This paper articulates a general framework that can be useful in predicting the circumstances under which states will decide to develop or forego nuclear weapons. The identification of the dominant variables influencing the proliferation decision and the ability to articulate how those variables interact under different conditions to produce or prevent proliferation play a critical role in the development of a coherent international nonproliferation policy. Why have states such as Libya ultimately been willing to dismantle their nuclear weapons programs voluntarily when others have not? This paper distills the essential explanations for the pursuit or rollback of nuclear weapons to arrive at a unified framework of the most powerful explanatory pieces of existing models of nuclear proliferation. An in-depth survey of the cases of India, South Africa, and Brazil reveal three interacting conditions, whose values when taken together produce a discernable range under which different proliferation outcomes are likely to obtain. The reels of a slot machine provide a metaphor: depending on the different values that line up within each condition, a different outcome is predicted. The three interacting conditions are: level of technological development (a constraining factor for most countries), level of perceived international isolation (a constraining or propelling factor), and level of perceived insecurity (a propelling factor for most countries). Ultimately, the framework may be characterized as borrowing from the neorealist perspective wherein states pursue a strategy of “self-help” to protect their interests, while also acknowledging a relationship in which domestic-level priorities can ultimately shape the values of each condition described above. As revealed by its application to additional cases of varying proliferation outcomes, the framework appears reasonably robust; however, further study, including quantitative analysis, will sharpen each factor into a more focused theoretical tool.

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Introduction

Why have some states built nuclear weapons, while others have only dabbled in weapons programs? Why do some ultimately abandon their bomb aspirations and others build an arsenal? The identification of the dominant variables that play a role in the outcome of a decision to proliferate and the ability to articulate how those variables interact under different conditions to produce proliferation or not play a critical role in the development of a coherent international proliferation policy.

The articulation of a generalizable framework of analysis would provide policymakers a valuable tool in formulating lasting solutions to the scourge of nuclear proliferation. Much of the current literature devoted to the issue of either why states “go nuclear” or why they disarm approaches the subject matter from a rigid “case-by-case” perspective. While it is important to be sensitive to the particulars of individual states that are of concern, the problem is that the case study literature does not contemplate a greater theory that can be applied in universal fashion. A strict, idiographic approach to dealing with nuclear proliferation, in which each instance of proliferation is viewed as sui generis, does not easily allow for the application of the experiences of a particular case to that of a novel situation. While valuable contributions and insights have been developed through the work of scholars who adopt a case-centric approach, their work often falls back on the conclusion that “many things mattered” to the proliferation of country X, without daring to establish a predictive model describing which factors matter the most or how they interact synergistically. Case-by-case approaches will always retain their usefulness from the perspective of offering an examination of the specific values of the variables affecting each particular outcome, but a generalizable framework has the potential to offer greater initial insight into futures episodes of nuclear proliferation.

Some scholars have noted that it is tough to explain nuclear proliferation because few countries have actually acquired weapons. However, as scholar Zachary Davis has pointed out, such academics “overlook the fact that many more countries could have built nuclear weapons but decided not to do so. Because the decisions to acquire or not to acquire nuclear weapons belong in the same domain, the understanding of why a certain state decided not to acquire nuclear weapons is helpful in understanding why another country chose to acquire them.” Thus, there is a larger universe of cases to study than is often perceived.


The Existing Literature

In the past, the literature aimed at explaining proliferation has either denied the possibility of a general theory of proliferation, (instead emphasizing the importance of unique conditions at play within each case), argued for proliferation based primarily on the “inevitable” spread of nuclear technology, argued for theories based solely on one level of analysis, which usually only succeed at explaining a handful of test cases, or established numerous sources of causality, such as security, prestige, bargaining, public opinion, or bureaucratic politics, without attempting to either rank or link them together in a coherent fashion. Instead, they argue along the lines of “a little of this, a little of that.”

It is the position of this paper that none of these theoretical or pseudo-theoretical postures alone are adequate. For instance, while classical realism is useful in explaining the influence of security considerations to developing nuclear weapons, it does so while ignoring domestic factors, and it cannot account for why states sometimes choose to proliferate even when it would rationally contradict their security interests.

On the level of the state as the unit of analysis, neo-liberal institutionalism, which holds that the internal traits of a state such as its political regime type or economic system, offer clues as to whether or not it will proliferate, overlooks the decision-making process of the individuals in charge as an important determinant of a state’s action. The organizational model, which posits that the formulation of nuclear policy is the product of “organizational culture,” fails to account for what

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4 Meyer 9.
5 For example, see Saira Khan’s *The Dynamics of Nuclear Proliferation in Protracted Conflict Regions: A Comparative Study of South Asia and the Middle East* (Chippenham, England: Ashgate, 2002) with an account that rests on systemic factors, while Etel Solingen seeks to explain proliferation decisions from a domestic level perspective in her article “The Political Economy of Nuclear Restraint,” *International Security*, Vol. 19, No. 2 (Fall 1994).
6 See Mitchell Reiss, *Bridled Ambition: Why Countries Constrain Their Nuclear Ambitions* (Washington, DC: Woodrow Wilson Center Press, 1995). While Reiss is excellent at developing individual case studies, he connects them “thematically,” rather than through the development of a theoretical mechanism. For another example of the “numerous factors mattered” argument see Peter Liberman’s article on the South African bomb article (“The Rise and Fall of the South African Bomb” in *International Security* 26.2, 2001.) Liberman is also very good at reconstructing the details of a case, and while he leans toward applying a general theory of “organizational politics” to explain the South African case, he maintains that he would prefer to withhold establishing any causal priorities.
8 Ogilvie-White 55.
role individuals can play in affecting the culture or for how “new information that challenges past assumptions” can change the culture.⁹

The explanatory models that take a cognitive or psychological approach, such as belief systems theory, which speculates that irrational decisions are taken by individuals due to their oversimplified views of reality or their inability to put themselves into the mindsets of other states’ leaders, are hard to verbalize precisely and “too narrow” to make their application useful to the issue of why states proliferate.¹⁰ Finally, historical-sociological models seek to incorporate the growth of nuclear technology as an outcome of various social forces, but the central problem with such a perspective is that it enumerates too many dependent variables to make it practical for purposes of forecasting future proliferation.¹¹

Still other literature on the issue of nuclear proliferation holds that having technical proficiency in nuclear technology itself is the ultimate arbiter of whether or not a state will proliferate.¹² Besides the fact that technological-determinist theories are not borne out by the historical record,¹³ it is apparent that this kind of approach would offer policymakers little advice other than to “stem the flow” of nuclear information and materials, which is a prescription already implemented through provisions in the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), but to no satisfying avail.

The Framework-Building Cases

Using the data obtained from a review of the cases of India, South Africa, and Brazil, I have sought to construct a framework that would apply to other cases of nuclear proliferation occurring after the Nuclear Non-Proliferation Treaty (NPT) came into force. My explanation excludes the cases of the original five weapons states – the

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⁹ Ogilvie-White 51.
¹⁰ Ibid 53.
¹¹ Ibid 54.
¹² As described by Stephen Meyer, this group of theories, known as the “technological-determinist” hypotheses, exists in three slightly different formats: the first holds that countries simply “go nuclear” in some quantity of time after they have acquired the latent capacity to do, “if not as soon as they are able” (p.20); the second variation, in order to deal with the obvious empirical difficulties of the first, states that “the overall manifestation of the technological imperative is spread out randomly over time,” (p.11) and finally, the third expression of the thesis states that “the greater the level of nuclear-related infrastructure in a country, the more likely it is to ‘go nuclear’. ” (p.12.) Tanya Ogilvie argues that the bottom line of all three is that if a state possesses the nuclear “know-how” and the right resources, it will develop weapons. See Ogilvie-White 44.
¹³ Ogilvie-White 44.
US, the USSR, Britain, France, and China, all of whose proliferation is strongly linked to the unique security dilemmas of WWII’s immediate Cold War aftermath.\textsuperscript{14}

The cases of India, South Africa, and Brazil share both significant similarities and differences. Each state embarked on nuclear weapons programs in the late 1960s to mid-1970s, with varying proliferation outcomes: South Africa developed a weapons capability and then dismantled it, becoming the first state to ever “rollback” an indigenous weapons capability. India developed the bomb with indigenous resources, but shows no signs of giving up its weapons status. Brazil is believed to have had a program dedicated to achieving a capability for a nuclear weapons option, but ultimately chose not to build a bomb.\textsuperscript{15}

\textit{The Framework}

My survey of the cases of India, South Africa, and Brazil has led me to identify three conditions that, taken together in an interacting framework, may help determine proliferation tendencies, in a fairly predictable manner. Variances on each of these conditions cause a deviation in the degree to which states pursue a nuclear weapon (i.e. they develop only a bomb program, they develop nuclear weapons but ultimately dismantle, or they develop nuclear weapons and maintain them). The first condition is that the state possesses a level of development that ensures it either has or is capable of acquiring the technological resources needed to develop and sustain weapons production. A lower level of development is a constraining factor. The second condition is that the state possesses a level of international isolation that colors its ability to either accept or reject the offers of major patrons to provide a nuclear umbrella or other major defense commitments, or an important bilateral relationship, and to what extent the would-be proliferator possesses a “pariah” status. Level of international isolation may be a constraining or propelling factor. The third and final condition is the extent to which a state feels it possesses a level of insecurity that requires a nuclear deterrent to respond to the threat it faces. Level of insecurity is a propelling factor.

An apt metaphor for the framework is that of slot machine reels. Depending on the different values that line up within each column, a different outcome is achieved. For instance, a “high” measurement under the level of development, and a “high” measurement under international isolation, combined with a “high”

\textsuperscript{14} As the scholar Itty Abraham notes, “...all the acknowledged nuclear weapons states had military objectives for their nuclear programs from the outset. This stands in contrast to the second generation of nuclear powers,” where the establishment of civilian programs often preceded the decision for military nuclear development. \textit{The Making of the Indian Atomic Bomb}, (London: Zed Books, 1998) 8.

measurement under perceived insecurity would indicate a country that is very likely to “go nuclear.”

