

# Correspondence

## Civilian Nuclear Cooperation and the Proliferation of Nuclear Weapons

Christoph Bluth  
Matthew Kroenig  
Rensselaer Lee  
William C. Sailor  
Matthew Fuhrmann

*To the Editors (Christoph Bluth writes):*

In his article, Matthew Fuhrmann challenges the conventional wisdom about the relationship between civilian nuclear cooperation and nuclear weapons proliferation.<sup>1</sup> The literature on nuclear proliferation focuses on the demand side and explains decisions to acquire nuclear weapons on the basis of security threats, hegemonic ambitions, national identity, or related factors.<sup>2</sup> The role of civilian technical nuclear cooperation is generally discounted as a motivating factor in the acquisition of nuclear weapons capabilities. Fuhrmann argues that there is a causal connection between peaceful nuclear cooperation and proliferation and that civilian nuclear assistance over time increases the likelihood that states will initiate nuclear weapons programs. The implications of the notion that civilian nuclear technology promotes nuclear proliferation are disturbing, because they lead to the conclusion that the central bargain of the nuclear nonproliferation regime—namely, access to civilian nuclear technology in return for the renunciation of nuclear weapons—is not viable and that instead the Nonproliferation Treaty (NPT) might be a vector for the spread of nuclear weapons technology.

The central thesis of Fuhrmann's article seems implausible. Nuclear proliferation is exceedingly rare. One hundred eighty-nine states are members of the NPT, including five nuclear states. There are only four states that are not members of the NPT and that have nuclear weapons. Of the four, the last one to make the decision to go nuclear and that received civilian nuclear assistance started its nuclear program in 1972. North Korea went nuclear in the absence of civilian nuclear assistance.<sup>3</sup> Belarus, Kazakhstan,

---

*Christoph Bluth is Professor of International Studies at the University of Leeds.*

---

*Matthew Kroenig is Assistant Professor of Government at Georgetown University.*

---

*Rensselaer Lee is Senior Fellow at the Foreign Policy Research Institute and President of Global Advisory Services in McLean, Virginia.*

---

*William C. Sailor is a research scientist at Los Alamos National Laboratory. In 2000 he was an adviser to William Perry, President Bill Clinton's special envoy to North Korea.*

---

*Matthew Fuhrmann is Assistant Professor of Political Science at the University of South Carolina. He thanks Erica Chenoweth, Alexander Downes, and Todd Sechser for helpful comments.*

---

1. Matthew Fuhrmann, "Spreading Temptation: Proliferation and Peaceful Nuclear Cooperation Agreements," *International Security*, Vol. 34, No. 1 (Summer 2009), pp. 7–41. Further references to this article appear in parentheses in the text.

2. Etel Solingen, *Nuclear Logics: Contrasting Paths in East Asia and the Middle East* (Princeton, N.J.: Princeton University Press, 2007); Jacques E.C. Hymans, *The Psychology of Nuclear Proliferation: Identity, Emotions, and Foreign Policy* (Cambridge: Cambridge University Press, 2006); and Scott D. Sagan, "Why Do States Build Nuclear Weapons? Three Models in Search of a Bomb," *International Security*, Vol. 21, No. 3 (Winter 1996/97), pp. 54–86.

3. Although North Korea received assistance from the Soviet Union in the early phases of its nuclear program, unlike East European countries, it was denied nuclear power plants because the So-

and Ukraine not only had civilian nuclear technology but had fully functional nuclear weapons on their territory, which they decided to give up, partially in return for increased civilian nuclear cooperation.<sup>4</sup> The number of cases of nuclear proliferation is so small that it is hard to see how statistical analysis can give any meaningful answer about causation, and whatever real causal effect there might be is extremely small. In fact, it is not clear that the history of nuclear proliferation supports this thesis at all. It is interesting that the two cases Fuhrmann examines, India and Pakistan, are countries that never joined the NPT. Given that only one state (which did not receive civilian nuclear assistance at the time) has left the NPT (i.e., North Korea), it is impossible to develop any kind of statistical analysis that will predict whether countries that do receive civilian nuclear assistance are more prone to leave the NPT. This is a significant issue, because there are no more nonnuclear states outside the NPT, so there can be no further nuclear weapons proliferation without states defecting from the NPT.

Fuhrmann is on safer ground when he argues that civilian nuclear assistance has an enabling function for states that seek to acquire nuclear weapons. Indeed the production of fissile materials is greatly aided by civil nuclear technology, and civilian nuclear programs help to build technical knowledge essential for the development of nuclear weapons. This part of Fuhrmann's argument is not particularly controversial.

The core of Fuhrmann's article comprises four hypotheses, which bear repeating for the purposes of discussion:

*Hypothesis 1:* Countries receiving peaceful nuclear assistance are more likely to begin nuclear weapons programs.

*Hypothesis 2:* Countries receiving peaceful nuclear assistance are more likely to begin nuclear weapons programs when a security threat arises.

*Hypothesis 3:* Countries receiving peaceful nuclear assistance are more likely to acquire nuclear weapons.

*Hypothesis 4:* Countries facing security threats and receiving peaceful nuclear assistance are more likely to acquire weapons. (p. 15)

These hypotheses are rather trivial. Excluding the original nuclear powers, the only nuclear state denied civilian nuclear technology is North Korea (although, as Fuhrmann points out, North Korean nuclear scientists were trained in the Soviet Union in the 1950s, and the country received a small research reactor). Moreover, denial of civilian nuclear technology is rare, because members of the NPT are entitled to nuclear technological cooperation. Sanctions have been applied to states outside the NPT and a small number of "states of concern," but even states that have been or are subject to sanctions have received significant civilian nuclear cooperation, as the cases of India

---

viets were concerned about Pyongyang's intentions. See Christoph Bluth, *The Crisis on the Korean Peninsula* (Dulles, Va.: Potomac, forthcoming). The initial decision to acquire nuclear weapons was probably made in 1962.

4. For more details, see Christoph Bluth, *The Nuclear Challenge: U.S.-Russian Strategic Relations after the Cold War* (Aldershot, U.K.: Ashgate, 2000).

and Pakistan illustrate.<sup>5</sup> If one takes hypothesis 4, of the four examples where proliferation did occur, three of the states received civilian nuclear assistance and all faced security threats. Consequently, it is not to be expected that any statistical analysis will refute these practically self-evident hypotheses. They do not, however, confirm the larger claim that Fuhrmann makes, namely, that all types of civilian nuclear assistance raise the risks of proliferation and that such assistance can be a cause of proliferation. In other words, the evidence in favor of the hypotheses does not establish that the supply side can be a causative factor of the acquisition of nuclear weapons in the absence of a demand side. According to Fuhrmann's data, in the period since Pakistan decided to acquire nuclear weapons, more than 2,000 nuclear cooperation agreements have been concluded, and none of these agreements (excluding the small number of agreements involving Pakistan) has produced another nuclear power.

