Talking Peace, Making Weapons

IAEA Technical Cooperation and Nuclear Proliferation

IAEA Governance and Reform
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Jeff Kaplow
Ph.D. Student
University of California, San Diego

Robert L. Brown
Stanton Nuclear Security Fellow, Belfer Center
Assistant Professor, Temple University

A few technical cooperation anecdotes

- From 1987-1994, the IAEA spent about $400k in TC projects focused on uranium processing and exploration in North Korea
- According to a former IAEA inspector, *all uranium* in Pakistan's weapons program came from sources developed by IAEA TC projects and was processed in a plant backed by TC
- In 2009, the IAEA launched a TC project to conduct a technical feasibility study and site-selection for a nuclear power plant in Syria, even as Syria refused IAEA inspectors access to the al-Kibar site

IAEA technical cooperation and proliferation

- There has long been concern about the proliferation risks of IAEA technical cooperation
- This study contributes to the debate by:
  - Confirming that not all types of nuclear assistance are equally worrying
  - Identifying a clear link between TC and nuclear weapons programs
  - Proposing a useful indicator of weapons behavior that can help us assess proliferation risk

The risk of (civilian) nuclear assistance

- Existing work in political science argues that civilian nuclear cooperation leads to proliferation (Fuhrmann 2009)
  - Focus is on state-to-state cooperation
  - Does not distinguish between different kinds of nuclear cooperation (i.e. different technology areas)

The risk of (civilian) nuclear assistance

- Nuclear assistance might lead to proliferation by reducing the anticipated cost of a weapons program
  - Improved nuclear infrastructure and knowledge-base
  - Access to international experts and training resources
  - Connections to like-minded nuclear aspirants
  - Introductions to international nuclear suppliers and service providers
- But not all kinds of assistance would reduce the cost of an eventual weapons program
  - Fuel cycle-related assistance seems more applicable than, say, agricultural or industrial applications of nuclear technology

IAEA TC process

- IAEA General Conference and the Board of Governors set overall policy direction for the TC program
- Member states submit proposals in September of the prior year
- TC screens project proposals Sept-July; decides which to support for approval
- TC project proposals publicized 2+ weeks prior to General Conference (September) for member state discussion
- Approved projects go to the Board for final approval in November of following year (almost always by consensus)

