an explanation of our new approach to the study of red lines and nuclear proliferation more generally. The theory we present in this section provides a logical micro-foundation that explains why states place red lines at very specific points in their proliferation negotiations and how those specific points vary with the target state. Next, we develop a series of hypotheses based on our theoretical framework. We then test our theory using a focused comparison of a select number of cases. Finally, we conclude with a discussion of our findings and the implications of this research for both the academic and policy communities.

*Literature Review – Bargaining and International Relations*

Explanations for state behavior that are based in a bargaining framework abound in the literature on international conflict and cooperation. In the international conflict literature the bargaining framework for war scholarship is directly tied to the neorealist theoretical tradition (Fearon, 1995). The neorealism idea of anarchy producing states without constraints does not lead to warfare between stats, as many early neorealist argued, without first a rationalist explanation of why war is rational under anarchy. The bargaining model of war provides scholars that exact logic.

To begin we first must define what we mean by bargaining. The conceptualization argued by Dan Reiter (2003) that bargaining in international politics is the contentious exchanges between states over scarce goods, which include control over territory, borders, and resources. Included in these
contentious exchanges is bargaining over the policies and actions of a state in relation to the preferred actions of that state by the international community. In our context, this means movement toward nuclear proliferation by one state when the international communities’ (or another state -generally the US) preferred action is movement away from nuclear proliferation.

In our context it is also important to explain the difference and importance of implicit vs. explicit bargaining. Implicit bargaining occurs when one actor takes an action in order to produce a response from another actor. This is mostly likely introducing a decision point into the situation to force the other actor to reveal preferences, resolve or some other type of private information. Explicit bargaining is overt discussion between two or more actors that is designed to produce a partial or full agreement over the contentious issue.

While the first independent treatment of bargaining and conflict is given by Bailey (1988), the argument’s most familiar form comes from the formalized version of Fearon (1995). The model’s basic argument is that war is an inefficient way of resolving issues and should, therefore, be avoided by disputants. This inefficiently results from the high cost associated with the destruction of property and life necessary in war. Placing this high cost action in a bargaining model with perfect information produces a robust finding -- negotiation settlements are always preferable to war. Theories of war onset must, therefore, explain why the disputants chose war over negotiated settlement. Fearon’s (1995) influential article creates its potency by offering
three clear and concise conditions where a rational actor will choose an inefficient war over a more efficient settlement. These conditions are private information and/or incentives to misrepresent information, comment problems, and indivisible issues.

Blaney (1988) first employs the idea of private information and argues that war is an information pathway where disputants acquire information about each other’s capabilities and resolve. The information acquisition logic was advanced and to include a progression from war toward negotiation settlement as conflict continues. This progression comes from each side being able to continually update their victory and loss probabilities as they acquire more information. (Wagner 2000; Goemans 2000; Slantchev 2003). War under this condition is, therefore, seen to be result of private information and solved via the release of that information via battle.

Powell (1999, 2006) offers an extension on the second condition of war by arguing that the “relative distribution” of capabilities between states changes over time, which makes settlement terms less or more appealing. This shift means that settlements signed in time T are likely to be less acceptable to one or other of the parties in time T+1. Both states, however, understand that as capabilities shift over time and as the attractiveness of settlements change their adversary is likely to want a new deal. Each state is, therefore, unlikely to trust the other to honor a settlement’s commitments.
The final condition that leads to war under the bargaining model is indivisible issues. The majority of this work has revolved around either territory (Goertz and Diehl 1992; Vasquez 1993; Hensel 1996, 2000) or ethnicity (Posen 1993; Toff 2003). Each of these issue types are theorized to be so indivisible (under certain conditions) that a rational actor will engage in war even with the probability of victory is very quite low. Indivisible issues are theorized to remove any potential bargaining space where a negotiated settlement could be obtained. They, therefore, often produce war or, at least, long term contention. This argument is, perhaps, most relevant to the study of nuclear weapons and nuclear proliferation, as many states view the acquisition of nuclear weapons, especially by those they perceive or judge to be irresponsible to be an indivisible issue. It is unclear, however, whether this argument extends to the actual process by which nuclear weapons are obtained, particularly as it relates to the acquisition of the capability to produce nuclear weapons.