The best qualitative interpretation of the data is that causality operates in the opposite direction of that proposed by Fuhrmann. It is not that civilian nuclear cooperation results in a decision to initiate a nuclear weapons program, but rather that a decision to go nuclear prompts the establishment of civilian nuclear programs that rely on international technical cooperation. There is much historical evidence to support this proposition. Iran, Iraq, Libya, North Korea, and Pakistan all started civilian nuclear programs with the primary purpose of developing nuclear weapons. Even India's nuclear program was dual purpose from the outset. The cases of North Korea and Pakistan, in particular, demonstrate that when civilian nuclear cooperation is absent or restricted, states will go to any length to circumvent sanctions and export controls to acquire the technology they need. This would suggest that although civilian nuclear cooperation can facilitate nuclear weapons programs, the latter are not dependent on the degree of such cooperation. Even if such dependence did exist, this would not reveal anything about states that have civilian nuclear programs without any intent to produce nuclear weapons and what effect these programs will have on future decisions.

Fuhrmann warns that the renaissance of civilian nuclear power will result in further proliferation and advises policymakers to take this concern seriously. He considers the "puzzle" of why suppliers engage in civilian nuclear cooperation if they seek to limit the spread of nuclear weapons. He suggests that countries ignore proliferation risks for economic and strategic gains. It may also be the case, however, that suppliers do not share Fuhrmann's view of the risks of proliferation. Moreover, member states of the NPT are entitled to civilian nuclear technology. Technology denial would be a breach of the commitments made by the parties to the NPT and would undermine the treaty.

As Fuhrmann points out, there is a rich literature that examines the causes of proliferation from the point of view of demand rather than supply. Again the central issue of the proliferation puzzle is to understand why demand for nuclear weapons is so low. This is particularly puzzling given that nuclear weapons seemingly can resolve a state's security dilemma in one stroke. Nuclear weapons, if Kenneth Waltz, John Mearsheimer, and many other realists are to be believed, enable weaker states to balance stronger states.<sup>6</sup> They deter and prevent armed conflict and guarantee the security of the state

---

5. George Perkovich, *India's Nuclear Bomb: The Impact on Global Proliferation* (Berkeley: University of California Press, 1999).

6. Scott D. Sagan and Kenneth N. Waltz, *The Spread of Nuclear Weapons: A Debate Renewed* (New York: W.W. Norton, 2002); and John J. Mearsheimer, *The Tragedy of Great Power Politics* (New York: W.W. Norton, 2001).

that possesses them. Then how can it be that so few states have acquired them? The proposition that the existence of the NPT as an international security regime that is discriminatory in its very design and offers only feeble security assurances to its non-nuclear members has persuaded states to forego such a powerful means to provide for their security seems implausible. There are reasons to believe that the nonproliferation regime is not nearly as shaky as pessimists claim and that there are deeper reasons why proliferation has remained rather limited.

The explanation for the lack of nuclear proliferation must lie both in the development of norms in relation to armed conflict and geopolitics. During the Cold War, both superpowers sought to prevent their allies from acquiring nuclear weapons (although this failed in the case of Britain, China, and France). To some extent, the NPT was an instrument of this policy, with the Federal Republic of Germany being a particular target.<sup>7</sup> The end of the Cold War was the beginning of a total transformation of the international system. The military contingencies that the nuclear powers are likely to face do not involve nuclear weapons either as a deterrent or as a useful military tool. For example, in the Balkans conflicts in the 1990s, four nuclear powers were engaged with armed forces, but this had no relevance for their conduct or the course of the conflict. Few states face an external threat that would compel them to acquire nuclear weapons. Countries that might have previously contemplated the acquisition of nuclear weapons are no longer doing so, because there is simply no need for them. Thus the non-Russian former Soviet republics where strategic nuclear weapons were based permitted all of these weapons to be dismantled, and South Africa renounced its nuclear status.

Another significant factor is the development of norms. In particular, international norms in relation to the use of force have changed fundamentally. It is no longer considered legitimate to use force to support national interests (including the resolution of territorial disputes). Rather, the use of force is permissible only under specific conditions, such as self-defense or the enforcement of international law and security as mandated by the United Nations Security Council (which may include humanitarian intervention). Moreover, the use of force is subject to stringent conditions, among which proportionality and the avoidance of civilian casualties are paramount. Although the possession of nuclear weapons is not against international law, their use would be illegal in almost all conceivable circumstances. Although one may question how strictly these norms are being adhered to, they demonstrably restrain the use of force by states. Many former practices in the conduct of warfare are no longer acceptable, such as the kind of strategic bombing practiced during World War II, the annexation of foreign territories, or the execution of prisoners of war. Even the kind of planning for the use of tactical nuclear weapons in Europe during the Cold War now looks bizarre and beyond all moral bounds.<sup>8</sup>

This analysis indicates that the effectiveness of the nuclear nonproliferation regime depends critically on whether states are committed to the adherence to international law and the norms of the international community more generally. A good case in point is China, where the adoption of the NPT and other global arms control regimes matches

---

7. Christoph Bluth, *Britain, Germany, and Western Nuclear Strategy* (Oxford: Oxford University Press, 1995).

8. John Mueller, *Retreat from Doomsday: The Obsolescence of Major War* (New York: Basic Books, 1989); and Michael Mandelbaum, "Is Major War Obsolete?" *Survival*, Vol. 40, No. 4 (January 1998), pp. 20–38.

the emergence of a policy line according to which China seeks to be perceived as a responsible power that is integrated into the international community.<sup>9</sup> Obvious counterexamples are Iran, Iraq, and North Korea, which have (or had) little respect for international law more generally. The political price and economic cost of a nuclear weapons program is extraordinarily high, especially for members of the NPT, where the UN Security Council has an established record of imposing severe economic sanctions. For this reason, states such as Japan, Qatar, Saudi Arabia, and South Korea will likely continue to rely on the United States to deter any nuclear threats from the likes of Iran and North Korea. It still remains to be seen whether Iran will take the final step and break out from the NPT, given the international reaction such a step is likely to provoke. Therefore, it does not seem plausible that peaceful nuclear cooperation alone is a sufficient cause for initiating a nuclear weapons program. If new nuclear states do arise, it will be in response to severe challenges to their national security.