In order to show how these variables play out, the year that a weapons or weapons program decision was most likely taken in each case is first documented. Doing so is important for establishing the correct time windows around which to measure the framework’s three conditions. In some cases, the empirical record contains evidence of proliferation decisions; in the cases where no clear empirical confirmation exists, this study relies upon scholarly consensus.

In order to measure variation of the independent variables, it is important to define them precisely to establish benchmarks that differentiate them from case to case. The “level of development” condition examines the type of nuclear infrastructure extant in each case prior to a proliferation decision such as the presence of scientists and research reactors, versus power reactors, versus advanced reprocessing or enrichment facilities. To measure this condition, I have drawn on the technical distinctions provided in Stephen Meyer’s *The Dynamics of Proliferation*, and Alexis Blanc’s work at the Institute for Defense Analysis. A shorthand version of Meyer’s and Blanc’s distinctions can be located in the attached quantitative chart.

The “level of isolation” condition examines each given state’s status in the international community by studying its relationship vis-à-vis a major international patron, measured through the existence of a valuable bilateral relationship, (such as a trade agreement), through the existence of a nuclear umbrella provided by the patron, or through other serious defense commitments provided by the patron. I hypothesize that the presence of such relationships will tend to constrain a state from proliferation. However, this condition is also measured in terms of whether or not the given state was heavily sanctioned or possessed a “pariah” status prior to its decision to proliferate. I further propose that being subject to numerous international sanctions and/or possessing “pariah” status (i.e., possessing a “high” level of international isolation) will tend to propel a state in favor of gaining a weapon, because there is less to lose in terms of sanctions and fewer relationships at risk in choosing to develop nuclear weapons.

The “level of perceived insecurity” condition examines how a nation’s perception of a threat (i.e., at minimum, the threat of a land grab or dismemberment of some territory to which the threatened state lays claim), influences a decision for nuclear weapons. It takes into account the history of wars of each given state within

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the years preceding a decision for a nuclear weapon to establish threat levels for comparison with later threat levels that might have influenced a change in proliferation stance. It also examines subjective governmental assessments, where possible to obtain, of the threats facing each given state. Additionally, it tracks whether or not each state possessed a nuclear-armed neighbor or rival prior to the given state’s decision for bomb development, and the state’s past relationship with the neighbor (i.e., friend or foe).

The suggested framework is not only generalizable, but also unified, because the conditions that make it up seek to integrate concepts from various levels of analysis and previous explanations of proliferation.\(^{17}\) The “level of development” condition focuses on technological variance across the cases and the framework reveals that it plays an important role in determining whether or not a state can “go nuclear,” but does not go as far as the technological-determinist hypothesis that states with high levels of nuclear infrastructure will go nuclear. The “level of insecurity” condition focuses on security variances across the cases, and the framework shows how insecurity plays a crucial role in determining whether or not states will seek nuclear weapons, but not at the expense of excluding level of isolation and level of development. Finally, the “level of isolation” variable is a systemic factor that looks at relationships between states.

While the framework establishes these conditions as the proximate causes for proliferation outcomes, I acknowledge that domestic level factors, such as political priorities, can impact these three conditions. For instance, the South African regime’s commitment to apartheid shaped the extent of its level of isolation. Not until South Africa’s leadership perceived that its international isolation would decrease by abandoning apartheid, did the isolation variable value drop and nuclear rollback occur.

**India**

India’s decision for a nuclear weapon can be dated to 1964, the year that Indian Prime Minister Shastri approved work by the Indian Atomic Energy Commission on “theoretical preparations” for a nuclear explosives capability.\(^{18}\) My measures of the conditions of level of development, level of international isolation, and level of insecurity reveal the factors that shaped India’s choice in 1964, and sent it down the path to nuclear weapons status. Further, this analysis shows there have been no

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\(^{17}\) I draw on Saira Khan’s (previously cited) notion of “protracted conflict” areas, except I articulate the issue as one of existential conflict, because I believe there is something important about the past experience of war to the perceptions that actors have and the calculations that they make. In addition, it is not only states in protracted conflict areas that have considered weapons development.

fundamental variances in the values of the key variables that would persuade India to “rollback” its nuclear status.

**India’s Level of Development**

India’s level of development of nuclear technology is impressive in comparison to the other cases examined in this study. Even prior to independence from Britain in 1947, India was engaged in developing civilian nuclear technology within the country. By 1946, India had set up an Atomic Energy Research Committee, and in 1948 Prime Minister Nehru proffered an Atomic Energy Act that aimed to ensure the “complete secrecy” of the research and called for the construction of an official Atomic Energy Commission to develop India’s nuclear infrastructure.

The first Indian research reactor, Apsara, was constructed in 1956. Later, India collaborated with Canada to build a reactor that went critical in 1960 with the help of heavy water borrowed from the United States under the auspices of the Atoms for Peace program, known as the CIRUS reactor. Eventually, the spent fuel CIRUS produced was reprocessed at an indigenously built reprocessing center constructed in Trombay in 1964, which ultimately served as the source for the plutonium used in India’s May 1974 “peaceful nuclear explosive” test.

In 1963, the US and India joined forces to construct the Tarapur Atomic Power Station. India also benefited from the assistance of the Soviet Union, with whom it signed “an agreement for cooperation on the peaceful uses of atomic energy” in 1961 and from whom it received some heavy water in the 1970s, and also from collaboration with German scientists in the 1960s and 1970s with whose assistance it sought to perfect the thorium cycle.

**India’s Level of Insecurity**

At the time of its decision for a nuclear explosives capability in 1964, India was faced with an unenviable security situation, particularly as it related to its tense relationships with Pakistan and China. Following the August 1947 partition of India and Pakistan, hundreds of thousands of people were killed in sectarian violence that

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23. Ibid 22.
24. Ibid 22, 25. Monazite contains thorium, which can be used to produce a fissile form of uranium. According to Chari and Cheema, “Bhabha...envisioned...[the ultimate establishment of]...a self-sustaining thorium-uranium cycle.”
erupted along the borders and in major Pakistani and Indian cities. By October 1947 war erupted between the two new governments over unresolved claims to Kashmir.

Besides the threat India faced from Pakistan in the years leading up to 1964, India also faced a menace from its neighbor to the north, China. In 1962, China soundly defeated Indian forces in a heated border conflict over territory in the Aksai Chen plateau, which India considered part of Kashmir, but China considered its own. After shattering India’s military confidence in the 1962 confrontation, China upped the ante exponentially with its October 1964 test of a nuclear device. Yet in the face of such pressure, the Indian government held to its long-term opposition to the development of nuclear weapons – at least publicly. In private, the Indian Prime Minister Shastri (who came to power after Nehru’s death in mid-1964), authorized Bhabha to begin work on a nuclear weapons capability by the end of November.

On top of the threats India faced from both China and Pakistan independently, in the years running up to its decision for a nuclear explosive capability, it saw a relationship between Pakistan and China blossom: they struck an agreement “provisionally demarcating their borders” that was sealed with a trip by Pakistani Foreign Minister Bhutto to Beijing in 1963. Hence, by 1964, not only had India faced direct military confrontation over strategic pieces of land with both Pakistan and China separately over time, but it also saw the increased cooperation between its two enemies, which would serve to elevate its perception of its insecurity even higher.

India’s Level of Isolation

In the weeks following China’s first nuclear test in October 1964, India privately sought reassurances to be taken under the nuclear umbrella of weapons states, even while maintaining publicly its long-standing distaste for nuclear weapons. This behavior lends partial credence to the security-oriented theorists who have argued about the “domino effect” of nuclear weapons, given that India sought an umbrella after the Chinese test. However, the fact that India ultimately did not receive such assurances due to her “nonaligned” stance also speaks to the role that domestic level factors play in nuclear outcomes. India’s nonaligned stance sprung from its position as a founding member of the Non-Aligned Movement. It was, in a sense, a “third way” for states that did not desire to become beholden to either the US or the USSR as the Cold War emerged.

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26 Perkovich 49.
27 Ibid 87.
28 Abraham 77.
After the Chinese nuclear explosion in October 1964, Prime Minister Shastri reportedly sent two envoys “to the capitals of the two superpowers in quest of security assurances that would have the effect of deterring nuclear attacks by China.” The Indian scholar K. Subrahmanyam characterizes India’s perception of the responses as “lukewarm” and “imprecise.” Shastri later stated that India was interested in seeing a solution that reassured all countries either through the elimination of all nuclear arms, through nuclear guarantees from both the West and East simultaneously, or through the creation of an international weapons stockpile available to those states without permanent weapons through the UN. There is scant evidence to show that Washington or Moscow, thoroughly locked into the Cold War by the mid-1960s, ever took India’s simultaneous nuclear guarantees proposal to heart. India’s refusal to abandon her nonaligned stance precluded the chance that either the West or Moscow would ever yield to requests for such guarantees.

Besides losing out on its push for universal disarmament and failing to be provided with a nuclear umbrella, India’s level of isolation with the US and USSR can also be judged “medium” prior to its deciding for a nuclear capability because there was no continuously reliable source of defense commitments or support for India’s military decisions from either side. Although the US did not supply Pakistan with nuclear guarantees either, it did provide “economic and military assistance,” to Pakistan in the years prior to 1964. India’s relationship with the Soviet Union was also unsteady. In 1953 the two signed a special trade agreement that was more favorable to India than previous trade deals it had completed with the West, and in 1955, Prime Minister Nehru traveled to the Soviet Union where a Joint Declaration between the two countries was signed. However, in October 1962, the Soviets disappointed the Indians by supporting the Chinese in the Sino-Indian border conflict.