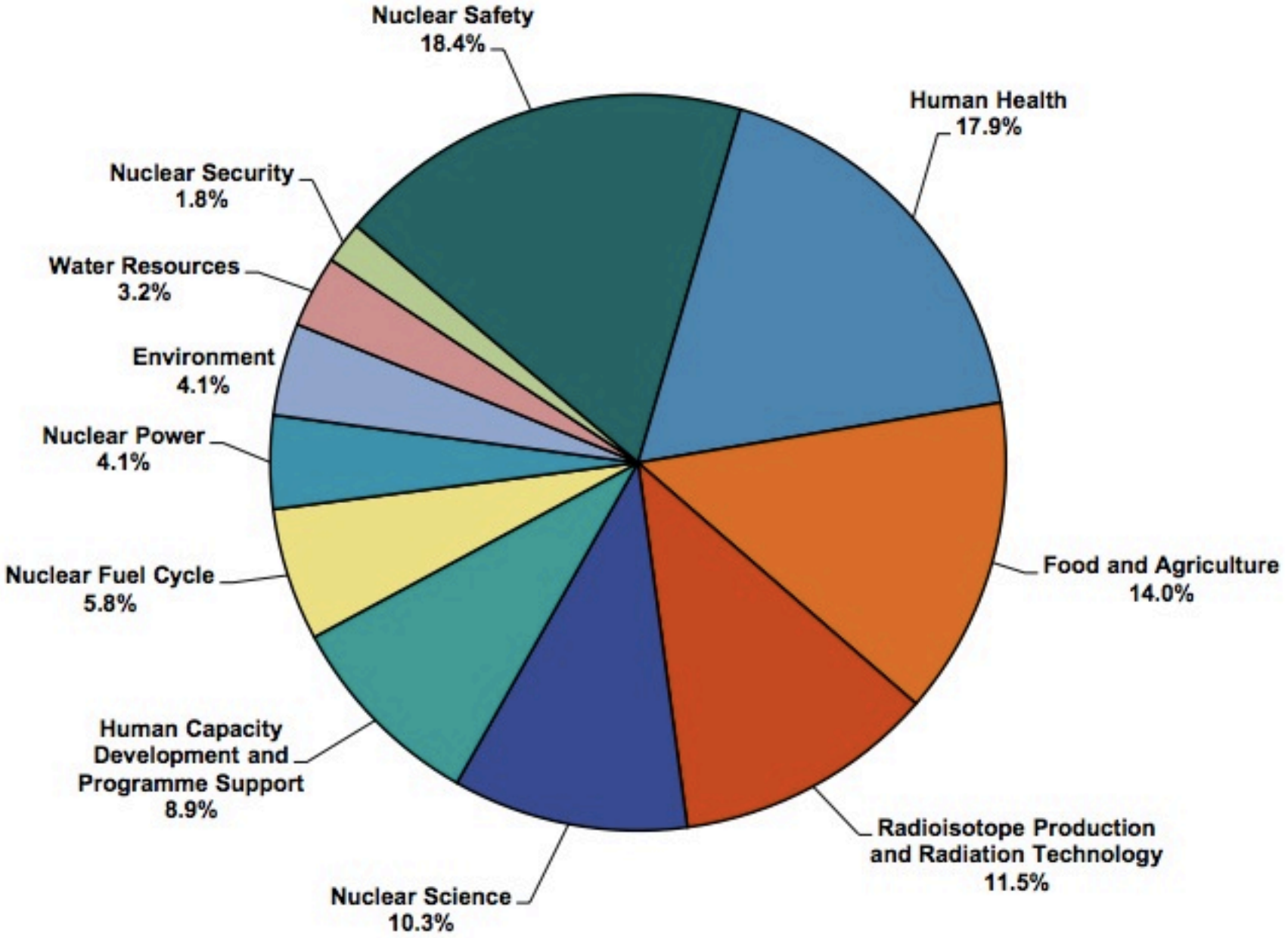
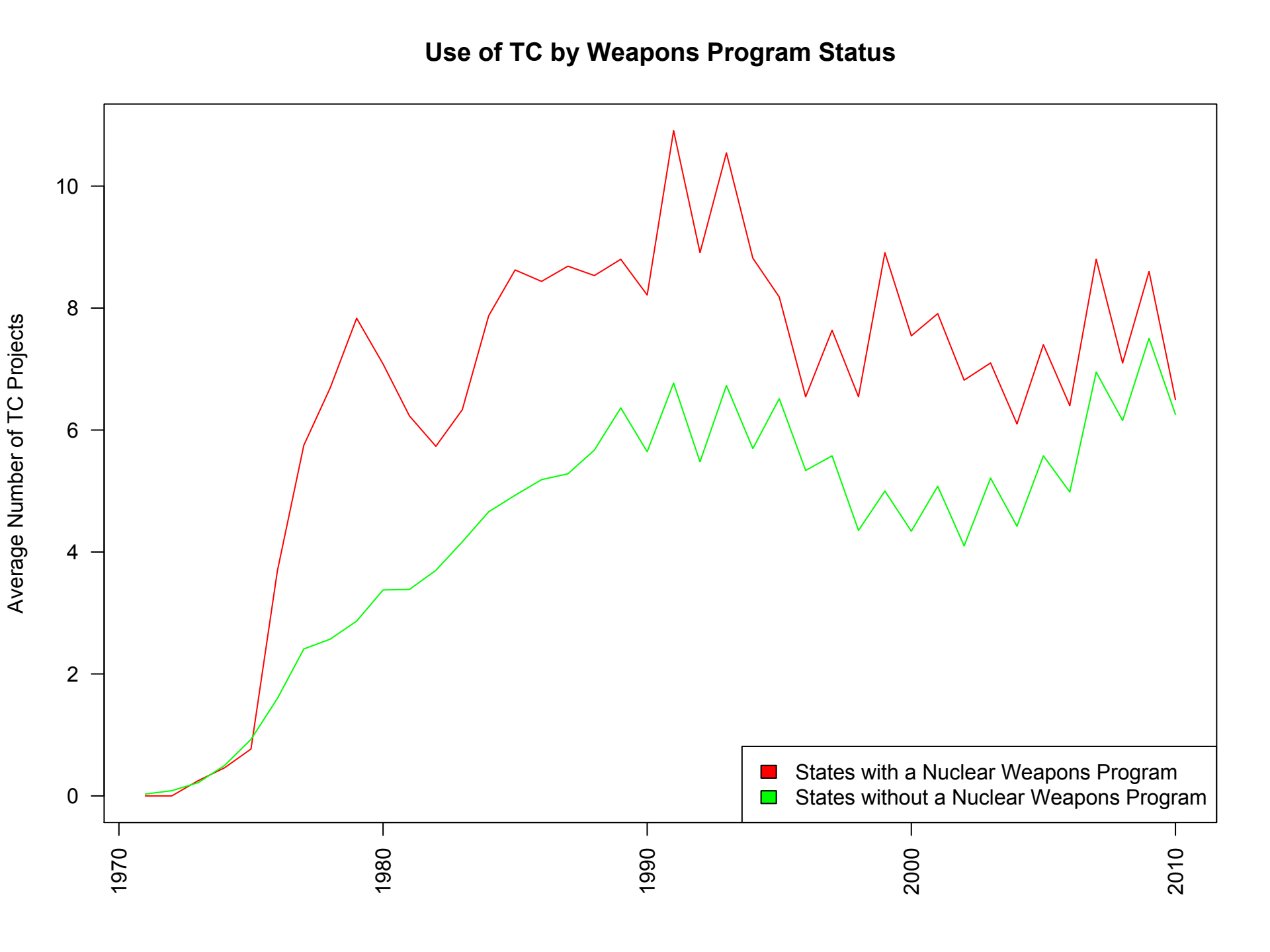
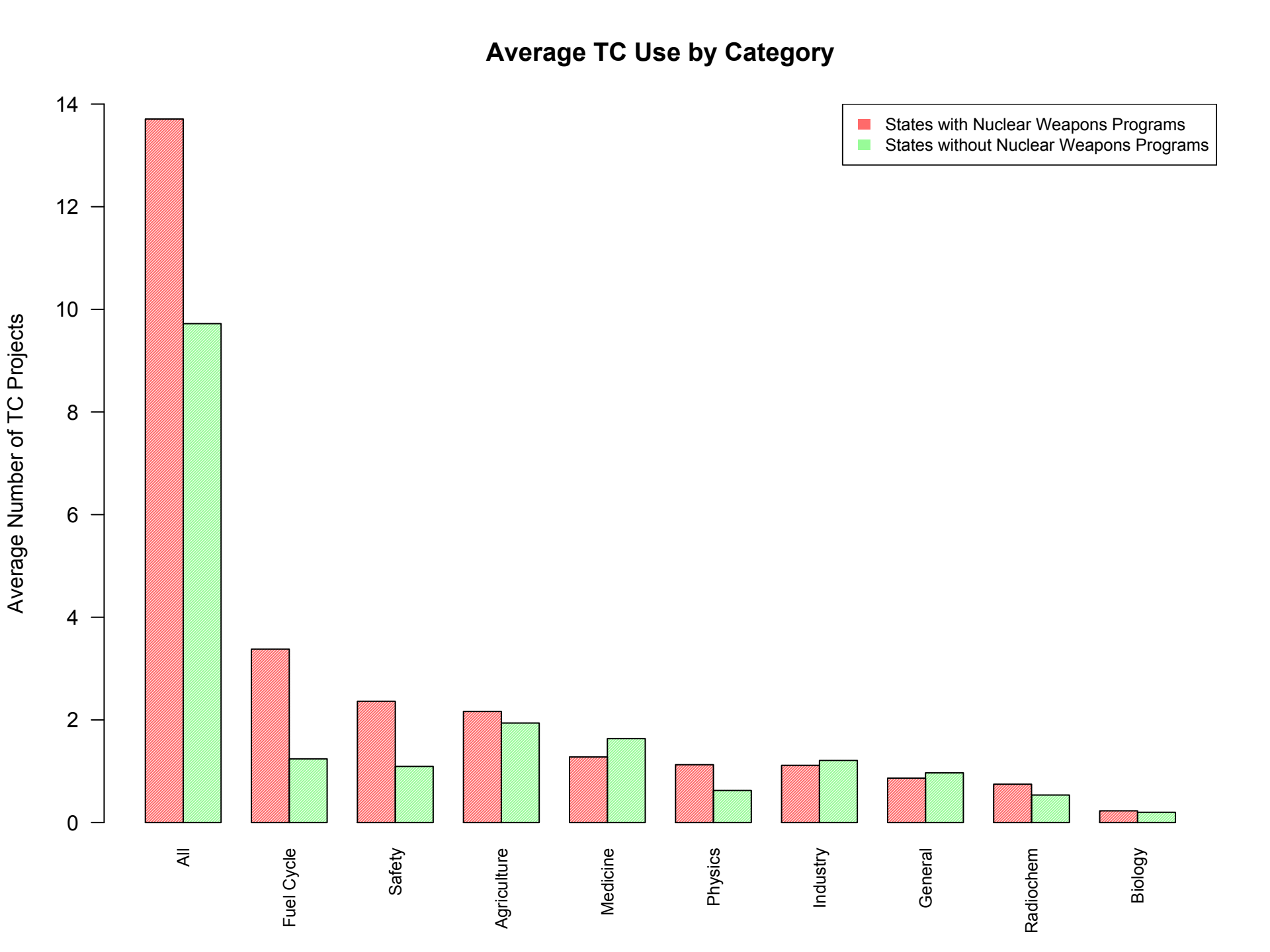