*Bargaining and Nuclear Weapons/Proliferation*

The relationship between nuclear weapons and bargaining has long been a topic of investigation for scholars of international relations, albeit somewhat indirectly. Much of the bargaining literature of the past half century derived from, in some form or fashion, game theoretic modeling which, in its earliest incarnations, focused almost exclusively on the use and control of nuclear weapons. A cottage industry of research on the bargaining dynamics of arms
control and disarmament arose that continues to inform both academic research and policy-making on this subject.

Nuclear weapons also frequently appear in more general analyses or investigations of bargaining and state behavior, appearing alongside a number of major issue areas often at the center of interstate negotiations (Schelling, 1960; Morrow, 1994; Fearon, 1995; Powell, 2002; Wagner, 2000; Powell, 2006). The logic underlying the focus on bargaining as the framework to understand state interaction is that bargaining itself is the link between the macro level processes and the micro level motivations of states.¹ More recently, quantitative research, such as Gartzke and Jo (2009) and Sechser and Fuhrmann (2013), has shed light on the bargaining advantages conferred by nuclear weapons possession.

What is often overlooked, however, are the bargaining dynamics that occur prior to the acquisition of nuclear weapons or, more succinctly, bargaining and, or perhaps more accurately, during nuclear proliferation. The one exception to this might be the vast literature on the negotiation and/or bargaining processes leading to the creation of the Treaty on the Non-proliferation of Nuclear Weapons (NPT) ("need lit references), which, itself, is often colloquially referred to as the nuclear “grand bargain.”² Somewhat curiously, the NPT is often considered to be the conclusion of the nuclear proliferation bargaining process, as it set the rules by which all states, excluding non-signatories (although this is debatable), are

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¹ Levy and Thompson (2010) offer a good explanation of this bargaining as the link between higher order processes and lower level motivations on page 63-68.
² http://www.armscontrol.org/act/2003_12/Weiss
meant to behave. However, we contend that the creation of the NPT was only a starting point in the negotiation process. In fact, we suggest that every state who has or will develop nuclear technologies, whether they be overtly weapons-related or not, enters into a bargaining process, one with both formal and informal components. And, as we will argue, conceptualizing nuclear proliferation as a bargaining process is key to understanding both why states use red lines and why they place them where they do.

Theory

Underlying virtually all of the nonproliferation efforts undertaken in the last past half century is the realization that, when states begin to construct, procure, or in some other way acquire nuclear technologies, there is a non-zero probability that they may, either in the short or long term, also attempt to develop nuclear weapons. Thus, non-proliferation related treaties and institutions, such as the NPT and the IAEA’s full scope safeguards agreements, are designed to serve both as signaling mechanisms of a state’s compliance with the non-proliferation norm and as assurance mechanisms for states to trust in other state’s commitment to said norm. The difficulty, however, lies in the fact that, with few exceptions, states cannot directly observe and/or conclusively know whether other states who have or are in the process of developing nuclear technologies are also developing nuclear weapons, even for those states who have signed, ratified, and seemingly conform to the terms of these treaties and institutions. This is due to what is known as the “dual-use problem,” and is the fact that, with
very few exceptions, virtually all of the technologies required to produce nuclear weapons may be obtained as a part, byproduct, or under the guise of other processes.\(^3\) This gives rise to an interesting dynamic, in that it is difficult to distinguish, as an outside observer, between states who have little or no interest in developing nuclear weapons and those that do. Further, states that do have an interest in developing nuclear weapons, particularly those who wish to do so covertly, have strong incentives to appear as if they have little or no interest in developing nuclear technologies, further exacerbating the aforementioned “dual-use problem.” It is for this reason that, when a state begins to acquire or construct nuclear technologies, they, in effect, enter into an extended bargaining process between themselves and the rest of the international community.\(^4\)

The goal of this bargaining process is to arrive at an equilibrium point where the developing state has achieved a level of technological development that matches their preferences, and the other party, whether it be a single state, a group of states, or the entire international community, is satisfied with the developing state’s level of technological development \textit{and} is satisfied that the developing state has no intention to use this technology, either in the short or

\(^3\) Developing the capability to produce enriched uranium for use as fuel in nuclear reactors, for example, in most cases also provides a state with the ability to produce enriched uranium for use in nuclear weapons production.