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30 Perkovich 87-88.
32 “US-Pakistan Relations,” Background Note: Pakistan, US State Department, http://www.state.gov/r/pa/ei/bgn/3453.htm (accessed 21 July 2010). There was a desire to improve the US-India relationship that began in 1957 under President Eisenhower, who wanted increased bilateral aid and trade with India. Although these ideas were met with opposition by the US Congress, which had a “distaste” for India’s nonalignment, increases in aid did eventually go forward, and by 1960 the US was the largest donor of foreign aid to India. However, following an Indian deal to purchase a number of Soviet MiGs, cooperation between the U.S. and India slowed. Additionally, there was a decision not to increase military aid to India unless Kashmir was resolved out of fear of upsetting Pakistan. See Perkovich 45-50.
33 Perkovich 41.
34 Ibid 42. Interestingly, the US offered assistance after India’s emergency request for US aid during that crisis, although India specified that it did not want a “military alliance as a quid pro quo” in order to maintain its policy of nonalignment. (See Perkovich 45.) Thus, even with
In sum, in the years prior to India’s 1964 decision for a nuclear explosives capability, it was not well engaged with the major powers in the international community. It possessed no nuclear umbrella, no permanent sources of military support, and was the advocate of a lost cause in terms of universal disarmament. It is clear that India’s domestically-driven obsession with remaining “nonaligned” shaped the level of engagement it had with the international community. This, in turn, meant that India would face fewer constraints and have less to lose in obtaining a nuclear weapon.

The Framework At Work in India

As demonstrated above, at the time of its decision to begin work on a nuclear explosives capability, India possessed the advanced technological base to allow it to develop such a capability; it had extensive experience with existential warfare; and it had no non-proliferation treaties, nuclear alliances, or reliable defense relationships that would tend to constrain it from developing an explosives ability (lest it face a backlash or loss of such relationships).

Since its initial decision for an explosive capability in 1964, India’s nuclear force has only grown more potent: India tested its first bomb in 1974, under the rubric of a “peaceful nuclear explosives test,” but tested again in 1998, openly proclaiming its status as a state armed with nuclear weapons, even if outside the NPT. Its continued level of nuclear development has been highlighted with the recent US-India nuclear deal, first articulated by President Bush in 2005.

In terms of level of international isolation, India continues to exclude itself from the NPT or sign other important international arms control treaties, such as the Comprehensive Test Ban Treaty, still claiming that such agreements are discriminatory. Finally, while India has increasingly been identified as a geo-strategic partner for the US, there is still no official military alliance between the US and India.

In terms of insecurity level, the relationship between India and China is no longer as strained as it once was – in 2005 the two signed a trade and border

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varying US or Soviet assistance, India stuck with its policy of not growing too dependent or loyal to either side.


accord — but the Pakistani threat has only increased. In 1965 it was engaged in a second war with Pakistan, and in 1971, India fought a third war, in which it helped dismember the eastern wing of Pakistan, to become Bangladesh. Additionally, Pakistan made a decision to adopt nuclear weapons in 1972, and although Pakistan did not test until 1998, India and the rest of the world were long suspicious of Pakistani nuclear intentions. In 1990, the conflict over Kashmir worsened. For these reasons, India has not rolled back its nuclear weapons capability.

A high level of technological development, medium level of international isolation, and high level of existential insecurity were jointly sufficient conditions for proliferation in India. Indian proliferation cannot be explained by one condition alone; only when all three are examined together and their interactions observed can one understand the synergy for the weapons proliferation outcome in India.

Competing Theoretical Explanations for India

In order to demonstrate the analytical advantages of the framework described above, it is worth comparing explanations based on a one dimensional analysis of international relations theory and the shortcomings of their application in this case. For instance, accounts of Indian proliferation that rest on the personal psychology of the leadership, such as a theory that emphasizes the importance of Shastri’s personal psychology, would be invalid in this case: Shastri was highly disdainful of the bomb, as were both his predecessors and his immediate successors. Furthermore, even when an Indian leader has been personally opposed to nuclear weapons, none of them has gone so far as to reverse or stop the bomb program.

One example of a “domestic” level explanation might be that India’s scientific bureaucracy was the true driving force behind India’s development as a weapons state. Although it is proper to give credit to the scientists for the impressive level of technological advancement achieved by India, there are clear examples of leaders asserting final authority on proliferation decisions and even warning scientists of their duty to follow the leaders’ commands, including an instance of Shastri remarking to Bhabha: “scientists should realize that it was the responsibility of the Government to defend the country and adopt appropriate measures.” There was also an instance of Nehru questioning Bhabha in 1960 about India’s ability to make

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39 Khan 79-83.
40 Perkovich 74. Emphasis added.
a nuclear weapon. When Bhabha replied that India could develop a weapon, Nehru pointedly remarked, “Well, don’t do it until I tell you to.”

The same argument would hold for those who argue about a “bomb” lobby in the Indian parliament in the years prior to 1964. As explained in the section on the Atomic Energy Act, nuclear policymaking was kept secret. Further, as George Perkovich reports: “From 1948 through 1963, nuclear policy barely figured in Indian politics….[Parliamentary] debates [on the subject], while illuminating, assumed little importance in the overall Indian polity. Parliament did not exert itself on nuclear policy issues.”

Finally, a theory that seeks to argue for India’s proliferation based solely on systemic “self-help” notions of security would have a difficult time accounting for India’s medium level of isolation vis-à-vis the major powers, who were not India’s enemies. Based on India’s existential security threats, it could have been in India’s best interests to be taken under the nuclear umbrella of a weapons state; however, its commitment to the domestic legacy of a “third-way” and “nonalignment” precluded any such nuclear shield arrangements.

South Africa

South Africa is the only country to ever have developed nuclear weapons indigenously which later chose to roll its program back. For this reason, it presents a special challenge for students of proliferation, because the best analytical tools should be able to capture not only why South Africa chose to build bombs in the first place, but also why it chose to give them up. Based on the strong scholarly consensus that a bomb decision was probably made no earlier than 1974 and no later than 1977, this paper will infer 1975 as the timeframe in which a decision took

41 Perkovich 36.
42 Ibid 39.
43 Other states in possession of actual weapons that have chosen to forgo them include the Ukraine, Kazakhstan, and Belarus. The US lobbied hard for nuclear rollback in these states in the early 1990s. These countries inherited the weapons from the Soviet Union after its collapse, having once been part of its empire. Since the decision for a bomb in each of these countries was a Soviet decision related directly to the Cold War, not an indigenous one, these cases are not addressed within the scope of this paper. Cirincione 365-380.
44 Case selection is important to analysis, and in general, theorists are warned not to select cases based on the dependent variable or outcome, which they seek to explain. The framework advanced here, however, might be comparable to an “independently necessary, jointly sufficient conditions” argument. Analytic methods scholar Barbara Geddes has written that, “Some kinds of tests of conditions proposed as necessary or sufficient for explaining outcomes can be carried out using only cases that have experienced an outcome” and further, that “selection on the dependent variable does not undermine tests of ‘necessary but not sufficient’ or ‘necessary and sufficient’ arguments.” See Barbara Geddes, Paradigms and Sand Castles: Theory Building and Research Design in Comparative Politics (Ann Arbor: University of Michigan Press, 2006), 90.
place. However, measurements for the independent variables will seek to account for the time before 1974 and after 1977 in order not to exclude any possible, important causal events in the more general timeframe for the bomb decision that would explain why South Africa constructed six nuclear devices by 1989.\textsuperscript{45}

**South Africa’s Level of Development**

Like India, South Africa was able eventually to develop its nuclear weapons thanks to its advanced level of civilian nuclear infrastructure. In fact, by 1987 South Africa’s nuclear development was characterized as “one of the most formidable nuclear infrastructures available to a second-level state in the international system.”\textsuperscript{46} As with India, it also benefited significantly from the Atoms for Peace Program. The 1946 creation of the Uranium Research Committee led to the passage of the 1948 South African Atomic Energy Act, which established the South African Atomic Energy Board in 1949.\textsuperscript{47} In 1952, South Africa agreed to sell uranium from its very significant natural supply to its WWII allies Britain and the US,\textsuperscript{48} “in exchange for nuclear scientific and technological assistance.”\textsuperscript{49} In 1957, the US and South Africa reached a deal in which South Africa agreed to purchase the SAFARI-1 research reactor and the highly enriched uranium to power it from the United States. The same deal allowed for the “extensive transfer of technical personnel” and “technical assistance and training,” as well as licensing US companies with permission to export “special nuclear materials and technology” to South Africa.\textsuperscript{50} Because of South Africa’s willingness to sell large quantities of uranium for the American and British weapons programs, the US Atomic Energy Commission and the UK Atomic Energy Authority “felt obliged to cooperate in the development of South Africa’s capability in nuclear science and technology.”\textsuperscript{51}

The US-supplied SAFARI reactor went critical in 1965 and was boosted to full operational capacity of 20 megawatts in February 1969, a capacity that might have allowed it to produce two bombs every three or four years.\textsuperscript{52} In 1970, Prime Minister Vorster informed the South African Parliament that South Africa was capable of producing enriched uranium via what he claimed was a unique,
indigenously developed innovation. Additionally, he announced plans for the
construction of a pilot enrichment plant at Pelindaba, known as the “Y” plant, which
would help power the large civilian program that was in the works at the time.\textsuperscript{53} The
Pelindaba plant was announced as not being subject to IAEA safeguards, because
according to Prime Minister Vorster, putting it under safeguards would risk the
infringement of the “commercial secrecy of [the new] enrichment process.”\textsuperscript{54}