—*Christoph Bluth*  
Leeds, United Kingdom

*To the Editors (Matthew Kroenig writes):*

Matthew Fuhrmann's recent article draws attention to the important issue of international nuclear assistance and its relationship to the spread of nuclear weapons.<sup>1</sup> As I have demonstrated in previous research, sensitive nuclear assistance (i.e., assistance related to uranium enrichment, plutonium reprocessing, weapons-grade fissile material, and nuclear weapons design) contributes to nuclear proliferation.<sup>2</sup> Fuhrmann takes issue with this point, arguing instead that the relationship between nuclear assistance and proliferation is "much broader," because other less sensitive forms of nuclear cooperation also lead to the spread of nuclear weapons (p. 12). Indeed, Fuhrmann claims that "all forms of atomic assistance—whether it involves training scientists, supplying reactors, or building fuel fabrication facilities—raise the likelihood that nuclear weapons will spread" (ibid.). By claiming that such nonsensitive nuclear assistance causes nuclear proliferation, Fuhrmann goes too far. A more careful analysis reveals that nonsensitive nuclear assistance does not contribute to nuclear proliferation and that it may even reduce the risk of the spread of nuclear weapons.

Fuhrmann claims to demonstrate that nonsensitive nuclear assistance contributes to nuclear proliferation by showing a positive correlation between the number of civilian nuclear cooperation agreements (NCAs) a country has signed and the probability

---

9. Cristina Hansell and William C. Potter, eds., *Engaging China and Russia on Nuclear Disarmament*, Occasional Paper, No. 15 (Monterey, Calif.: Monterey Institute of International Studies, 2009); and Jae-Ho Hwang and Christoph Bluth, "China and the MTCR: The Dilemma of China's Membership," *Korean Journal of Security Affairs*, Vol. 12, No. 1 (June 2007), pp. 31–48.

1. Matthew Fuhrmann, "Spreading Temptation: Proliferation and Peaceful Nuclear Cooperation Agreements," *International Security*, Vol. 34, No. 1 (Summer 2009), pp. 7–41. Additional references to this article appear parenthetically in the text.

2. On the relationship between sensitive nuclear assistance and nuclear proliferation, see Matthew Kroenig, "Importing the Bomb: Sensitive Nuclear Assistance and Nuclear Proliferation," *Journal of Conflict Resolution*, Vol. 53, No. 2 (April 2009), pp. 161–180.

that it acquires nuclear weapons. The number of NCAs signed, however, is a highly inaccurate measure of nuclear cooperation, because a large percentage of NCAs are subsequently canceled and do not result in the transfer of nuclear material or technology. For example, Russia canceled a deal to provide Iran with uranium enrichment in 1995; France canceled a planned plutonium reprocessing plant in Pakistan in 1978; the United States tore up an agreement to build reactors in North Korea in 2002; Argentina scrapped a plan to build a plutonium reprocessing plant in Libya in 1985; and the list goes on.<sup>3</sup> That many NCAs are never consummated means that Fuhrmann studies which countries sign agreements, not which countries receive assistance.

Using more accurate measures of nuclear assistance, which count only nuclear transfers that have taken place, I arrive at results very different from Fuhrmann's.<sup>4</sup> I find that countries that receive sensitive nuclear materials and technology are more likely to acquire nuclear weapons.<sup>5</sup> This is because the production of weapons-grade fissile material is the most difficult step in producing nuclear weapons, and sensitive nuclear assistance can help countries to overcome the common technical and political hurdles that they encounter on their path to acquiring the bomb.<sup>6</sup> In contrast to Fuhrmann, however, I find that either there is no relationship between nonsensitive nuclear assistance and nuclear proliferation, or, in some tests, that countries receiving nonsensitive nuclear assistance are less likely to acquire nuclear weapons.<sup>7</sup> The intuition behind this finding is simple: although a small number of countries, such as India, have applied nonsensitive nuclear assistance toward developing a militarized nuclear program, many more have not. For a variety of reasons, countries as diverse as Australia, Bangladesh, Belgium, Congo, Egypt, Finland, Germany, Hungary, Jamaica, Peru, the Netherlands, Vietnam, and many others have used imported nuclear facilities for research or energy purposes, or let them sit idle, but they have not used them to produce nuclear weapons. In fact, this finding suggests that one of the grand bargains of the nuclear Nonproliferation Treaty may be working and that countries are willing to trade their nuclear weapons ambitions for peaceful nuclear cooperation.

These results raise the question of why Fuhrmann finds a strong correlation between NCAs and nuclear proliferation, even after accounting for sensitive nuclear assistance (pp. 38–39). The answer may be in part that signing larger numbers of NCAs is a by-product, not a cause, of the nuclear proliferation process. First, countries of proliferation concern sign more NCAs because they have more NCAs canceled. As a country becomes internationally recognized as a proliferation risk, it becomes politically difficult for nuclear suppliers to honor contracts in that country. Proliferating countries find themselves repeatedly signing similar agreements, only to have the nuclear suppliers eventually pull out. Iran, for example, has had a series of nuclear cooperation agree-

---

3. For analysis of why countries provide nuclear assistance, see Matthew Kroenig, "Exporting the Bomb: Why States Provide Sensitive Nuclear Assistance," *American Political Science Review*, Vol. 103, No. 1 (February 2009), pp. 113–133; Matthew Kroenig, *Exporting the Bomb: Technology Transfer and the Spread of Nuclear Weapons* (Ithaca, N.Y.: Cornell University Press, 2010); and Matthew Fuhrmann, "Taking a Walk on the Supply Side: The Determinants of Peaceful Nuclear Cooperation," *Journal of Conflict Resolution*, Vol. 52, No. 2 (April 2009), pp. 181–208.

4. Kroenig, *Exporting the Bomb*, pp. 151–172; and Kroenig, "Importing the Bomb."

5. *Ibid.*

6. *Ibid.*

7. Kroenig, *Exporting the Bomb*, p. 169; and Kroenig, "Importing the Bomb," p. 178 n. 21.

ments canceled or scaled back over the years by Argentina, China, France, Germany, Russia, Ukraine, and the United States.