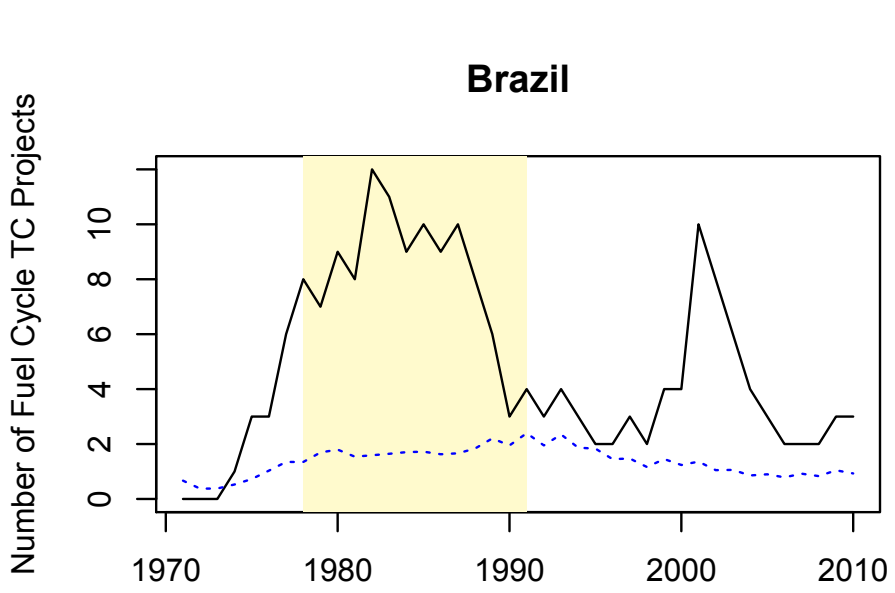
Fig. 1. Disbursements by Technical Field for 2010 (Nuclear safety includes transport safety and safe management of radioactive waste, nuclear fuel cycle includes predisposal and disposal of nuclear fuel waste).[4]