\(^4\) It is important to note that we are not assuming that the international community as a whole is a singular actor. It is common practice in the bargaining/negotiation literature to treat multiparty groups as singular actors when discussing the logic underlying the bargaining process if it can be assumed that the actor’s preferences align. We are not making that assumption, as will be discussed, but it is useful to use this shorthand as an illustrative tool.
long term, to develop nuclear weapons (i.e. the nature of the technology). The difficulty arises in the fact that the preferences of each party may either be unknown to the other or, perhaps more interestingly, each party may have differing private preferences than those that have been announced publicly (the crux of the dual-use problem).

For the developing state, there are numerous ways in which preferences, both public and private, may be transmitted. Technological decisions (heavy water vs. light water reactors, for example), whether they sign, ratify, and abide by existing non-proliferation treaties and institutions, or whether they purposefully conceal the construction of facilities are all examples of how a state’s preferences might be made known to other parties. For observing states, on the other hand, there are very few ways in which their preferences, particularly those that diverge from or are more explicitly restrictive than existing treaties, may be transmitted to the developing state. The one exception to this is the use of red lines, which may provide valuable information to the developing state, and other interested parties, of an observer state’s preferences regarding both the level and scope of technical capability they are willing to accept, and whether and to what extent they are willing to act to insure their preferences are satisfied. Thus, we define red lines as formal or informal communications authorized by the leadership of a state (the sender) that identify actions or behavior that, if undertaken or adopted by another state (the target), may result in the sender
state adopting some action or behavior to “punish” the target. Red lines thus both communicate preferences and act as a form of coercive diplomacy designed to dis-incentivize states from taking certain actions or behavior that run counter to the preferences of the sender state. To illustrate, say that state A begins to develop nuclear technologies. State B perceives that state A may be interested in developing nuclear weapons. State A publicly states that they have no interest in developing nuclear weapons and proceeds with the construction of a series of nuclear reactors. State B, fearing that state A may be using the construction of the nuclear reactors to mask their true intentions, issues a red line to state A saying that the construction of either uranium enrichment facilities or plutonium reprocessing facilities will be unacceptable and, if crossed, may cause state B to sever formal diplomatic ties with state A. If state A had no intention of pursuing uranium enrichment or plutonium reprocessing capabilities, then the red line will not be crossed and, more importantly, reinforces that their private preferences do not include the manufacture of nuclear weapons. However, if their private preferences do include the acquisition of such technologies, whether it be for military or strictly civilian use, then state A may be forced to choose whether to continue their pursuit of these technologies, or risk retaliation/punishment by state B. The central issue, in this case, is that there are no international treaties or laws that prohibit the acquisition of either uranium enrichment or plutonium reprocessing/separation facilities. Further, and perhaps more interestingly, not

5 The resultant action or behavior may or may not be explicitly stated.
all states that undertake the construction of such facilities are subject to ultimatum or threats by other states. So state A may perceive that state B’s preferences are both out of alignment with what is guaranteed or at least prohibited by international law and has been allowed for other states. This may, in turn, lead to the conclusion that other state’s perceptions and threats should not influence whether they decide to produce or acquire these technologies or not. Yet, the possibility that state B might in some way respond to the crossing of the stated red line might be enough to cause state A to re-consider whether satisfying their preferences is worth the risk. While the decision whether to ignore other state’s threats or attempts at coercion is an important one to understand, it is somewhat outside the scope of the current analysis. As a first step, it is perhaps more important to develop an understanding of why states use red lines in some situations and not in others, as well as why the red lines that are placed take their observed form.

As mentioned previously, red lines are mechanisms whereby a state seeks to 1) determine both the scale and scope of another state’s interest in nuclear technologies, 2) test their resolve regarding the production and/or acquisition of specific technologies, and 3) influence their decision-making when it comes to the production or acquisition of said technologies. Red lines can take a number of forms, but can generally be characterized as either technically or politically
oriented. Technologically oriented lines are those that either aim to restrict or deter the construction or acquisition of specific technologies, such as enrichment or reprocessing facilities, or how certain technologies are used (enriching uranium beyond 20%, as an example). For each of these, while states may place red lines at virtually any point along the weapons production process (shown below), there are specific points and/or thresholds that are more likely than others.