Second, nuclear proliferators are likely to attract NCAs because the international community often uses nonsensitive nuclear cooperation as a tool to dissuade countries from working on more sensitive technologies. The international community, for example, is currently negotiating an agreement to provide Iran with nuclear fuel-cycle services in exchange for a curb on its uranium enrichment program. If Iran acquires nuclear weapons in the coming years, as many analysts believe is likely, the numbers will show a correlation between NCAs and proliferation. Tehran will not enter the nuclear club, however, because it signed many NCAs that were subsequently canceled or that were specifically designed to steer it away from the bomb. Rather, it racked up large numbers of these types of agreements because it was at risk of developing nuclear weapons. Indeed, Iran is on the brink of becoming a nuclear power in large part because of the sensitive nuclear assistance it received from Pakistan from 1987 to 1995.<sup>8</sup> Similar dynamics can be seen in other cases of nuclear proliferation, including China, India, Israel, North Korea, and Pakistan. In short, larger numbers of NCAs do not cause nuclear proliferation, but imminent nuclear proliferation might cause a country to sign larger numbers of NCAs.

The differences in findings, and the strength of the analysis on which they are based, not only appeal to scholars, but they also have important policy implications. According to Fuhrmann, policymakers are damned if they do and damned if they don't. They can control the spread of nuclear weapons or promote peaceful uses of nuclear energy to combat global climate change, but not both. In contrast, my findings provide reason for hope. The United States must carefully control the spread of sensitive nuclear materials and technology to prevent nuclear weapons proliferation. At the same time, it can encourage nuclear power as a clean energy source and run little risk of contributing to proliferation. Indeed, by satisfying countries' demand for peaceful nuclear assistance, such an approach may even help to discourage the international spread of nuclear weapons.

—Matthew Kroenig  
Washington, D.C.

*To the Editors (Rensselaer Lee writes):*

Matthew Fuhrmann argues that civilian nuclear cooperation agreements are a significant predictor of nuclear weapons programs.<sup>1</sup> Few would dispute the strength of the relationship, well described in this thought-provoking piece; but inconveniently for his analysis, the list of top recipients of nuclear cooperation agreements in table 1 of his article excludes many past and current proliferation-prone states that have benefited from infusions of civilian nuclear assistance. These are Iran, Iraq, Israel, Libya, North

---

8. For an analysis of Pakistan's sensitive nuclear transfers to Iran, Libya, and North Korea, see Kroenig, *Exporting the Bomb*, pp. 134–148.

---

1. Matthew Fuhrmann, "Spreading Temptation: Proliferation and Peaceful Nuclear Cooperation Agreements," *International Security*, Vol. 34, No. 1 (Summer 2009), pp. 7–41.

Korea, Pakistan, and South Africa. All of these states have or have had weapons programs; four (Israel, North Korea, Pakistan, and South Africa) carried the programs to fruition by building bombs. What additional explanatory power the author's statistical model provides for such important cases is unclear. Indeed, for most if not all of these states, the decision to develop a nuclear weapons capability could well have preceded the acquisition of civilian nuclear technology and expertise, making the latter more of a dependent than an independent variable. The significance of covert acquisition programs and smuggling for these proliferators' nuclear activities would seem to underscore this reality.

—Rensselaer Lee  
McLean, Virginia

*To the Editors (William C. Sailor writes):*

In his recent article, Matthew Fuhrmann argues that a correlation exists between the more than 2,000 civilian bilateral nuclear cooperation agreements that have been concluded and cases of nuclear weapons proliferation in an unspecified number of countries.<sup>1</sup> He claims that civilian nuclear assistance leads to the proliferation of nuclear weapons. Fuhrmann's conclusion, however, is stronger than what the data suggest. His article shows only a weak relationship between the diffusion of peaceful nuclear knowledge and the growth in the number of weapons states. These two trends exist mostly in parallel without causality. Moreover, Fuhrmann's study does not address international efforts to prevent nuclear proliferation.

Fuhrmann does not exclude cases where nuclear proliferation has occurred because supplier states have deliberately assisted other states that are trying to develop nuclear weapons. He writes, "If countries generally want to limit the spread of nuclear weapons and if nuclear cooperation agreements lead to proliferation, then it seems puzzling that supplier states would engage in civilian nuclear cooperation" (p. 41). There is, however, no puzzle. Some observers believe that French aid to Israel was critical for the success of Israel's clandestine nuclear program. In addition, nuclear aid from the Soviet Union to China and from the United States to Britain, which in both cases led to new weapons states, should rightly be considered deliberate policies. The same can be said of Chinese nuclear aid to Pakistan. An accurate correlation analysis would have omitted all of these cases. Moreover, such cases may be in the majority.

Fuhrmann is correct about one central fact: the diffusion of nuclear knowledge has led to the emergence of at least one or two weapons states, where this result was not the suppliers' intention. He cites the Indian case as one such example. Regardless, I doubt the value of Fuhrmann's analysis correlating a small number of new weapons states to a large number of new international trade agreements.

Case studies that demonstrate a lack of correlation between the dispersion of nuclear knowledge and nuclear weapons would include Brazil, Japan, Libya, South Korea, and

---

1. Matthew Fuhrmann, "Spreading Temptation: Proliferation and Peaceful Nuclear Cooperation Agreements," *International Security*, Vol. 34, No. 1 (Summer 2009), pp. 7–41. Subsequent references to this article appear parenthetically in the text.

Taiwan.<sup>2</sup> All of these countries are thought to have had weapons ambitions or actual programs that they abandoned as a result of diplomatic influence from other countries. Moreover, except for Libya, they all have growing nuclear power programs. The Libyan government stated that it abandoned its weapons program partially because it expected to receive peaceful nuclear assistance in return. Did Fuhrmann include these cases of nuclear reversal in his study? I suspect not.

Fuhrmann's work could potentially be extended to answer such questions as: Why are there so few nuclear weapons states? Since the 1940s, observers have often claimed that, for reasons of national self-interest, the spread of nuclear knowledge would inevitably and rapidly lead to more weapons states. Immediately after World War II, the Nobel Prize-winning physicist Harold Urey predicted the addition of one new weapons state per year for half a dozen years.<sup>3</sup> In the early 1960s, some of President John F. Kennedy's advisers were sure there would be twenty weapons states by 1980. Decades later, the growth in the number of nuclear weapons states has been much slower than the alarmists' predictions,<sup>4</sup> which I suggest is the result of U.S. and international policy changes. Not until President Kennedy, for example, did the prevention of nuclear proliferation become U.S. policy. Reflecting this change, Kennedy met with David Ben Gurion, the president of Israel, in an attempt to make that state's nuclear program more transparent.<sup>5</sup> By the late 1960s, new international institutions were put in place to address growing concerns over proliferation, most notably the Nonproliferation Treaty (NPT) of 1968.