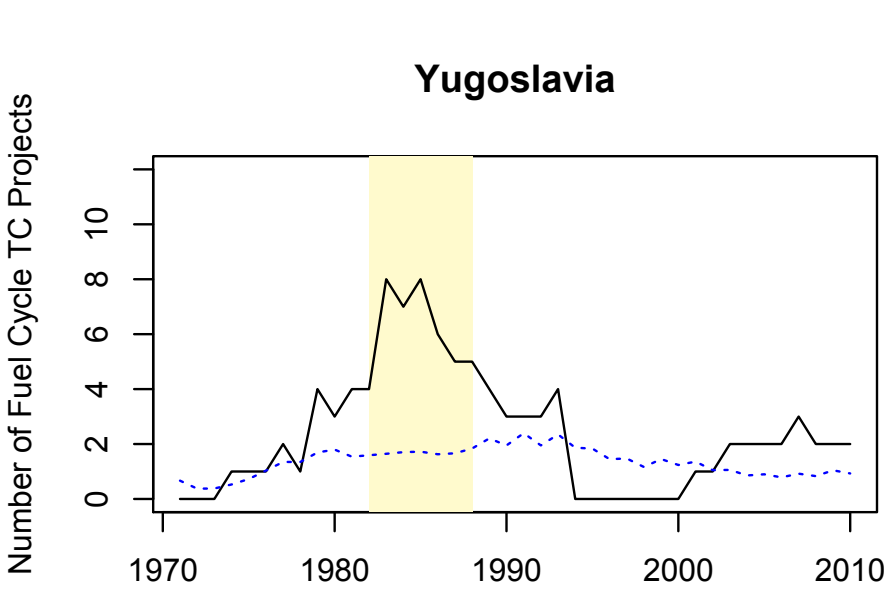
IAEA technical cooperation and proliferation