For both pathways, the only technology that is exclusive to the production of weapons is the manufacture or production of pits. It is widely recognized that once a state has the requisite materials for pit production, it is largely too late to prevent the state from producing nuclear weapons. Therefore, states that choose to place red lines often do so before this stage and, indeed, before the actual weapons materials are produced. Thus, the most logical point at which to
place a red line is the stage immediately preceding the production of weapons usable material. For the uranium pathway, this would be enrichment. Plutonium, on the other hand, would be separation.\(^6\)

Complicating this, however, is the fact that the production and/or acquisition of both uranium enrichment and plutonium separation capabilities are allowed under the terms of the NPT. The development of such capabilities, therefore, does not necessarily indicate that proliferation is occurring, or will in the future. Thus, many states choose to focus not on their construction, but on their operation.

As a general rule, uranium must be enriched to above 90% to be useful in the production of nuclear weapons, and is therefore considered to be “weapons-grade.” It would therefore be logical for states to act to restrict or deter the enrichment of uranium to below this threshold. Unfortunately, the process by which naturally occurring uranium, with concentrations of the \(^{235}U\) isotope of approximately .7%, is enriched to the levels commonly used to power commercial power reactors (typically between 3-5% \(^{235}U\)) is the same as the process by which weapons grade uranium (above 90% \(^{235}U\)) is obtained. It is simply an extension of the process, typically through repetition, or by the use of additional “stages” of enrichment. Perhaps more importantly is the fact that the energy requirements to

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\(^6\) It is important to note that plutonium separation and plutonium reprocessing are virtually identical processes. Separation is conventionally used to identify military-oriented applications, while reprocessing is used to describe its civilian/commercial equivalent.
enrich uranium decrease as the concentration of $^{235}\text{U}$ increases. Thus, enriching uranium from 20% (the LEU/HEU threshold) to 90% (weapons grade) is a comparatively easier task that enriching natural uranium to a level useful for most modern reactor designs (3-5%).

Historically, the majority of the world’s nuclear reactors (for research, weapons, and/or naval purposes) have been powered with HEU. Only in the past few decades, with the advent of programs such as the United State’s Reduced Enrichment for Research and Test Reactors (RERTR) program, has there been an effort to use LEU. Thus, obtaining the capability to enrich uranium to levels above the LEU/HEU threshold, or even to weapons-grade levels, has not been a definitive indicator that proliferation is occurring or has occurred. Yet, every state that has enriched uranium beyond the 20% threshold has also gone on to produce nuclear weapons. Further, for states that do not currently operate reactors that require fuel enriched beyond the 3-5% range used in most modern reactors, enrichment beyond this level may be an indication that proliferation is occurring. Thus, if a state pronounces a red line with the goal of restricting or deterring the production of weapons-grade uranium, for those states that operate reactors powered by HEU, the 20% threshold is a logical choice, and therefore the most likely decision (Hypothesis 1). For those that do not operate reactors fueled with HEU, however, then the placement of a red line at the 5% threshold becomes the most logical, and most likely decision (Hypothesis 2).

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7 For more information, see http://www.rertr.anl.gov.
The production of plutonium usable for the manufacture of nuclear weapons is the result of a two-stage process: irradiation and separation. The first step, irradiation, is a byproduct of the normal use of virtually all nuclear reactors, regardless of their form or function. However, of the various isotopes of plutonium commonly produced in nuclear reactors, only Pu^{239} is considered to be the most conducive or desirable for weapons construction, and there are only certain reactor types that are more conducive to this purpose than others, and thus only select reactors have been used as such, historically. Therefore, to produce Pu^{239} in quantities sufficient to sustain a chain reaction in a single weapon, not to mention support an actual weapons-program, nuclear reactors are usually specifically designed and/or operated in a manner conducive for this purpose. Reactors designated for commercial or civilian power use, for example, typically have high “burn-up” rates, with the most common type, the pressurized water reactor (PWR), typically operating between 30,000 - 40,000 MWd/t. Production reactors, on the other hand, which are operated to maximize the production of Pu^{239}, typically have low “burn-up” rates, typically on the order of 400 MWd/t, which is done to prevent the buildup of the less desired isotopes of plutonium.\(^8\) While it is technically possible to operate a power reactor in a manner similar to a military production reactor, by removing the fuel elements after a brief period of irradiation, this is costly, in terms of a loss in power generation, and also easy to detect.