\textit{South Africa’s Level of Insecurity}

Beginning in the 1960s, the ruling South African apartheid regime faced security
challenges that would continue to develop and intensify throughout the 1970s and
into the 1980s. Much of the threat emanated from black nationalists in and around
South Africa that were opposed to South Africa’s apartheid. Between 1961 and 1968,
“apartheid leaders cited growing threats from black guerilla movements backed by
the Soviet Union and China as justification for a six-fold increase in defense
expenditures.”\textsuperscript{55} The UK was also a source of upset for South Africa beginning in the
1960s, when it awarded the indigenous people of several African states their
independence. By 1966 South Africa faced direct incursions by the South West
Africa People’s Organization (SWAPO) for the first time into Namibia, a region
South Africa claimed as its own.\textsuperscript{56}

Throughout the 1970s, South Africa’s security situation worsened tangibly:
in April 1974, Portuguese domination over Angola and Mozambique collapsed; in
March 1975, Angola began receiving Soviet aid; and beginning in October 1975,
Cuba intervened militarily in Angola to help the regime respond to South African
backed rebels. November 1976 heralded the election of US Jimmy Carter, who was
generally unsympathetic to South Africa’s position; November 1977 saw the launch
of a mandatory United Nations arms embargo that had previously been voluntary;
and pressure from the West to get out of Namibia increased beginning in 1977.\textsuperscript{57}

Though South Africa never directly clashed with Soviet forces, South Africa
attributed the increasing instability in the region to “total onslaught by the forces of

\textsuperscript{53} Moore 85.
\textsuperscript{54} The Y plant at Pelindaba, completed in 1974, was the eventual source of South African
highly enriched uranium used to construct its bombs. Another “commercial-scale ‘Z’ plant
was built at Pelindaba East as well, and it is also reported that South Africa conducted
research at Valindaba into the gas-centrifuge process in the 1980s. Cirincione 409.
\textsuperscript{55} Helen Purkitt and Stephen Burgess, “Correspondence: South Africa’s Nuclear Decision,”
\textsuperscript{56} Helen Purkitt and Stephen Burgess, \textit{South Africa’s Weapons of Mass Destruction},
(Bloomington: Indiana University Press, 2005) 47. When the United Kingdom indicated in
1965 that it would oppose Rhodesian white settlers’ Unilateral Declaration of Independence
but not block growing Black Nationalist movements in Zimbabwe, South Africa was
increasingly alarmed, perceiving a change in the previous security situation under which the
United Kingdom had been an ally.
\textsuperscript{57} Liberman 6.
international communism.” The seriousness with which these threats coalesced to create an existential crisis for the white regime is evident: a 1977 governmental White Paper warned that “We are today involved in a war, whether we wish to accept it or not,” and the same year an Interior Minister stated publicly that “If we are attacked, no rules are applied at all if it comes to a question of our existence. We will use all means at our disposal, whatever they may be.” Hence, there is significant evidence tying increased existential insecurity fears for South Africa’s government to its decision to develop its bomb.

South Africa’s Level of Isolation

South Africa’s level of international isolation worsened in the years running up to its decision for the bomb. The United Kingdom had provided South Africa with security guarantees during both World War I and World War II; in return, South Africa contributed troops to other parts of the world where British interests were threatened, including Africa, Europe, and Asia. However, in 1961, South Africa dropped out of the British Commonwealth after its membership and apartheid status was harshly criticized by many newly independent, black-ruled African states in the Commonwealth. Subsequent to its 1961 withdrawal from the Commonwealth, its membership in international organizations by 1972 had decreased from forty to two.

South Africa’s exit from the Commonwealth marked the beginning of its descent to pariah status. In 1963, South Africa was the target of an anti-apartheid Security Council resolution at the UN “recommending” an embargo on the sales of arms to South Africa (later made mandatory in 1977). South Africa’s 1968 decision to withhold membership in the NPT heralded its decreasing status at the IAEA and in the Western Suppliers Group, two organizations in which it had played an early and important role. In the mid-1970s, South African and US nuclear collaboration begin to falter, with the US Congress blocking the sale of fuel elements and demanding increased access for IAEA inspectors. South Africa looked elsewhere in

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58 Reiss 9.
59 Moore 141.
60 Purkitt and Burgess 30.
62 Purkitt and Burgess 47.
63 Moore 50 and Purkitt and Burgess, “Correspondence,” 189.
64 Moore 108.
order to ensure its nuclear program, receiving help from France, Belgium, Switzerland, and Israel.\textsuperscript{65}

South African engagement with the West began declining in the 1960s and continued throughout the 1970s, as evidenced by South Africa’s isolated status outside the British Commonwealth, as well as the NPT. The Soviet Union was a sworn enemy of South Africa, so no hope for a nuclear umbrella or steady defense or arms supplies existed from the East, either. Fewer engagements meant that South Africa had “less to lose” in seeking nuclear weapons development. Just as Indian dedication to nonalignment prevented its full embrace by a major power under a nuclear umbrella, so, too, did South Africa’s apartheid identity preclude a close relationship with the West. This domestic idiosyncrasy was a significant contributor to the international isolation portion of the predictive equation.

\textit{The Framework at Work in South Africa}

By the time that South Africa decided to pursue a nuclear weapons program in 1975, it possessed a high level of nuclear development (e.g., frequent technological exchanges with the United States and the United Kingdom, as well as an indigenously-crafted enrichment technique), a high level of insecurity (e.g. growing Black Nationalist movements nearby in the 1960s and the “total communist onslaught” in the 1970s), and a high level of international isolation (e.g., forced from the British Commonwealth in 1961 because of its refusal to end apartheid). Each of these conditions lined up to produce a proliferation payout in favor of weapons. Ultimately, significant changes in the values of these variables produced a reversal of its proliferation outcome.

In 1993, South African President De Klerk confirmed publicly for the first time that apartheid South Africa had not only possessed an indigenously-crafted weapons arsenal,\textsuperscript{66} but also dismantled it in 1990.\textsuperscript{67} By the time dismantlement was ordered (February 1990),\textsuperscript{68} the South African leadership understood that the existential security threats it once faced from the Soviet Union and its proxies had diminished, and that economic re-engagement with the West could be won by abandoning apartheid,\textsuperscript{69} whose end seemed increasingly inevitable.

\textsuperscript{65} Purkitt and Burgess 49-50.
\textsuperscript{67} Cirincione 410.
\textsuperscript{68} Ibid 410.
\textsuperscript{69} Peter Liberman, “Correspondence: South Africa’s Nuclear Decision, \textit{International Security}: 27.1 (2002) 193. Liberman writes that De Klerk “believed that once he had taken major steps to unravel apartheid, accommodating this long-standing nonproliferation demand would hasten the West’s normalization of economic relations with South Africa.”
The 1980s saw a sharp increase in civil unrest in South Africa. In 1985, Prime Minister PW Botha declared a state of emergency that permitted the government to use even harsher tactics to subdue the opposition. The following year, in response to growing distaste among the American population for continued South African apartheid, the United States Congress passed the Comprehensive Anti-Apartheid Act, which instituted severe economic sanctions against South Africa.

By the mid to late-1980s, there was an understanding that white minority rule could not last, and that a transition to a democratic regime was needed because “the alternative was an increasingly brutal repression of the black population and a descent into greater domestic violence and chaos.” However, the notion of a nuclear-armed ANC was not palatable for the white regime. It is likely that “fear and loathing of the ANC” drove De Klerk to wait until March 1993, long after the destruction of the nuclear weapons, to reveal the defunct program publicly. Indeed, De Klerk ordered all files and records related to the program destroyed. It is quite possible that the US also leaned on South Africa to destroy its suspected nuclear weapons, with some reports indicating it threatened South Africa with a “hostile nation” status, in order to keep the weapons out of the hands of the ANC, a group that was friendly with “Qaddafi’s Libya and Castro’s Cuba.”

South Africa’s external security situation was changing in important ways, as well. By 1987, Mikhail Gorbachev indicated that the Soviet Union would pull out of Africa. In other words, the “total onslaught” threat was abating. De Klerk confirmed this in his 1993 speech explaining the existence of nuclear weapons, stating that because of these security changes, nuclear weapons were superfluous, “in fact, an obstacle to the development of South Africa’s international relations.”

Hence by 1989-1990, the second major decision period in the history of the South African weapons program, variances or imminent, predicted variances in the

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70 Purkitt and Burgess 103.
71 National Archives 4-5.
73 Reiss 22.
74 Purkitt and Burgess, “Correspondence,” 190.
75 Liberman “Correspondence,” 194.
76 Purkitt and Burgess, “Correspondences,” 190.
77 Purkitt and Burgess 130.
78 Purkitt and Burgess, “Correspondence,” 190. In August 1988, a ceasefire on the Namibian border was reached, and in December 1988, South Africa reached an agreement with the Cuban and Angolan regimes in which South Africa would permit Namibian independence if Cuban troops were withdrawn. See Reiss 20 and 14, respectively.
79 Reiss 22.
conditions of level of isolation and level of insecurity shaped South Africa’s decision to rollback its weapons program. The future possibility of a return to strong engagement with the West, after 40 years of decreasing relations, coupled with the disappearance of the existential threat provided by a nuclear-armed Soviet Union backing regimes with territorial goals opposed to South Africa, spelled the end of the weapons program. South Africa’s level of nuclear development voluntarily decreased with the dissection and destruction of its weapons.

**Competing Theoretical Explanations for South Africa**

In order to demonstrate why arguments that rest primarily on one level of explanatory analysis are inadequate in the South African case, it is worth examining a few such explanations and their shortcomings. For instance, Peter Liberman has advanced an argument in which he applies traditional organizational politics theory, which places an emphasis on the role of military or defense establishments in advancing policy choices in line with their own interests, by examining the role of the nuclear scientists in South Africa. He argues that the “South African nuclear science agency...[had]...a vested interest in a nuclear explosives research program,” while downplaying the role of South Africa’s perceived insecurity by focusing on objective accounts of the security situation, which emphasized South Africa’s relative conventional military superiority in the region. The major difficulty with Liberman’s account, however, is its inability to predict or explain the rather sudden dismantlement of the nuclear-scientific complex. His argument about scientific organizational politics would require the nuclear scientists to have also led the effort to dismantle the weapons. There is scant evidence for such a proposition.