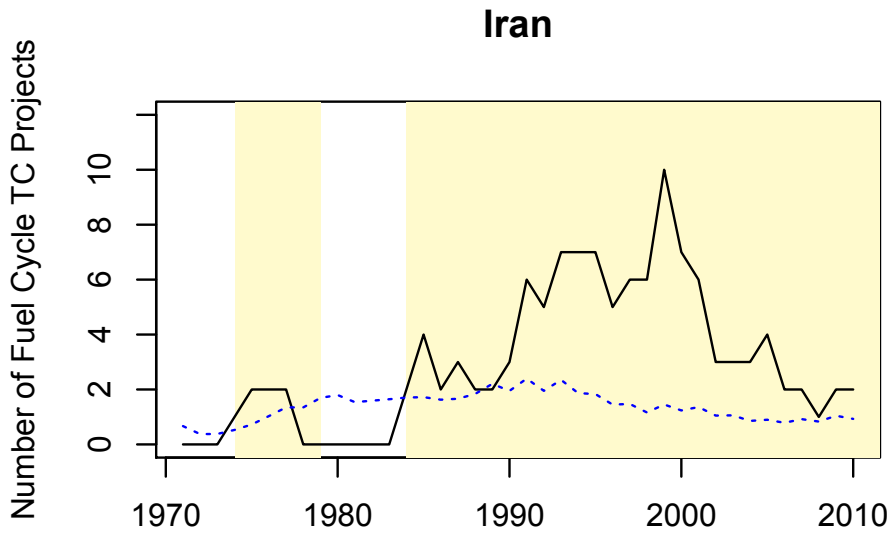
- The IAEA no longer offers "sensitive" technical assistance (enrichment or reprocessing)
- But fuel-cycle-related assistance might still build capacity that makes states more likely to pursue weapons programs
- Hypothesis: States that engage in more fuel-cycle-related TC projects will be more likely to begin and to continue nuclear weapons programs

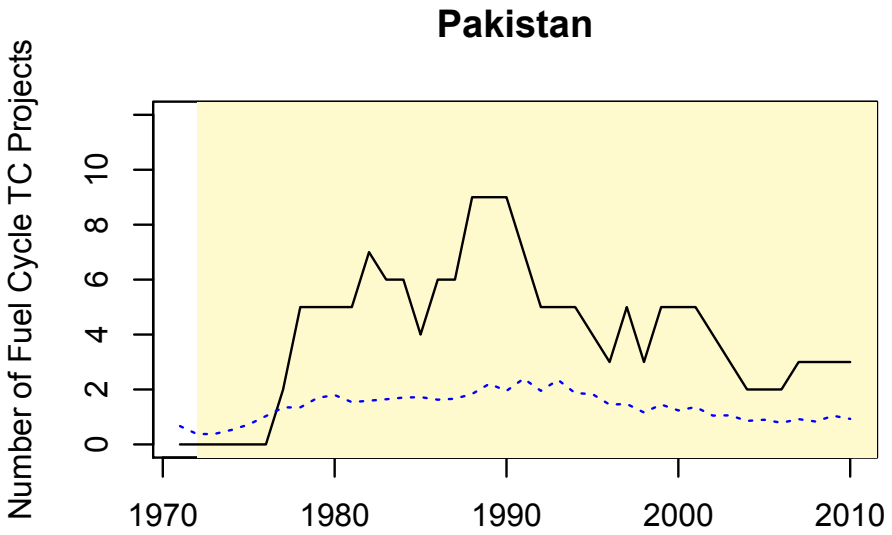

Use of TC by Weapons Program Status
Average Number of TC Projects
0
2
4
6
8
10
1970
1980
1990
2000
2010
States with a Nuclear Weapons Program
States without a Nuclear Weapons Program