\(^8\) Berkhout and Walker (1996)
In a similar vein as what was seen with the uranium-based weapons production path, to sustain a nuclear weapons program, according to criteria established by the IAEA, a proliferating state must construct and operate a nuclear reactor of sufficient size to produce at least eight kilograms per year, or what they term a "threshold" amount. Reactors with low operating capacities generally cannot produce enough Pu-239 on an annual basis to support a nuclear weapons production program, even if they are operated specifically for this purpose (which, even in cases where these reactors have supplied small amounts of Pu-239 for weapons-related purposes (such as North Korea), they are typically used simultaneously for other purposes as well). This may be circumvented, somewhat, by employing a number of small-scale reactors for this purpose, but such an endeavor increases both the cost of constructing and operating such facilities, and increases the likelihood of detection and discovery of proliferation-related activities. Thus, the construction of a research reactor with a relatively high operating capacity, generally greater than 10 MWth, is a much stronger signal than the construction of a reactor with a relatively small operating capacity, (a 250 kWth TRIGA reactor, for example). It is necessary to point out, however, the construction of a large-scale reactor, even one that does not appear to be for power-production purposes, does not unequivocally indicate that it is for proliferation-related purposes, as large scale reactors may also be used for non-weapons research and education purposes.

It is also important to recognize that some reactor types (in terms of
composition) are more effectively used for proliferation-related purposes than others, the construction of which may further suggest that proliferation-related activity may be occurring. Specifically, those moderated by heavy water pose the greatest proliferation risk of the various reactor types, as the fuel required to power the reactor does not need to undergo enrichment before use, thereby allowing potential proliferators to avoid the costly and easily identifiable step of uranium enrichment. In addition, heavy water moderated reactors (HWRs) produce more plutonium and tritium than other forms of reactors.

HWRs are not the only type of reactor conducive for the production of $^{239}$Pu in sufficient quantities for use in nuclear weapons, however. As mentioned previously, any nuclear reactor may be employed in the production of plutonium for weapons use. Historically, two reactor designs have been most often used in the production of weapons-grade plutonium: the light-water-cooled, graphite moderated reactor (LWGR), which has been used, although not exclusively, by the USA, the former Soviet Union, and China in their weapons-related plutonium production efforts, and the carbon-dioxide cooled graphite-moderated reactor (the GCR, or more commonly named Magnox reactor), utilized by the UK, France, and North Korea. Other reactor types, including light water moderated, pool or tank type reactors (LWRs), pressurized water reactors (PWRs), or boiling-water reactors (BWRs), are less conducive, on their own, to producing $^{239}$Pu of sufficient quality and quantity for use in a nuclear weapons production program, and are typically seen as less of a proliferation risk than graphite moderated or
heavy water reactors. Thus, the construction of these reactors send a much weaker signal than where a state to construct a LWGR, GCR, or HWR. Thus, if a state were to issue a red line restricting or deterring the production of weapons usable plutonium at the irradiation phase, then it is most likely that they would target HWRs, LWGRs, or GCRs, than any other form of reactor (Hypothesis 3).

While the irradiation of nuclear fuel is a critical step in the production of weapons-usable plutonium, the second step in the process by which weapons usable plutonium is produced is perhaps more important. Known as reprocessing for commercial or civilian applications and separation for military application, this process removes or separates a number of transuranic elements and various other fission products from the irradiated material produced by nuclear reactors. Without undergoing this procedure, the material produced in nuclear reactors generally cannot be used in the manufacture of nuclear weapons.

Although a number of plutonium separation processes have been investigated over the years, including pyroreprocessing and electrochemical separation, only one of these processes has been used on an industrial scale. Developed by the United States in the late 1940’s and early 1950’s, the Purex (plutonium-uranium extraction) process is a chemical based process whereby plutonium isotopes are separated from the remaining uranium and other transuranics found in the spent nuclear fuel. While the chemical requirements are not unique to this process, due to the highly radioactive nature of irradiated
fuel, Purex facilities must be heavily fortified with concrete, which makes external
discernment of proliferation intent difficult. In addition, potential criticality
concerns necessitate exacting engineering standards, which further increase the
costs associated with the construction and operation of such facilities, increasing
the barrier of entry for all but a handful of the most wealthy, technologically
advanced states. The construction of such a facility is possible to observe by
outside observers, typically through aerial or satellite surveillance.