Furthermore, for those who wonder about the validity of a military-industrial “organizational politics” explanation, the evidence is also thin: the military did not take on a meaningful role in the nuclear policymaking until it was asked to oversee the construction of a proposed firing range in the Kalahari desert in 1977. Additionally, there are reports of military opposition to the bomb program, due to its costs and its tendency to detract from more conventional and practical military expenditures.

Other explanations in search of a key domestic factor, such as a “bomb lobby” in parliament prior to a decision for weapons also fail flat, as most nuclear planning was kept secret ostensibly to protect nuclear ambiguity and technological advancements. The fact that South Africa never openly declared itself a nuclear-armed state and did not admit to a weapons program until years after the weapons

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81 Liberman 1.
82 Ibid 1.
83 Ibid 2.
84 Purkitt and Burgess “Correspondences,” 187.
85 Ibid, Correspondences,” 188.
were dismantled also devalues arguments about the bomb as bargaining tool. While it is clear that South Africa intended to utilize its bomb in a bid to pressure the West into rescuing or aiding it in the event of a military crisis, it is hard to find evidence that South Africa ever “put the bomb on the table” as a tool to gain leverage and end sanctions.

Etel Solingen has derived a hypothesis about the nuclear restraint of economically liberalizing states, pointing to Brazil and Argentina as cases of states that dropped pursuit of weapons ambitions as military juntas were replaced by democratic leaders. She argues that economic liberalizers (politicians, interest groups, and government agencies) do not like the “budgetary burden” and “political influence of state arms and energy complexes,” and are more concerned about using nuclear restraint as a way to gain international rewards, something that “nationalist-statist” regimes care little for. However, as Helen Purkitt and Stephen Burgess point out, South Africa’s reform was done out of a desire to repair relations with Western powers and to exert a degree of control in the transition away from minority rule, not out of an emphasis on economic conversion to more liberal policies.

Did desire for prestige play a role in South African nuclear weapons acquisition? As previously demonstrated, South Africa suffered a loss of prestige throughout the 1960s and 1970s. Some might argue that a bomb would restore respect for the nation, but the empirical record does not bear this out. South Africa was isolated from previous important roles in nuclear regulatory agencies and also suffered consequences for its suspicious nuclear behavior: in 1977, the US halted its export of low-enriched uranium to South Africa for its Koeberg reactors; the following year, it formalized this ban via the Nuclear Non-Proliferation Act.

Although some analysts have suggested that, objectively speaking, South Africa did not face the type of security threats that “normally” justify pursuit of nuclear weapons, such as the threat of a nuclear armed neighbor or of conventional territorial invasion, for the purposes of this paper, subjective perceptions of insecurity are taken into account, because if perceptions by nuclear policymakers of existential threats are one of the factors driving proliferation, then it does not matter if such perceptions are, in fact, misperceptions. Transition from apartheid meant transition to a new set of (majority) interests, which were not necessarily affected by the same issues that affected the minority regime. The focus switched from regime survival to avoidance of prolonged, violent, civil chaos and unrest.

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86 Liberman 2. See Solingen’s argument in “The Political Economy of Nuclear Restraint.”
87 Purkitt and Burgess “Correspondences,” 189.
88 Paul 114.
89 See writings by JDL Moore, Mitchell Reiss, and Peter Liberman. In addition, these scholars typically point out that South Africa’s army was far better trained and equipped than that of any other state in the region.
Finally, some have sought to emphasize the personality of President De Klerk, who eventually won a Nobel Peace Prize, as the key to the dismantlement of nuclear weapons. While it is true that De Klerk was willing to make tough calls for the sake of a peaceful future, I would argue that the variances on the three interacting conditions that this paper articulates provide the best explanation for the South African case. De Klerk recognized the link between South Africa’s isolation and its nuclear program, telling the directors of the Atomic Energy Commission after he had assumed office that: “I want to make this country once again a respected member of the international community and we’ll have to turn around the politics and we’ll have to terminate this program...and accede to the Nuclear Non-Proliferation Treaty.”

Brazil

In 2005, former Brazilian President Jose Sarney admitted that a nuclear weapons program had existed in Brazil 20 years earlier, under the auspices of the Brazilian military. His confirmation served to confirm once and for all that Brazil did possess a nuclear weapons program from approximately 1975 to 1990, when Brazil renounced its right to peaceful nuclear explosives. However, the Brazilian program was not actually dedicated to nuclear weapons production in the same manner that the Indian or South African programs were. Instead, there was simply an understanding that Brazil should achieve the “technological capacity for the option to build atomic weapons.” As shown below, the values of the Brazilian variables for level of nuclear development, level of international isolation, and level of insecurity are consistent with Brazil’s development of a nuclear program at the time a “weapons option” decision was made. Furthermore, the fact that Brazil merely chose to pursue the ability to go nuclear at some future point if it pleased, points to the relatively mild or “medium” level values registered across each condition at the initial time interval.

Any discussion of the Brazilian program, however, must consider the suspected Argentine military program, which began in approximately 1978. Brazil and Argentina were long-time rivals for leadership and dominance of South America. Argentina possessed the oldest, most developed civilian nuclear program on the continent, but Brazil recognized that it might eventually acquire nuclear weapons and be able to surpass Argentina in prestige. Instead of the simultaneous pursuit of nuclear weapons in each state devolving into an arms race, however, the

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90 Purkitt and Burgess 124.
91 Sharon Squassoni and David Fite, “Brazil’s Nuclear History,” Arms Control Today (Vol. 35, No. 8, October 2005), 16.
92 Cirincione 396–397.
93 Ibid 395.
94 Reiss 47.
95 Ibid 52.
two found common cause in disdaining the international nonproliferation regime enshrined by the NPT.

_Brazil’s Level of Development_

Brazil’s interest in civilian nuclear development originated in the 1930s when it discovered vast, indigenous deposits of uranium. In 1956, the IPEN (Institute for Energy and Nuclear Research) was created in Brazil. In 1957, Brazil constructed a nuclear research reactor in Sao Paulo, and in 1960 it constructed another at Belo Horizonte, both with the assistance of the United States. By 1965 Brazil had constructed its own indigenous research reactor in Rio de Janeiro, for which the US supplied the enriched uranium needed to operate it. Over time, Brazil grew impatient with the Westinghouse Electric Corporation (with whom it had struck a deal in 1968) for further nuclear development, due to the strict US control and management over the reactors and over the fact that all Brazilian nuclear facilities had to be safeguarded to IAEA standards.96

Hence, in 1975 Brazil opted for a “radical change” and sought a nuclear agreement with West Germany. In what would become known as the nuclear “deal of the century,” Brazil arranged to purchase “eight nuclear reactors, a commercial-size uranium enrichment facility, a pilot-scale plutonium reprocessing plant, and jet nozzle technology.” This deal was extraordinary because it would have represented the first transfer of the “complete nuclear fuel cycle.” The US pushed West Germany hard not to carry out the deal, and eventually, West Germany pledged to enforce “stringent safeguards.”97

The US had managed to dictate the deals of a term to which it was merely a third party. Following the US-orchestrated outcry against the deal, Brazil decided to develop a secret parallel military program that would leave it free to develop its nuclear technology uninhibited, to any degree it wanted. The “Solimoes Project” consisted of “nuclear weapons research design and the excavation of a...shaft for underground nuclear explosive test....Each branch of the military had its own approach [towards producing weapons material], with none subject to IAEA safeguards.”98

Brazil sought to pursue a nuclear development program, so as not to be at the whim of the US-supported NPT regime, which Brazil felt unfairly legalized the gap between the nuclear haves and have-nots. At the time of its decision for a weapons option, Brazil possessed a low level of nuclear development as demonstrated by its foreign acquisition of mere research reactors and its failed

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98 Cirincione 396.
attempt at buying several power reactors from the West Germans. By the time Brazil chose to renounce the right to a weapons program in 1990, its technical nuclear skills had progressed to an advanced level, but “Brazil was never in a position to develop a nuclear explosive device....the military never overcame the technical hurdles to produce weapons-grade material suitable for nuclear bombs.”

**Brazil’s Level of Insecurity**

Brazil’s level of insecurity at the time of its decision for a weapons option in 1975 is classed as “medium” because, although it had not fought a war with Argentina in over 130 years, there were still-simmering, conflicting territorial claims. According to scholar John Redick, historical disagreements were centered on the “buffer areas that form the present-day countries of Uruguay, Paraguay, and southern Bolivia,” as well as multiple disagreements related to the Rio de la Plata. Brazil also competed with Argentina “for export markets and political influence throughout South America, and overlapping boundary claims in Antarctica.” When Brazilian President Figueiredo visited Argentina in 1980, after the initiatives that were taken in 1979 to resolve the Rio de la Plata issues, forty years had passed without a Brazilian-Argentine summit. This speaks volumes to the competitive friction of nationalistic pride between the two. Furthermore, given Brazil’s predominant size and population, the largest in South America, Brazil envisioned itself, not Argentina, as the natural, rightful leader of the continent.

**Brazil’s Level of Isolation**

The traditionally strong US-Brazil relationship faltered in important ways in the years leading up to Brazil’s decision to acquire a nuclear weapons option. From 1967-1969, Brazil was unimpressed by the US’s global leadership, and in fact, envisioned it slipping, because of its “winding down in Vietnam.” Brazil felt that it was growing harder to “support US positions in world forums.”