Of the five successful proliferators since the NPT was created (i.e., India, North Korea, Pakistan, South Africa and, allegedly, Israel), none belonged to the NPT in the year it obtained its first weapon; four of the five never signed the NPT; and the fifth, North Korea, withdrew from the treaty in 2003. In a footnote, Fuhrmann explains why he does not include the NPT in his study (p. 36 n. 115). My reading of this footnote is that he has found that a nation's signature on the treaty simply predicts too well that it will not produce weapons, singularly forbidding other conclusions. I suggest that Fuhrmann could have focused more on studying this singularity, instead of dismissing it.

Reducing the risk of weapons proliferation has been central to the concerns of most nuclear suppliers, at least since the formation of the Nuclear Suppliers Group (NSG) in 1976. Fuhrmann's data could productively be evaluated a second time to investigate the effectiveness of the NSG.

Fuhrmann's analysis leads to recommendations for limiting the supply of nuclear technology and knowledge to states that face security threats and for providing more

---

2. Mitchell Reiss, *Bridled Ambition: Why Countries Constrain Their Nuclear Capabilities* (Baltimore, Md.: Johns Hopkins University Press, 1995).

3. Robert Zarate and Henry Sokolski, eds., *Nuclear Heuristics: Selected Writings of Albert and Roberta Wohlstetter* (Carlisle, Pa.: Strategic Studies Institute, 2009).

4. William C. Sailor, "How to Think About Proliferation and Nuclear Power," Forum on Physics and Society of the American Physical Society, Spring 2001, <http://www.aps.org/units/fps/newsletters/2001/april/ap3.html>.

5. Avner Cohen, *Israel and the Bomb* (New York: Columbia University Press, 1998). Despite Kennedy's efforts, it is widely believed that Israel clandestinely continued with its weaponization efforts. The help obtained from France may have been far more significant than heavy water assistance supplied by the United States.

resources to the International Atomic Energy Agency (IAEA), so that it can monitor nuclear facilities. My own analysis leads to another recommendation: provide stronger incentives to nations to join—and stay in—the NPT. For most nations, nuclear weapons have no clear utility for enhancing their security, either as a component in a military strategy or as a political tool. This is why most nonnuclear weapons states will tend to conform to the NPT on their own. Efforts that strengthen the NPT are, in general, those that decrease the value of weapons. Security guarantees provided by the United States or the Soviet Union are past examples of successful incentives. Future U.S. policy changes that could help the NPT include ratification of the Comprehensive Test Ban Treaty and progress in reducing nuclear stockpiles.

Other measures to strengthen the nonproliferation regime should also be considered in conjunction with emerging cooperative agreements. For example, in crafting future climate-change mitigation treaties (Kyoto II, III, etc.), states should include the sharing of nuclear technology with the developing world, under proper safeguards, in accordance with Article 4 of the NPT. If necessary, stronger standards of compliance can be added to these treaties, going beyond the language of the NPT. Technology transfer should require the recipient not only to ratify the NPT, but to accept the most recent IAEA safeguards if it wants to receive subsidized power reactors or fuel or both. Such policy suggestions are being widely discussed in the academic literature, the IAEA, and the United Nations. With the proper incentives, increased nuclear energy production with its environmental benefits can be realized with no new weapons states or even a decline in their number.<sup>6</sup>

Finally, the 1985 nuclear deal with North Korea should be investigated as a template for future bilateral and multinational agreements. The North Korean leadership signed the NPT in 1985 as part of a package deal with the Soviet Union that included subsidized construction of power reactors at a site called Sinpo. Economic troubles in the Soviet Union (and later Russia) led to the cancellation of the reactor project. North Korea proceeded with its indigenous dual-purpose nuclear program in about 1991, as a reaction to a perceived loss of its security guarantee from the Soviets, but also as a reaction to the reactor cancellation. The United States, South Korea, and Japan together were able to halt the progress of weapons work from 1994 to 2000 through energy assistance and an agreement to construct power reactors at the Sinpo site. Progress was made toward normalization of relations and a treaty formally ending the Korean War. Beginning in about 2001, however, the alarmists were again in charge of U.S. foreign policy, canceling the reactor deal on scant evidence that some North Korean actions were not in the spirit of the agreement. By 2006 North Korea had become a nuclear weapons state.

If either the Soviet nuclear deal or the U.S.–South Korean–Japanese nuclear deal had been allowed to proceed, North Korea might have decided not to pursue its nuclear program. Agreements similar to the ones that slowed or stopped the North Korean weapons program should be extended to all developing nations.

—William C. Sailor  
Los Alamos, New Mexico

---

6. William C. Sailor, David Bodansky, Chaim Braun, Steve Fetter, and Bob van der Zwaan, "A Nuclear Solution to Climate Change?" *Science*, May 19, 2000, pp. 1177–1178.

*Matthew Fuhrmann Replies:*

In my article “Spreading Temptation: Proliferation and Peaceful Nuclear Cooperation Agreements,” I analyzed conditions under which states are likely to initiate nuclear weapons programs and build the bomb.<sup>1</sup> I argued that states receiving peaceful nuclear assistance are more likely to start bomb programs and acquire nuclear weapons, and that security threats further enhance these probabilities. A statistical analysis covering the period 1945–2000 supported these arguments; civilian nuclear cooperation agreements (NCAs) were positively correlated with both weapons program initiation and bomb acquisition, and these relationships became substantively stronger as the number of militarized interstate disputes increased. Case studies of the initiation of India’s nuclear weapons program and Pakistan’s acquisition of the bomb showed that the causal processes driving my argument operated correctly in specific instances of proliferation.

I thank Christoph Bluth, Matthew Kroenig, Rensselaer Lee, and William Sailor for their thoughtful responses to my article, and I welcome the opportunity to respond. All of the letters raise interesting issues and contribute to an important debate on the consequences of peaceful nuclear cooperation. Yet their criticisms do not undermine the core arguments or evidence I presented in my article. Below I reply to four principal issues that appear in the letters. I respond to the comments not addressed below in an online appendix.<sup>2</sup>

ISSUE #1: THE DEMAND SIDE VERSUS THE SUPPLY SIDE

Bluth emphasizes the demand side of the proliferation equation and downplays the supply side. He argues that norms and geopolitics drive proliferation, stating that “it does not seem plausible that peaceful nuclear cooperation alone is a sufficient cause for initiating a nuclear weapons program.” I never argued, however, that atomic assistance was a sufficient condition for proliferation. In fact, I emphasized that the relationships between nuclear cooperation and proliferation were probabilistic, not deterministic (pp. 29, 32). I noted that although states receiving peaceful assistance were more likely to begin weapons programs and acquire the bomb, the majority of states that benefit from such aid do not proliferate. The cross-tabulation analyses presented in tables 2 and 3 make this distinction clear (p. 29). Moreover, whether states have a compelling security rationale for developing nuclear weapons is an explicit part of my argument. I argued that “countries that have received considerable assistance are especially likely to initiate bomb programs when threats arise because they have greater demand for the strategic advantages that nuclear weapons offer” (p. 14). I went on to argue that threats should also magnify the relationship between atomic assistance and weapons acquisition (pp. 14–15). The empirical findings lent strong support to these arguments (see figures 2 and 3). Thus, while my argument emphasizes peaceful nuclear cooperation, it integrates both the supply side and the demand side of nuclear proliferation.