A number of variations of the Purex process, exist, but perhaps the most
significant one, from a proliferation observation or detection perspective, is the
mixed-oxide (MOX) production process, whereby reprocessed plutonium is
blended with either natural, enriched, or depleted uranium to produce reactor
fuel. The MOX process renders the reprocessed plutonium useless in nuclear
weapons. Facilities, such as Japan’s Rokkasho reprocessing facility, utilize this
process for the majority of their reprocessed plutonium, thus signaling that
proliferation is likely not occurring. However, even in facilities where the MOX
process is universally employed, it would be technically possible to either not use
the MOX process on some amount of reprocessed plutonium if weapons-usable
material was desired, or divert reprocessed plutonium away from the MOX stage.
Thus, even for facilities such as Rokkasho or the french Cogema reprocessing
facility, potential proliferation cannot be ruled out with absolute certainty.
Therefore, if a state chooses to pronounce a red line intended to deter or prevent
the production of weapons-usable plutonium, then it is likely that they would do
so by preventing or deterring the construction of reprocessing or separation facilities, rather than by preventing the construction of any particular type of reactor, or preventing specific irradiation periods (Hypothesis 4).

While technically oriented red lines are utilized to prevent or deter the acquisition of specific technologies, or to prevent or deter the operation of technologies in specific ways, perhaps more useful, and more common, are those that are meant to test the resolve and discover the privately held preferences of suspected proliferators. Political red lines do this by attempting to restrict or deter certain actions or behavior perceived to be indicative of the development of nuclear arms, or the development of the capability to produce nuclear arms.

We identify three types of political red lines, those that: 1) seek to deter or prevent the development of nuclear technologies by those states not party to the NPT or under an IAEA safeguards agreement, 2) seek to deter or prevent a state from engaging in the covert development of nuclear technologies, and 3) seek to deter or prevent non-compliance with international treaties and institutions. The first of these is a proclamation by one state that another state should not endeavor to develop or acquire nuclear technologies, or additional technologies, if they are not party to the NPT or under an IAEA safeguards agreement, else risk retaliation or punishment. This could mean that they wish to either prevent the development of these technologies in total, or to encourage the state to first ratify the NPT or enter into a safeguards agreement before proceeding with their
development (need hypothesis).

The second such line is a pronouncement by a state seeking to prevent or deter the covert development of nuclear technologies by another state. These lines seek to influence another state’s decision to purposefully conceal nuclear-related activities. If such a line is pronounced, and covert activity is discovered, such a discovery would send a strong signal regarding the target state’s intentions and preferences (need hypothesis).

The third politically oriented line, related to the second, is a pronouncement by a sender state that a target state should comply with terms of any non-proliferation related treaties or institutions to which they are party, else they risk retaliation or punishment. As the majority of these treaties and institutions do not have enforcement mechanisms, these lines, in essence, serve that purpose, by suggesting that non-compliance may result in retaliation or response by the sender party (need hypothesis).

While the placement of red lines is important to understand, it is also necessary to develop an understanding of why states place specific types of red lines. We identify three related characteristics that are theoretically significant. The first is what we term red line transmission. Simply put, this is how a red line is communicated, and can largely be characterized as being formal or informal in nature. Formally communicated red lines are those that are pronounced publicly, via a policy speech or by some other similar mechanism. Informally communicated lines, by contrast, are those that are transmitted through un-
publicized channels, such as diplomatic communiques.

The second theoretically significant characteristic is what we term red line conditionality. This is whether there are terms or conditions attached to the communicated line. Such conditions can take a number of forms, but most often signal steps that may be taken by a target state that may alleviate concern on the part of the sender state that a target state's private preferences do not align with their publicly stated ones. An example of this would be to enter into an Additional Protocols (AP) agreement with the IAEA before beginning construction of a uranium enrichment facility.