At the same time, Washington was providing less military and economic aid, and “sharply reduced its military mission in Brazil (from 200 in 1968 to sixty in 1971).” The period was one of a “low profile” for the US in Brazil, an inadequate

99 Reiss 66.
103 Ibid.
policy to address the changes occurring there.\textsuperscript{104} This is epitomized by the flat, lukewarm statement of US Secretary of State Rogers in 1993 after a meeting with Brazilian President Medici that “We don’t have any problems really, at the moment, at all between Brazil and the United States.”\textsuperscript{105}

The oil crisis that exploded in 1973 further damaged US-Brazil relations, as the US’s hegemonic economic status, to which Brazil had attached its economic fortunes, took a beating.\textsuperscript{106} In 1978, President Carter’s administration adopted a “get tough” policy on human rights abuses. When demands were put on the military junta in power in Brazil, it “rejected any further military assistance...since such aid...had as a condition a Congressional requirement of a report on human rights; later Brazil cancelled long-standing bilateral military pacts between the two countries.”\textsuperscript{107} The US had also put human rights demands on the Argentine military junta that carried out the infamous “Dirty War” of the 1970s, murdering thousands of its own civilians. This was one more area in which Brazil and Argentina would find common cause to shun the international system.

\textit{The Framework at Work in Brazil}

Brazilian leaders desired to see their country rise to the top as the unquestioned regional leader and a new global power. One of the ways to accomplish this was through the acquisition of advanced nuclear infrastructure to modernize the country. However, Brazil resented the restrictions imposed by the NPT and backed by NPT supporters. Additionally, its good relationship with the US deteriorated in the years leading up to its decision for a weapons option, and the US blocking response to the 1975 West Germany deal motivated Brazil to begin its private, parallel program. Brazil did not “buck the system” on its own. Instead, it worked with its long-time rival, Argentina, to establish their own nuclear technology-sharing agreement, as well as their own set of verification and confidence-building measures that eventually allowed each to abandon its respective weapons aspirations. Scholars have often marveled at how such an outcome of cooperation was possible, but examining the changes on the variables of level of insecurity and level of international isolation can help explain the story.

In 1979, prior to the 1980 agreement to “promote nuclear fuel-cycle cooperation”\textsuperscript{108} that ushered in the period of nuclear confidence-building, Brazil and Argentina undertook a treaty to “establish a framework for managing their energy

\begin{footnotes}
\textsuperscript{105} Ibid 396. \\
\textsuperscript{106} Ibid 394. \\
\textsuperscript{107} Ibid 387. \\
\textsuperscript{108} Reiss 71.
\end{footnotes}
and water disputes in the Rio de la Plata area.”

Both nations apparently perceived the dangers in not knowing what the other was up to. Over time, though, the “technology-denial strategy” levied against Brazil and Argentina by nuclear supplier states “increased project completion timelines and raised costs, which, together with harsh economic recession in Latin America in the early to mid-1980s, severely strained budgets for nuclear activities.” This budget squeeze, coupled with the recognition of the potential financial gains from peaceful nuclear development that had been lost by bucking the NPT regime, is one of the reasons Brazil and Argentina eventually renounced weapons.

One scholar concludes that: “Brazil reevaluated and then adjusted previous nuclear policies to align them with broader foreign policy objectives [at the end of the Cold War].” Brazil and Argentina... “developed] a greater appreciation of the benefits of joining the nonproliferation regime, as well as a greater understanding of the penalties for remaining outside of it.” They recognized the potential improvement in their international standing by ending their weapons programs. Brazil’s drive to be a leader in the region, which originated from the domestic sphere, was sated once it recognized that if it could not be a great power for having nuclear weapons, it could be greatly respected for not having them.

**Competing Theoretical Explanations for Brazil**

In order to assess the explanatory power the framework, it is important to examine a few other arguments that have been advanced as theoretical models to explain the proliferation outcome in Brazil. Etel Solingen has argued that Brazil’s and Argentina’s transitions away from military juntas to democratically elected leaders in the mid-1980s can explain their respective renunciations of nuclear weapons. The theory postulates that democratic rulers are less interested in isolating themselves and their countries in the international community than their military dictator counterparts. But scholar Mitchell Reiss takes on this argument that the transition to democracy allowed for rapprochement, because, as he argues, “The historical record does not support such a single, overarching reason. Nuclear cooperation started in 1980, when military regimes ruled both countries.” The implication is that bilateral nuclear cooperation helped avoid an arms race, ratcheting down suspicions over time.

Additionally, some scholars hold that the Brazil case is best explained by the internal dynamics of the situation, that is, the anti-imperialist nuclear solidarity,
and then later the confidence-building measures. However, such an account leaves out the fact that Brazil and Argentina ultimately missed out on the benefits of the international system when it came to dealing with nuclear development. Their budgets and development plans often suffered as they tried to self-navigate the world of nuclear development, forgoing any outside assistance under the NPT regime.

**Testing the Proposed Framework**

In general, the framework-building cases of India, South Africa, and Brazil have suggested that the greater the extent of civilian nuclear development, international isolation, and existential insecurity of a state, the more likely it will be to fully proliferate. However, testing the framework across a different universe of cases can confirm its usefulness, or perhaps reveal subtle insights about how the variables can interact in different combinations.

The universe of test cases included in this study consists of states that appear to have acquired weapons (Pakistan, Israel, North Korea); states that appear to be actively trying to do so (Iran); states that possessed a weapons program at one point before it was suspended (Egypt, South Korea, Taiwan, Egypt, Libya, Iraq); and states that are control cases, because they have never made a commitment to develop indigenous weapons or weapons programs (Canada, Australia).

The attached tables illustrate the variables’ variances over time in both the original framework-building cases, as well as in additional examples of proliferation. The first set of tables provides a numerical assessment for “high,” “medium,” “low,” or “none” measurements under each condition, and the attendant, numerical range of proliferation outcomes that spring from the framework-building cases. The “high,” “medium,” “low,” and “none” ratings that are ascribed to the states under each condition (level of development, level of engagement, level of insecurity) are also assigned a numerical point value. Each state’s point value is totaled, and a recognizable range for states that develop weapons or weapons programs emerges. A rating totaling one to three points would fall under the “no weapons program or bomb” category, a rating totaling four to six points would fall under the “possible weapons program,” but no bomb category, and a rating totaling seven to nine points would fall under the “weapons program very likely, weapons possible” category. The second set of tables provides a more qualitative description of the variable values in order to provide the reader with a better understanding of the specific factors at play in each case.

An application of the framework to the additional cases performs well in explaining proliferation in the cases of Israel, Iran, North Korea, South Korea, Taiwan, Egypt, Libya, Argentina, Canada, and Australia. The cases of Iraqi and Pakistani proliferation are more complicated. The framework has some trouble
explaining Iraq, because even though US defense assistance increased following the beginning of the Iran-Iraq war (and after the Iran hostage crisis), Iraq increased its attempts to gain nuclear weapons. These are unique circumstances - counter to the usual effect of greater engagement with a major patron serving as a constraining factor in seeking a weapons program. Iraq’s low level of technological development was probably not an obstacle because of the state’s oil wealth. Ultimately, due to the US invasion in 1991, Iraq is a case of proliferation interrupted by the confounding factor of invasion.

While the framework correctly identifies Pakistan at time one as a “weapons likely” state, increased US military assistance (i.e. less international isolation) in the early 1980s would suggest that Pakistan should have been constrained from seeking nuclear weapons, given the millions of dollars of aid at risk in doing so, such as in the cases of Taiwan and South Korea where the US successfully threatened the entire bilateral relationships to stop their programs. However, it is possible that the value of the existential conflict variable was simply too high for Pakistan, and overrode the risk of international isolation. Similarly, its medium level of infrastructure at the time of a decision for a bomb indicates that existential insecurity threat can supply the will to override technological development challenges in some cases; alternatively, it might indicate that its technical expertise was more advanced at the time than is publicly known.

The Need for Further Study

This paper has demonstrated the need for and feasibility of a unified framework of proliferation and rollback, based on the three interacting conditions of level of technological development, level of international isolation, and level of insecurity. While the framework appears to explain multiple proliferation outcomes, there are some limitations to the present study. Quantitative analysis involving statistical regressions could help confirm the qualitative findings of this initial effort.

The usefulness of this tool might be improved by fine tuning and adding additional definitions and attendant numerical scores beyond the current thresholds of “none, high, medium, low” under each condition. For example, in the cases of Argentina, Brazil, South Korea and Taiwan, the scores at “time two” still register each country in the “weapons program possible” range, albeit at the lower end of that range than at the “time one” measurements, even though each has renounced a weapons program. (It is important to note, however, that some analysts still worry about the backsliding potential of these states, particularly since Brazil and Argentina have refused to sign the Additional Protocol, and South Korea seems
intent on reprocessing its own fuel. While the current framework is flexible enough to discern the variances in the key variables in these countries that move them from the high end of the “weapons program possible” range to the low end between times one and two, building in finer focus to the various thresholds under each condition could help avoid over predicting proliferation.

My hope is that the unified framework articulated in this analysis can be of practical use to policymakers whose job it is to decide how best to address the risks and menace of nuclear proliferation. The accurate prediction of nuclear proliferation and its necessary conditions has critical relevance to policy decisions, and weighty implications for all future generations.

