Attacking the Atom: Does Bombing Nuclear Facilities Affect Proliferation?

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Introduction

Research question: What are the consequences of military strikes against nuclear facilities? In particular, do they ‘work’ by delaying the target state's ability to build the bomb?

Four theoretical mechanisms for how strikes may affect nuclear weapons’ production capacity

- Direct mechanism:
  - can delay the target’s ability to build nuclear weapons by destroying chokepoint facilities that are critical for bomb development
- Indirect mechanisms:
  - could produce a change in the target’s fissile material production strategy
  - could make foreign suppliers less willing to provide nuclear assistance
  - lead to enhanced international inspections

Introduction Continued

Method: analysis of all 16 attacks against nuclear programs that have occurred from 1942 to 2007

- During peacetime
  - Evaluate all four mechanisms
- And wartime
  - Evaluate the direct mechanism

Findings:

- in many of the wartime cases the use of force did not significantly delay the target's nuclear weapons program
- the peacetime attacks tended to delay the target's nuclear program, providing some support for both direct and indirect mechanisms

How Could Attacks Affect Proliferators' Weapons Programs?

Initial observation: the acquisition of nuclear weapons requires both political willingness and technical capacity

- Political willingness due to:
  - Security threats
  - Insolation from the global economy
- Technical capacity: ability to produce adequate quantities of fissile material depends on key chokepoints
  - (1) uranium enrichment facilities
  - (2) plutonium reprocessing facilities
  - (3) reactors
- Attacks can delay a state's ability to produce nuclear weapons if they make it more difficult for the state to possess these chokepoint facilities

The Direct Effects of Attacks against Nuclear Facilities: Reversing Past Progress

The direct way: the destruction of facilities crucial to weapons development---any of the three checkpoints

- (1) uranium enrichment facilities
- (2) plutonium reprocessing facilities
- (3) reactors

The magnitude is determined by the ratio of destroyed checkpoint facilities to those still operational

How well a strike worked depends on:

- types of facilities countries possessed
- how much progress they had made toward building the bomb
- their level of indigenous knowledge
- Problems with the strike itself (failed strikes)
    - Due to:
        - poor intelligence
        - an accident
        - the attackers coming under enemy fire
    - Can cause:
        - Increase the state's willingness to build nuclear weapons
        - Measures that make future strikes more difficult

The Indirect Effects of Attacks against Nuclear Facilities: Impacting Future Behavior

Shift in the approach to fissile material production

- More covert
- Alter approach to acquiring fissile material
    - Shift from plutonium to uranium
        - Size of reactors and reprocessing facilities
        - Might shift to electromagnetic isotope separation (EMIS) facilities
    - Might also delay nuclear program

Reduction in willingness of foreign suppliers to provide assistance

- Because military action is costly, shows that attacking countries are serious and could lead to supplier countries rethinking their aid
    - Practical: personnel deaths
    - Suppliers may rethink proliferating countries intentions, security after the country gets a bomb, and its relationship with the attacking country

Enhanced international inspections and safeguards

- IAEA will want to show member countries that it can fulfill its mandate and increase presence
- The targeted country may encourage IAEA presence to demonstrate peaceful intentions to the international community

Peacetime Case Studies

Israeli Attacks Against Iraq's Nuclear Program, 1981

- Israeli Air Force raided the Osirak facility in 1981
  - The Israeli strikes completely destroyed the reactor and caused minimal collateral damage
  - Experts disagree on its affects
- Direct mechanism:
  - by destroying a facility suited for plutonium production, Israel removed Iraq's past nuclear progress, supporting the direct mechanism
- Indirect mechanisms:
  - Shifted to uranium production
  - France was less likely to assist the program
  - No indication that the strike enhanced international inspections

Peacetime Case Studies Continued

Israeli Attack against Syria's Nuclear Program, 2007

- The attack destroyed a Syrian reactor at Al Kibar that was in the early phases of development, likely with assistance from North Korea
- Direct mechanism:
  - Destroyed a facility similar to a North Korean facility that was in fact suited for plutonium production
- Indirect mechanisms:
  - No indication of shift in approach to fissile material production
  - Triggered international investigations
  - North Korea withdrew support of the program

Wartime Case Studies

Allied Attacks against Germany's Nuclear Program, 1942–1945 (WWII)

- Four separate attacks on Norsk-Hydro heavy water facility in German-occupied Norway

1. October 1942
    a. Failed
2. February 1943
    a. Destroyed electrolysis cells, flushed 500kg of heavy water, and took the facility out of commission for about two months
3. November 1943
    a. dispensed of more heavy water and shut down the facility for months
4. Sank the ferry *Hydro* in 1944
    a. sank another 607 kg of heavy water

Wartime Case Studies Continued

Iraqi Attacks against Iran's Nuclear Program, 1984–1988 (Iran-Iraq War)

- 1980 Iran attacked Iraq's Osiraq plant
  - operational failure and caused little damage to Osirak, necessitating the Israeli raid one year later
- From March 1984-1988 seven Iraqi raids on Iran's Bushehr reactors
  - not until November 1987 that Iraqi airstrikes actually caused significant damage
  - ultimately reversed a substantial amount of progress on the Bushehr projects

US Attacks against Iraq's Nuclear Program, 1991, 1993 (Persian Gulf War)

- Attacks
  - Tuwaitha Research Facility near Baghdad was struck repeatedly
  - US struck a suspected uranium feedstock production facility near Mosul and a uranium extraction facility at Al Qaim
- Mixed in terms of damage

Discussion

Findings

- Peacetime cases produced some support for the general argument that attacks delay states' acquisition of fissile material and for the specific mechanisms
  - size of this effect was generally modest.
- The wartime cases underscore the reasons why using military force to delay proliferation can encounter challenges
  - Problems with intelligence gaps

Assessment of the conditions under which strikes might be useful in delaying a proliferator's nuclear program

- Attacking countries can achieve the most success before a program becomes 'a train without brakes'
  - Also when they are considered least legitimate

Discussion Continued

Evaluation of the likely effects of strikes against Iranian nuclear facilities

- The three indirect mechanisms are unlikely to ‘work’ in the Iranian case
  - Does not depend on external support
  - Already relies primarily on centrifuge enrichment
  - Increase of international inspections could happen if an attack caused Iran to enter the AP which allows for more inspections
- The direct mechanism would be the main route to a successful attack
  - destroying Natanz and other related enrichment facilities could delay Iran’s ability to produce fissile material by about five years
    - Rests on two assumptions:
      - All of Iran’s sensitive nuclear facilities are known to Israel and/or the US
      - The operational feasibility of an attack
        - Although tech has advanced, so have defense measures
  - The authors are unsure if military action will yield even mild results