---

1. Matthew Fuhrmann, “Spreading Temptation: Proliferation and Peaceful Nuclear Cooperation Agreements,” *International Security*, Vol. 34, No. 1 (Summer 2009), pp. 7–41.

2. The appendix is available at <http://people.cas.sc.edu/fuhrmann/assets/Data.htm>.

ISSUE #2: MILITARY ASSISTANCE VERSUS PEACEFUL NUCLEAR ASSISTANCE

Sailor and Kroenig suggest that military assistance is salient in explaining nuclear proliferation and question whether peaceful nuclear cooperation matters. Sailor, for example, contends that I do not “exclude cases where nuclear proliferation has occurred because supplier states have deliberately assisted other states that are trying to develop nuclear weapons.” In “Spreading Temptation,” however, I conducted a battery of tests for robustness, including one test in which I did remove “sensitive” nuclear assistance from my coding of peaceful nuclear cooperation (pp. 38–39). The cases Sailor mentioned—French aid to Israel, Soviet aid to China, and Chinese assistance to Pakistan—are excluded from my coding of the independent variable as part of this robustness check.<sup>3</sup> And as I noted in the article, the findings relevant to my argument were generally unaltered when I removed these cases from my coding of nuclear cooperation agreements (p. 39). Peaceful nuclear assistance raises the risk of nuclear proliferation even when accounting for military aid intended to promote proliferation.<sup>4</sup> Thus, suppliers’ willingness to engage in civilian nuclear cooperation does represent an important puzzle worthy of scholarly examination, as I noted in the conclusion of the article (p. 41).

Moreover, military assistance may be less important for explaining nuclear proliferation than the conventional wisdom suggests. In a separate analysis on peaceful nuclear cooperation, I found that military assistance is statistically unrelated to both nuclear weapons program initiation and bomb acquisition.<sup>5</sup> My analysis underscores the importance of an indigenous knowledge base, which typically emerges from peaceful nuclear cooperation, in facilitating bomb acquisition. Indeed, NCAs that transfer knowledge or lead to joint research and development (i.e., intangible assistance) are strongly related to the successful production of nuclear weapons. Countries that do not have a cadre of trained scientists and technicians might fail to build the bomb despite decades of effort—even if they receive military assistance, as the case of Libya illustrates.

Kroenig disputes my core findings on the basis of his own analysis.<sup>6</sup> To evaluate whether peaceful nuclear assistance is related to nuclear weapons acquisition, he creates a dichotomous variable “measuring whether a county had ever received foreign assistance on the construction of a nuclear research or power reactor.” He found that this variable was statistically insignificant in some model specifications and negatively correlated with nuclear weapons acquisition in others. Kroenig’s analysis, however, does not appropriately test the arguments I advanced in “Spreading Temptation.” The empirical test Kroenig cites in his letter addresses only one of my four hypotheses. His analysis is based on a study of nuclear weapons acquisition; he does not thoroughly ex-

---

3. For a complete list of these cases, see Matthew Kroenig, “Importing the Bomb: Sensitive Nuclear Assistance and Nuclear Proliferation,” *Journal of Conflict Resolution*, Vol. 53, No. 2 (April 2009), pp. 161–180.

4. See the online appendix for further details.

5. I define military assistance as the transfer of bomb designs or dual-use material and technology to nonnuclear weapons states that is explicitly intended by the supplier to facilitate nuclear proliferation. Matthew Fuhrmann, “Atomic Assistance: The Causes and Consequences of Peaceful Nuclear Cooperation,” unpublished book manuscript, University of South Carolina, 2010.

6. Kroenig, “Importing the Bomb.”

amine the onset of nuclear weapons programs.<sup>7</sup> Additionally, he does not explore how militarized conflict conditions the relationship between peaceful nuclear assistance and nuclear weapons acquisition. Furthermore, Kroenig's measure of civilian nuclear cooperation is suboptimal because it neglects critical elements of atomic assistance, such as intangible transfers and the supply of nuclear materials. It also excludes transfers of uranium conversion centers, fuel fabrication facilities, heavy water production plants, and other nuclear technology. The exclusion of intangible assistance is especially inappropriate given that transfers of nuclear knowledge are strongly associated with weapons acquisition, as I noted above. Finally, Kroenig's dichotomous measure of civilian nuclear cooperation is problematic because it results in the loss of important information. For instance, based on his measure, Jamaica and India received the same amount of atomic assistance; in reality, these two countries received drastically different levels of aid. The measure of nuclear cooperation I employed appropriately captured differences in the amount of assistance that states receive over time.

Kroenig also overstates the problem associated with my data on nuclear cooperation agreements. He argues that "the number of NCAs signed . . . is a highly inaccurate measure of nuclear cooperation because a large percentage of NCAs are subsequently canceled and do not result in the transfer of nuclear material or technology." As evidence to support this assertion, Kroenig highlights four agreements that he claims did not result in assistance. Yet NCAs led to assistance in each of these cases, even if the full terms of the deals were not realized. Russia's 1995 NCA with Iran, for instance, led to the construction of the Bushehr nuclear power plant.<sup>8</sup> The Agreed Framework produced some cooperation, despite ultimately leaving North Korea without power plants capable of producing electricity.<sup>9</sup> Even if it were true that all four of the agreements Kroenig cites did not lead to nuclear cooperation, these deals constitute less than 0.3 percent of all NCAs signed from 1945 to 2000. It would be hard to classify this figure as a "large percentage."