<table>
<thead>
<tr>
<th>Nuclear Development</th>
<th>Perception of International Isolation</th>
<th>Perception of Insecurity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 = None = None</td>
<td>0 = None = Strong bilateral relationships with other actors and/or nukes umbrella</td>
<td>0 = None = None</td>
</tr>
<tr>
<td>1 = Low = Research reactors and/or scientists</td>
<td>1 = Low = Defense pact / trade</td>
<td>1 = Low = Rivals</td>
</tr>
<tr>
<td>2 = Medium = Power reactors &gt; 20 MWt</td>
<td>1 = Low = Defense pact / trade</td>
<td>2 = Medium = Distrust/competing claims</td>
</tr>
<tr>
<td>3 = High = Reprocessing facilities/enrichment plants</td>
<td>2 = Medium = Nonaligned</td>
<td>3 = High = Existential stakes and/or nuclear neighbor on bad terms</td>
</tr>
</tbody>
</table>

0-3: No weapons program or bomb 4-6: Possibly a weapons program 7-9: Weapons program likely; possibly a weapon

FRAMEWORK-BUILDING CASES AT TIME ONE: DECISION FOR WEAPONS / WEAPONS PROGRAM

<table>
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<th>Isolation</th>
<th>Insecurity</th>
<th>TOTAL</th>
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</thead>
<tbody>
<tr>
<td>India (in 1964)</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Pakistan (in 1972)</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>7*</td>
</tr>
<tr>
<td>South Africa (in 1975)</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Argentina (in mid-1970s)</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>6</td>
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<tr>
<td>Brazil (in 1975)</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>6</td>
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</tbody>
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FRAMEWORK-BUILDING CASES AT TIME TWO: DECISION FOR WEAPONS ROLLBACK OR PROGRAM SUSPENSION

<table>
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<th>Isolation</th>
<th>Insecurity</th>
<th>TOTAL</th>
</tr>
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<tbody>
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<td>India (N/A) – India is still a weapons state</td>
<td></td>
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<tr>
<td>Pakistan* (N/A) – Pakistan is still a weapons state</td>
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<td></td>
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<tr>
<td>South Africa (in 1990)</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
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<tr>
<td>(perception of future isolation if suspend) (perception of future insecurity if suspend)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Argentina** (in 1990)</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>(perception of future isolation if suspend) (perception of future insecurity if suspend)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brazil** (in 1990)</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>(perception of future isolation if suspend) (perception of future insecurity if suspend)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*The framework has some trouble explaining Pakistan (i.e. increased U.S. aid in the 1980s did not function as a constraining factor).
**The framework gives Brazil and Argentina a “possible weapons program” outcome even though both states have abandoned their programs. This is consistent, however, with lingering concerns about the backsliding potential of both states.
<table>
<thead>
<tr>
<th>Country</th>
<th>Development</th>
<th>Isolation</th>
<th>Insecurity</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Israel (1956)</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td><strong>8</strong></td>
</tr>
<tr>
<td>Iran (1984)</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td><strong>8</strong></td>
</tr>
<tr>
<td>North Korea (late 1980s)</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td><strong>8</strong></td>
</tr>
<tr>
<td>Egypt (1960)</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td><strong>5</strong></td>
</tr>
<tr>
<td>Taiwan (1967; in earnest, 1970)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td><strong>6</strong></td>
</tr>
<tr>
<td>(perception of potential abandonment)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South Korea (1971)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td><strong>6</strong></td>
</tr>
<tr>
<td>(perception of potential abandonment)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Libya (1970; accelerated 1990s)</td>
<td>1</td>
<td>1 / 3</td>
<td>2 / 3</td>
<td><strong>4 / 7</strong></td>
</tr>
<tr>
<td>(in 1970s) / (in 1980-1990s)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iraq* (1971; accelerated in 1980)</td>
<td>1 / 2</td>
<td>2 / 1</td>
<td>2 / 3</td>
<td><strong>5 / 6</strong>*</td>
</tr>
<tr>
<td>(in 1971) / (in 1980)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia (1956)</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td><strong>4</strong></td>
</tr>
<tr>
<td>Considers weapons capability</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canada (1958)</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td><strong>5</strong></td>
</tr>
<tr>
<td>Allows US weapons on soil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*The framework would predict that increased defense supplies from the US in 1980 would constrain Iraq from going nuclear (i.e. low isolation as a constraining factor against proliferation), especially at an accelerated pace. This was not the case.*
## TEST CASES AT TIME TWO: DECISION FOR WEAPONS ROLLBACK OR PROGRAM SUSPENSION

<table>
<thead>
<tr>
<th></th>
<th>Development</th>
<th>Isolation</th>
<th>Insecurity</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Israel</td>
<td>(N/A) – Israel is still (alleged) weapons state</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iran</td>
<td>(N/A) – Iran is still (a probable) weapons state</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Korea</td>
<td>(N/A) – North Korea is still a self-described weapons state</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Egypt (1968)</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Taiwan* (1988)</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>5*</td>
</tr>
<tr>
<td>South Korea* (1978)</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>4*</td>
</tr>
<tr>
<td>Libya (2003)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>(perception of future isolation if suspend)</td>
<td>(perception of future insecurity if suspend)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iraq (1991)</td>
<td>(N/A) – Decision for rollback in 1991 not indigenous; part of post-Gulf War UN resolutions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia (1973)</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Decides against weapons</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canada (1969)</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Decides to remove US weapons</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*The framework gives Taiwan and South Korea a “possible weapons program” outcome even though both states have abandoned their programs. This is consistent, however, with lingering concerns about the backsliding potential of both states.*
## Framework-Building Cases

<table>
<thead>
<tr>
<th>STATE &amp; DATE OF WEAPONS PROGRAM</th>
<th>LEVEL OF DEVELOPMENT</th>
<th>LEVEL OF INT’L ISOLATION</th>
<th>LEVEL OF EXISTENTIAL THREAT</th>
<th>PROLIFERATION STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>India</strong></td>
<td>High: Civilian program begins in 1944; produce indigenous enrichment facility at Trombay by year of bomb decision</td>
<td>Medium: No major patron (although SU provides military equipment); nuclear umbrella requests of British rebuffed; Gandhian anti-imperialism; Non-Aligned Movement</td>
<td>High: Three wars against Pakistan (1947-48; 1965; 1971); border war with China (1962); nuclear-armed China (1964)</td>
<td>“DECLARED WEAPONS” STATE</td>
</tr>
<tr>
<td>Program begins 1964</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>South Africa</strong></td>
<td>High: Civilian infrastructure expansive by 1974; many Western-trained nuclear scientists; “unique” uranium enrichment procedure developed indigenously by 1970</td>
<td>High: Drops out of British Commonwealth 1961; numerous sanctions throughout 1970s due to apartheid; previous voluntary ban on arms shipment becomes permanent (1977); US threatens with “hostile nation” status in mid-to-late 1980s, when US divestment begins; decline of apartheid heralds re-integration into int’l community and ending of sanctions</td>
<td>High: Perceives “total onslaught” of int’l communism; end of Portuguese control over Angola and Mozambique (April 1974), Soviet aid to the Marxist Angola (from March 1975), Cuban involvement in Angola (from October 1975); start of mandatory UN arms embargo (from November 1977), and growing pressure from West to withdraw from Namibia (from 1977)</td>
<td>“ABANDONED WEAPONS” STATE</td>
</tr>
<tr>
<td>Program begins middle to late 1970s (1974-1977); dismantlement 1990; weapons gone by 1991</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Brazil</strong></td>
<td>Medium: Possesses three research reactors, but greater nuclear technological autonomy desired</td>
<td>High: Series of military govt’s since 1964 coup; one continuous military govt 1979-1985; “special relationship” with US in decline by early 1970s due to economic woes; Carter Administration harshly critical of HR abuses; rejects US offer of military aid in 1977 b/c it is conditional on improved human rights</td>
<td>Medium: Argentina is a military and political rival – no summit with Argentina from 1940-1980, but had not fought a war with Argentina since 1828; competing claims to Rio de la Plata area/water issues; begin to resolve these issues in 1979</td>
<td>“ABANDONED WEAPONS PROGRAM” STATE</td>
</tr>
<tr>
<td>Program begins secretly in 1975 under “parallel” plan after int’l outcry at Brazil’s planned “nuclear deal of the century” with West Germany, capable of giving Brazil indigenous technology to potentially make bomb material; Brazil develops indigenous uranium enrichment processes by 1979 program renounced by early 1990s</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Universe of Test Cases at Time One, Decision for Weapons/Weapons Program