The third theoretically significant characteristic is whether a sender state designates a specific form of punishment or retribution if and when a target state violates a sender's pronounced red line. An example of such would be the threat of the imposition of economic sanctions if certain actions or behavior are observed.

The aforementioned hypotheses largely assume that a sender state would seek to restrict action or behavior by a target similarly regardless of who the target state happens to be. This, we suggest, is likely not reflective of reality. Simply put, states act differently towards some states than they do to others. Many explanations exist for these differences in behavior, including differences in regime type (need citations), whether they are rivals (Diehl and Goertz, Thompson and Rasler), whether the states have economic ties (need citations),
etc. In the case of red line usage and placement, we argue that sender states are primarily motivated by three factors. The first is whether they can identify a concrete reason as to why the target state may be interested in developing nuclear weapons. In most cases, this would be the presence of a rival with either a substantial conventional military superiority or one that possesses nuclear weapons. Thus, red lines should be much more common in cases where a real, identifiable motivation exists for the development of nuclear weapons (Hypothesis 5).

The second factor is whether the target state is a member of the NPT. Membership in the NPT serves two purposes. First, it signals a state’s commitment to refraining from developing nuclear weapons. Second, it signals to other states that the nuclear technologies developed by a state are strictly for non-weapons purposes. In a strict sense, this should mean that red lines have no utility for those states who have signed and ratified the NPT. Thus, red lines should be used with much more frequency for those states who have not signed and ratified the NPT, than those who have (Hypothesis 6). We know, however, that proliferation, even for those states who have signed and ratified the NPT, does occur. Thus, membership in the NPT alone may be a relatively weak signal of compliance with the non-proliferation norm. This has long been recognized and is the principle reason that safeguards agreements with the IAEA were established.

There are two stages to these agreements. The first is actually entering into
an agreement with the IAEA. States that do so send a stronger signal of their compliance with the non-proliferation norm than states who only sign and ratify the NPT. This should make the use of red lines much less likely in for states who have entered into safeguards agreements (Hypothesis 7). An even stronger signal results from the second stage of the safeguards system, and is the continued compliance with the terms of the agreement. Non-compliance sends a strong negative signal of a state’s commitment to non-proliferation, and may indicate that their private preferences do not align with their public preferences. Thus, the placement of red lines should be much more likely in cases where a state has been found to be in non-compliance with the terms of their specific safeguards agreement (Hypothesis 8).

The third and final factor that determines whether states will employ red lines is whether the state can credibly threaten punishment if the identified threshold is crossed. The inability to do so, whether it be the threat of economic sanctions, military attack on nuclear-related facilities, or even the cessation of formal diplomatic sanctions, may not only fail to deter the targeted state from crossing the threshold, but may actually deter the sender state from placing the line initially. This may be particularly salient in situations where either the potential sender is significantly less powerful than the target state, or the sender and target state are allied. For the former, the lack of credibility of any potential punishment imposed by a sender state that is significantly less powerful than the target might deter the sender from engaging in the placement of a red line.
Research Design

Why Focus on the United States?

While any state may issue a red line, and it is important to develop a general understanding of why states may do so, a focus on the United States allows for the investigation of case specific factors unique to the one actor that most often acts to prevent the development of nuclear weapons by other states, regardless of geographic location. There are many reasons, other than their level of activity, that distinguish the United States and make it an interesting case, both empirically and theoretically. First, the United States was the originator of nuclear technology and was the primary mechanism for the spread of nuclear technologies around the world, particularly during the Atoms for Peace program. Second, since the dawn of the nuclear age in 1945, the United States is the only state that has consistently possessed and demonstrated both a global reach, having the capability not only to pronounce red lines, but possessing the military capability to back up the threat if need be. Third, the United States is one of the few states that has continuously stated their interest in preventing the acquisition of nuclear weapons by other states, and has backed up this rhetoric.

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9 Israel, by contrast, is very active in preventing proliferation in the Middle East, but has not historically done so beyond the physical bounds of its own region.
by either engaging other states bilaterally, or supporting and often guiding the creation of international non-proliferation-related treaties and institutions.\textsuperscript{10}

\textsuperscript{10} Although the extent to which they have been willing to act to insure this, as will be discussed, has varied in both time and space.