#### ISSUE #3: THE NONPROLIFERATION REGIME

Sailor asserts that my study "does not address international efforts to prevent nuclear proliferation," a concern that Bluth shares. This statement is not entirely accurate, however. The most important international effort to limit the spread of the bomb is the 1968 nuclear Nonproliferation Treaty (NPT). When modeling the onset of nuclear weapons programs, I included a variable in the statistical model measuring whether a state is a member of the NPT. As I noted in the article, I found that membership in the NPT is statistically related to nuclear weapons program initiation in the negative direction

---

7. In a footnote, Kroenig states, "I do not include variables measuring state decisions to explore, pursue, or possess nuclear weapons, because my theoretical interest is limited to the effect of nuclear assistance on nuclear acquisition. Nevertheless, robustness tests performed using these alternate measures of nuclear proliferation produce similar results." Kroenig, "Importing the Bomb," n. 11. It is unclear, however, whether Kroenig included civilian nuclear assistance in these robustness checks, because this variable is not listed in any of the tables presenting the statistical findings (he discusses civilian assistance only in a footnote).

8. Nuclear Threat Initiative, "Russia: Nuclear Exports to Iran: Reactors," <http://www.nti.org/db/nisprofs/Russia/exports/rusiran/react.htm>.

9. See KEDO, "Light Water Reactor Project: Turnkey Contract," [http://www.kedo.org/lwr\\_turnkey\\_contract.asp](http://www.kedo.org/lwr_turnkey_contract.asp).

(pp. 9, 36). Because the variable for NCAs in the same model is positive and significant, the statistical results indicate that even when I accounted for the effect of the NPT, peaceful nuclear cooperation increases the probability of weapons program onset.

Sailor correctly notes that I excluded the NPT variable from models of nuclear weapons acquisition. He suggests that I did this because I found “that a nation’s signature on the treaty simply predicts too well that it will not produce weapons, singularly forbidding other conclusions.” This, however, is not the case. As I noted in my article, I excluded the NPT from acquisition models because of a statistical problem known as “separation,” which occurs when one or more of a model’s independent variables perfectly predict a binary outcome.<sup>10</sup> I conducted further analysis to demonstrate that the NPT does not swamp other variables, such as peaceful nuclear cooperation, when modeling the production of nuclear weapons. These findings, which are reported elsewhere, show that peaceful nuclear assistance remains statistically related to bomb acquisition, even when accounting for the effect of the NPT.<sup>11</sup>

In previous research examining the causes of peaceful nuclear cooperation, I analyzed the role of the NPT and the Nuclear Suppliers Group (NSG).<sup>12</sup> I found that NPT members are no more likely than nonmembers to receive civilian nuclear assistance, even controlling for the other factors that affect states’ demand for nuclear power. This finding suggests that the nuclear suppliers are not living up to their commitment under Article 4 of the NPT to share nuclear technology, materials, and knowledge with states that commit to the treaty. Based on this evidence, I would dispute Bluth’s unsubstantiated assertion that the “denial of civilian nuclear technology is also rare, because members of the NPT are entitled to nuclear technological cooperation.” With regard to the NSG, I found that members of the group are more likely to receive atomic aid than nonmembers, although the organization had less of an effect on the behavior of suppliers than the conventional wisdom suggests. Supplier states behaved similarly in the pre-nonproliferation regime period (1950–69) and the post-regime period (1970–2000).

My research addresses the effects of institutions such as the NPT and the NSG. There is, however, room for more research on how the nonproliferation regime influences the links between peaceful nuclear cooperation and weapons proliferation. I think this was the spirit of Sailor’s letter, and I agree with this sentiment. I devote greater attention to this important issue elsewhere.<sup>13</sup>

#### ISSUE #4: DIRECTION OF CAUSALITY

Bluth, Kroenig, and Lee question whether I have the causal arrow pointing in the right direction. Their counterarguments suggest that atomic assistance is a consequence—not a cause—of the proliferation process.

---

10. See Christopher Zorn, “A Solution to Separation in Binary Response Models,” *Political Analysis*, Vol. 13, No. 2 (Spring 2005), pp. 157–170.

11. Fuhrmann, “Atomic Assistance,” chap. 9.

12. Matthew Fuhrmann, “Taking a Walk on the Supply Side: The Determinants of Civilian Nuclear Cooperation,” *Journal of Conflict Resolution*, Vol. 53, No. 2 (April 2009), pp. 181–208.

13. In particular, I examined more thoroughly the extent to which the NPT-backed safeguards regime and the 1997 Additional Protocol have made a difference in limiting the connection between the peaceful and military uses of the atom. I also conducted additional analysis to evaluate whether the NSG has altered the behavior of nuclear suppliers. Fuhrmann, “Atomic Assistance,” chaps. 4, 10.

Bluth and Lee posit that the decision to develop a nuclear weapons program precedes the onset of civilian nuclear assistance. The first point to note is that I addressed this issue in "Spreading Temptation." I acknowledged that "nuclear cooperation may be endogenous to nuclear weapons pursuit," and I conducted a series of tests to explore the empirical validity of this claim (pp. 37–38 and the online appendix). The findings showed that nuclear cooperation remained statistically related to nuclear weapons pursuit even when accounting for the possibility of joint causality. States may continue to seek assistance once they have initiated a weapons program, but this does not undermine my argument because a significant amount of aid also precedes interest in the bomb.

A simple way to assess the direction of causality is to compare when countries first signed nuclear cooperation agreements and when they initiated nuclear weapons programs. If my argument is correct, atomic assistance should precede the onset of a bomb program. Bluth questions whether this is the case, claiming that "Iran, Iraq, Libya, North Korea, and Pakistan all started civilian nuclear programs with the primary purpose of developing nuclear weapons." He does not provide any evidence to support this assertion, and my own historical analysis suggests that it is incorrect.<sup>14</sup> Indeed, in almost every case, peaceful nuclear assistance preceded the decision to launch a weapons program. Iran, for example, signed its first NCA in 1957. I have seen no evidence that Iran sought nuclear assistance from the United States in the late 1950s because it wanted to develop the bomb. Moreover, Tehran did not initiate a nuclear weapons program until 1985, indicating that nearly thirty years passed between the initiation of the civilian nuclear program and the political decision to pursue the bomb.<sup>15</sup> Iraq signed its first NCA in 1959, twenty years before Saddam Hussein became president and well before the political decision to build nuclear weapons.<sup>16</sup> North Korea sought nuclear cooperation for the first time in 1956. The proliferation data I employed suggest that North Korea made a political decision to pursue nuclear weapons in 1980, twenty-four years after signing its first NCA. This long passage of time indicates that an interest in nuclear weapons was not the principal motivation for a civilian program. Bluth claims that "[North Korea's] initial decision to acquire nuclear weapons was probably made in 1962." Even if he is correct, Pyongyang's pursuit of atomic assistance still preceded the political decision to produce the bomb. The evidence is similar in the Pakistani case. Islamabad signed an NCA with the United States in 1955 but did not initiate a bomb program until 1972, following Pakistan's war with India. There is little evidence that Pakistan pursued nuclear cooperation with the United States in the 1950s because it wanted to develop nuclear weapons.<sup>17</sup> Libya is one of the few post-1953 outliers for my argument. Tripoli did not sign its first NCA until the year after it initiated a nuclear weapons program. Given that my theory is probabilistic, evidence from one case indi-

---

14. *Ibid.*, chap. 5.