<table>
<thead>
<tr>
<th>State &amp; Date of Weapons Program</th>
<th>Level of Development</th>
<th>Level of International Isolation</th>
<th>Level of Existential Insecurity Threat</th>
<th>Proliferation Status</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Israel</strong>&lt;br&gt;Program begins 1956&lt;sup&gt;1&lt;/sup&gt;</td>
<td><strong>Medium</strong>: French assistance and French power reactor deal in 1956, but Israel already has indigenous heavy water&lt;sup&gt;9&lt;/sup&gt;</td>
<td><strong>High</strong>: Recognition by US and UN but lack of reliable defense supply from US; pariah state status by Arab and Muslim world; attempts to get under Western nuclear defense umbrella rebuffed in 1950s, early 1960s&lt;sup&gt;1&lt;/sup&gt;</td>
<td><strong>High</strong>: Several wars against Arab states: 1948, 1956 Suez Canal Crisis; 1967; 1973; Iraqi missiles in 1991; ongoing terrorism</td>
<td>“Undeclared Weapons” State</td>
</tr>
<tr>
<td><strong>Iran</strong>&lt;br&gt;Program begins 1984&lt;sup&gt;4&lt;/sup&gt;</td>
<td><strong>Medium</strong>: US nuclear assistance to Shah prior to 1979 Islamic Revolution; however, damage during Iran-Iraq war&lt;sup&gt;2&lt;/sup&gt;</td>
<td><strong>High</strong>: Pariah status; no strong patron: “Neither the East nor the West, only the Islamic Republic”</td>
<td><strong>High</strong>: Distrust and competing claims with Israel; existential Iran-Iraq war, 1980-1988; 2001 (Afghanistan) and 2003 (Iraq) sees US on both borders</td>
<td>“Probable Weapons” State</td>
</tr>
<tr>
<td><strong>North Korea</strong>&lt;br&gt;Exact start date unclear; US concerned by NK nuclear activity beginning mid-1980s&lt;sup&gt;9&lt;/sup&gt;</td>
<td><strong>Medium</strong>: Soviet-supplied research reactor, plus indigenously built 30mw reactor&lt;sup&gt;7&lt;/sup&gt;; also some indigenous capabilities related to fuel cycle&lt;sup&gt;6&lt;/sup&gt;; Soviets training N.Korean scientists&lt;sup&gt;9&lt;/sup&gt;</td>
<td><strong>High</strong>: Developing a pariah status; with the end of Cold War comes the disappearance of Soviet patron; Russians reaching out to S.Korea in 1990&lt;sup&gt;10&lt;/sup&gt;; NK forced to accept separate entrance of the two Koreas into the UN when China and Russia no longer block S.Korea, which contradicts N.Korea’s one Korea policy&lt;sup&gt;11&lt;/sup&gt;; Chinese diplomatic opening to South Korea in 1992&lt;sup&gt;2&lt;/sup&gt;</td>
<td><strong>High</strong>: Korean War against South Korea, 1950-1953</td>
<td>“Self-Declared Weapons” State</td>
</tr>
<tr>
<td><strong>South Korea</strong>&lt;br&gt;Program begins 1971&lt;sup&gt;13&lt;/sup&gt;; ends 1975 when South Korea signs NPT&lt;sup&gt;14&lt;/sup&gt; although lingering concerns through late 1970s&lt;sup&gt;15&lt;/sup&gt;</td>
<td><strong>Low</strong>: Only a small research reactor online by decision time&lt;sup&gt;65&lt;/sup&gt;</td>
<td><strong>Medium</strong>: US providing security guarantees, including troops on the peninsula and nuclear umbrella since 1953 but S. Korea fears abandonment as US withdraws from Vietnam—1969 “Guam Doctrine”; NK aggressive behavior 1960s&lt;sup&gt;16&lt;/sup&gt;; US-China opening 1971-2; (eventually yields to US pressure and threats to end bilateral relationship&lt;sup&gt;18&lt;/sup&gt;)</td>
<td><strong>High</strong>: Korean War against North Korea, 1950-1953</td>
<td>“Abandoned Weapons Program” State</td>
</tr>
<tr>
<td>Country</td>
<td>Program Begins</td>
<td>Program Ends</td>
<td>Low:</td>
<td>Medium:</td>
</tr>
<tr>
<td>---------</td>
<td>----------------</td>
<td>-------------</td>
<td>------</td>
<td>---------</td>
</tr>
<tr>
<td>Taiwan</td>
<td>1967</td>
<td>1988</td>
<td>Only a research reactor online at decision time; although first power reactor follows one year later</td>
<td>US mutual defense treaty with nuclear guarantees for Taiwan, but fear of abandonment from US as US withdraws from Vietnam – 1969 “Guam Doctrine”; kicked out of UN 1970; US-China opening 1972; Shanghai communiqué of 1982 marginalizes Taiwan’s status and allows for arms sales decline to Taiwan (eventually, yields to intense US pressure)</td>
</tr>
<tr>
<td>Egypt</td>
<td>1960</td>
<td>1968</td>
<td>One small research reactor; no development of a civilian infrastructure, much less a weapons infrastructure; appeals to buy weapons from Soviet Union and China rebuffed; budget constraints; eventual atrophy and “brain drain” of nuclear scientists</td>
<td>Receives arms from USSR but not solid nuclear guarantees; relationship with Soviets declines by 1972; strong US-Egypt relationship cemented in 1979; since Camp David Accords in 1979, US gives Egypt billions in economic and military aid</td>
</tr>
<tr>
<td>Libya</td>
<td>1970-2003</td>
<td>2004</td>
<td>General low level of technological development across all industries except oil; attempts to buy weapons from Soviet and Chinese rebuffed; heavy reliance on nuclear black market; some civilian nuclear technology assistance from USSR (a 10 mw research reactor) and Argentina</td>
<td>1969 “revolution” in Libya forces out British and American military influences; Libya-Soviet military defense collusion mid-1970s to mid-1980s</td>
</tr>
<tr>
<td>Country</td>
<td>Program Begins</td>
<td>Medium</td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>---------</td>
<td>----------------</td>
<td>--------</td>
<td>-----</td>
<td>--------</td>
</tr>
<tr>
<td><strong>Argentina</strong></td>
<td>late 1970s; reprocessing facility constructed 1978⁶⁵; suspends reprocessing in 1990⁴⁴; signs various agreements forgoing weapons in early 1990s⁵⁰</td>
<td>Anti-leftist military junta in power 1976-1983⁴⁶; relationship with US declines due to HR abuses in the “Dirty War,” 1976-1983⁴⁶; begins cooperation with Brazil in 1980 to buck the international NPT regime together⁴⁹; failed 1982 war with British over Falkland Islands⁸⁰</td>
<td></td>
<td>Brazil is a military and political rival – no summit with Brazil from 1940-1980, but had not fought a war with Brazil since 1826⁵⁰; competing claims to Rio de la Plata area/water issues⁵²</td>
</tr>
<tr>
<td><strong>Canada</strong></td>
<td>1958 decision to accept US nukes on its soil⁵³; decision to remove in 1969⁴⁴</td>
<td>Participated in Manhattan project with Western allies⁴⁶; producing heavy water reactor prototypes by 195⁵⁰</td>
<td>No nuclear guarantees from British or Americans⁴⁶; initially fear US or UK abandonment⁴⁴, but defense relationships with both; (later, ANZUS treaty with the US considered nuclear guarantee⁶⁵)</td>
<td>Strong distrust of the Soviet Union⁵⁸; US is a nuclear-armed neighbor, but no war between the two since 1814; (later judges self to have no existential security threat)⁵⁹</td>
</tr>
<tr>
<td><strong>Australia</strong></td>
<td>Debates over need for nuclear program beginning 1956, and later ratifies NPT in 1973⁶⁰</td>
<td>Provides testing grounds and scientists to assist British efforts⁶⁰; by 195⁴ possessed only a small research reactor from Britain⁶⁰</td>
<td>No nuclear guarantees from British or Americans⁴⁶; initially fear US or UK abandonment⁴⁴, but defense relationships with both; (later, ANZUS treaty with the US considered nuclear guarantee⁶⁵)</td>
<td>Western powers distrust of Soviet Union; China goes nuclear in 196⁴⁶; (later perception of threat environment in which chance of existential attack by USSR or China is practically nonexistent)⁶⁷</td>
</tr>
<tr>
<td><strong>Iraq</strong></td>
<td>Program begins 1971⁴⁶; accelerates ahead of Iran-Iraq war, 198⁰⁶⁶; and “crash program” ahead of invasion of Kuwait, 199⁰⁸⁰; ends in 199¹ due to Gulf War and UN disarmament⁵¹</td>
<td>Iraq hatches plan to first develop civilian reactors and then create a parallel military program⁹⁶; later on, level of development improves as France provides Osirak and Isis reactors⁹⁷, although Osirak is bombed later</td>
<td>In 1971, US still supporting the Shah of Iran; however, by 198⁰, US giving arms and diplomatic support to Iraq during Iran-Iraq war (although no nuclear guarantees) while Saddam proliferating⁹⁵; by 1st Gulf War, US support evaporated and US is hostile to Iraq; international sanctions following Kuwait invasion and Gulf War</td>
<td>Distrust and competing claims against Israel, with whom it fought against in 194⁸; later on, High, due to threats to export Iranian Revolution; and Iran-Iraq war, 198⁰-198⁸</td>
</tr>
<tr>
<td><strong>Pakistan</strong></td>
<td>Program begins in 197²⁵</td>
<td>US-supplied research reactor goes critical in 19⁶⁵;⁵⁸ heavy water CANDU reactor critical in 19⁷¹⁷; but AQ Khan must steal nuclear secrets from European nations⁷⁹; key assistance from China⁹⁷</td>
<td>US military aid favors Pakistan over India until 196⁵ war, prompting Pakistan not to think of US as reliable ally⁸⁰; US aid flow increases in early 198⁰s due to Soviet invasion of Afghanistan when Pakistan was developing its weapon⁸¹</td>
<td>Three wars against India (19⁴⁷-⁴⁸; 19⁶⁵; 19⁷¹); 19⁷¹ war sees India dismember Eastern Pakistan, which later becomes Bangladesh</td>
</tr>
</tbody>
</table>
Notes

3 Cohen 66.
5 Cordesman 4-5.
8 “Nuclear Overview,” North Korea.
9 “Nuclear Overview,” North Korea.
11 Reiss 237.
12 Reiss 243.
17 As quoted in Pollack and Reiss 261. See also Paul 121.
18 Pollack and Reiss 263, and Paul 121.
21 Mitchell 294.
22 Mitchell 295.
24 Mitchell 300-301.
26 Einhorn 45.
27 Paul 139.
29 Einhorn 46.
32 Paul 139
33 Cirincione 317 and 321.
35 Cirincione 321.
39 “Libya: Military Cooperation with the Soviet Union.”
40 “US-Libyan Relations,” Background Note.
41 Cirincione 321.
45 “Nuclear Weapons Program,” Argentina.
46 Blanc 7.
47 Reiss 46-48.
49 Reiss 53.
50 Reiss 48.
51 Reiss 52.
52 Reiss 53.
53 Paul 66.
54 See Paul 69.
56 Blanc 70.
57 Bratt 13.
58 Bratt 7 and 13.
59 Paul 67.
60 Paul 75-76.
61 Paul 73.
63 Paul 75.
64 Hymans 4
In 1951, the US, Australia, and New Zealand signed the ANZUS treaty in connection with the Korean War, that “provided a bulwark against the least likely, worst-case contingencies against large-scale aggression by other nuclear states,” but it was not an explicit nuclear security guarantee from the US. See Paul 79. Later, the ANZUS treaty, while no longer observed by New Zealand, has come to be viewed as an implicit promise of extended deterrence from the US to Australia. See “Extended Nuclear Deterrence – Australia,” The Global Cooperative, http://gc.nautilus.org/Nautilus/australia/A-J-disarm/extended-nuclear-deterrence-1/australia/ (accessed 19 August 2010).

Hymans 8.

Paul 78-79.


Blanc 55.

Cirincione 244.


“Background Note: Pakistan.”