15. Etel Solingen, *Nuclear Logics: Contrasting Paths in East Asia and the Middle East* (Princeton, N.J.: Princeton University Press, 2007), p. 164. See also Sonali Singh and Christopher R. Way, "The Correlates of Nuclear Proliferation: A Quantitative Test," *Journal of Conflict Resolution*, Vol. 48, No. 6 (December 2004), pp. 859–885.

16. Saddam ordered the implementation of a plan to clandestinely develop nuclear weapons in 1972 and accelerated the program after the 1981 Osiraq strike. Solingen, *Nuclear Logics*, pp. 143–147.

17. See, for example, Ashok Kapur, *Pakistan's Nuclear Development* (London: Croom Helm, 1987).

cating that the causal arrow points in the opposite direction does not undermine my argument or empirical findings.<sup>18</sup>

Once a country has a weapons program, Bluth and Lee do not dispute my argument that peaceful nuclear cooperation facilitates bomb acquisition. Kroenig, on the other hand, implies that the correlation that I found between peaceful nuclear assistance and bomb production emerges because (1) states pursuing nuclear weapons have deals canceled and must seek additional agreements; and (2) countries use NCAs as a means to dissuade others from developing fuel-cycle facilities (e.g., uranium enrichment plants).

These are interesting suggestions, but Kroenig provides little evidence to support them. As noted above, he overstates the point about NCAs being canceled. Suppliers generally provide peaceful nuclear assistance as a means to strengthen bilateral relationships with recipient countries in ways that promote their strategic interests.<sup>19</sup> Non-proliferation considerations do not drive the nuclear marketplace, as I hinted above.<sup>20</sup> There is considerable historical evidence that suppliers follow through with peaceful nuclear cooperation to extract the benefits that accompany aid, despite any risk of proliferation.<sup>21</sup> Turning this logic on its head, suppliers usually refrain from inking agreements if they do not have incentives to engage in peaceful nuclear cooperation. This is far more common than signing an NCA and renege on a commitment. Iraq, for instance, did not sign a single agreement between 1985 and 2000 because suppliers did not have incentives to assist Baghdad's civilian nuclear program. If true, the evidence Kroenig cites from the Iranian case, which is the only support he provides for the first counterargument, actually inspires greater confidence that the statistical findings are consistent with my bomb acquisition argument.<sup>22</sup>

To buttress his second conjecture, Kroenig contends that Iran attracted lots of NCAs because the international community wants to end its enrichment work and that "similar dynamics can be seen in other cases of nuclear proliferation, including China, India, Israel, North Korea, and Pakistan." This is inconsistent with the historical record. My research identifies few NCAs signed from 1945 to 2000 where the primary purpose was to discourage a state from working on reprocessing or enrichment. The Agreed Framework is one possibility, but even here the objective was to end the North Korean nuclear weapons program rather than to limit work on enrichment and reprocessing per se. With such a small number of agreements designed principally to curtail these activities, Kroenig's explanation cannot account for the relationship I uncovered be-

---

18. Also note that Argentina, Brazil, India, South Africa, and South Korea obtained peaceful nuclear assistance many years before initiating weapons programs.

19. Fuhrmann, "Taking a Walk on the Supply Side."

20. *Ibid.*

21. Fuhrmann, "Atomic Assistance," chaps. 5, 6.

22. Iran is an outlier for this argument (but not for my program initiation argument) because it signed several NCAs but did not build nuclear weapons during the period of my study. I find a robust relationship between atomic assistance and nuclear weapons acquisition that is statistically significant in the positive direction, even when accounting for the outlying Iranian case. What Kroenig claims is that the number of NCAs Tehran signed is inflated because some agreements were scaled back or canceled. If I were to reduce the number of Iranian NCAs, this relationship between peaceful nuclear cooperation and weapons acquisition would only become substantively stronger. That said, many of the deals that Kroenig cites were scaled back rather than canceled altogether, meaning that they resulted in some nuclear cooperation—an important distinction captured by my original coding of the nuclear cooperation variable.

tween NCAs and nuclear weapons acquisition. The evidence he cites from the Iranian case is based on predictions about the future. He assumes that (1) Iran will build nuclear weapons and (2) Iran will sign numerous NCAs designed to persuade it to give up its enrichment program. These events might yet happen, but they cannot account for statistical findings that emerged from a historical analysis from 1945 to 2000. If Iran does build nuclear weapons, it is misleading to imply that nuclear cooperation would not have played a role in this outcome. Civilian nuclear assistance provided by the United States beginning in the late 1950s helped to establish an indigenous knowledge base in Iran; U.S. aid resulted in the construction of the Tehran Research Reactor and the training of Iranian scientists.<sup>23</sup>

Finally, there is substantial evidence to support my interpretation of the statistical findings on nuclear weapons acquisition. The Pakistani case study presented in "Spreading Temptation" showed that nuclear cooperation helped to enable the production of nuclear weapons by establishing an indigenous knowledge base in nuclear engineering and other relevant fields. In subsequent work, I found that peaceful nuclear cooperation played a critical role in explaining why countries that pursued nuclear weapons did or did not build the bomb. Peaceful nuclear cooperation facilitated the production of nuclear weapons in the cases of France, India, Israel, North Korea, Pakistan, and South Africa.<sup>24</sup> In addition, the lack of civilian nuclear assistance helps to explain why Iraq and Libya were unable to produce the bomb despite programs that spanned several decades.<sup>25</sup>

#### CONCLUSION

Peaceful nuclear cooperation is both theoretically interesting and substantively important. Yet it has been largely ignored by political scientists. I hope that my article and this exchange of letters promote additional research on the causes and consequences of civilian nuclear assistance.

—Matthew Fuhrmann  
Columbia, South Carolina

---

23. See, for example, Sam Roe, "U.S. Cold War Gift: Iran Nuclear Plant," *Chicago Tribune*, August 24, 2006.

24. These cases include all but one of the bomb acquisitions following U.S. President Dwight D. Eisenhower's "Atoms for Peace" address in 1954.

25. For further discussion, see Fuhrmann, "Atomic Assistance," chap. 9.