Average TC Use by Category
States with Nuclear Weapons Programs
States without Nuclear Weapons Programs
Average Number of TC Projects
0
2
4
6
8
10
12
14
All
Fuel Cycle
Safety
Agriculture
Medicine
Physics
Industry
General
Radiochem
Biology


Brazil
Number of Fuel Cycle TC Projects
0
2
4
6
8
10
1970
1980
1990
2000
2010

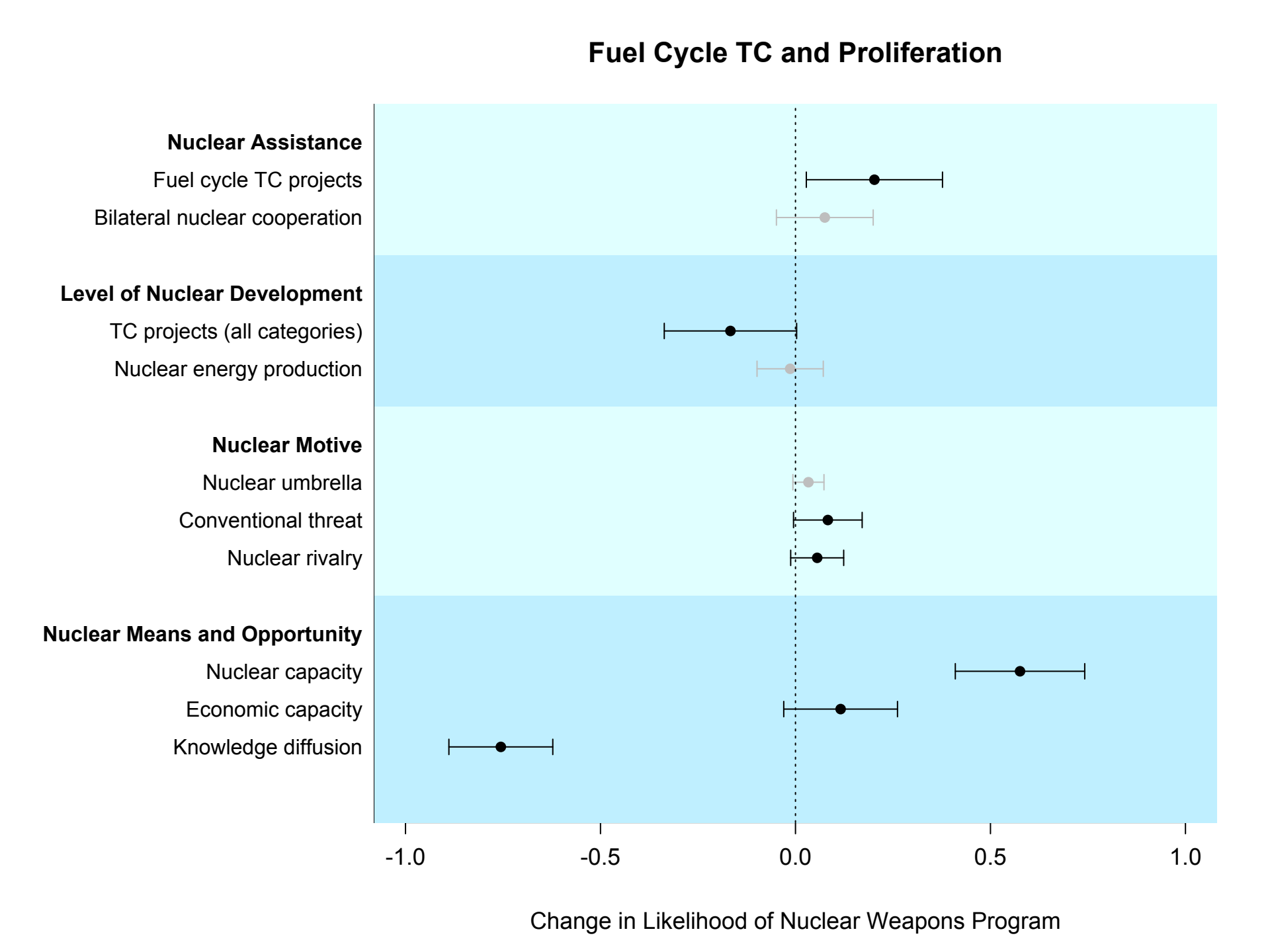

Yugoslavia
Number of Fuel Cycle TC Projects
0
2
4
6
8
10
1970
1980
1990
2000
2010

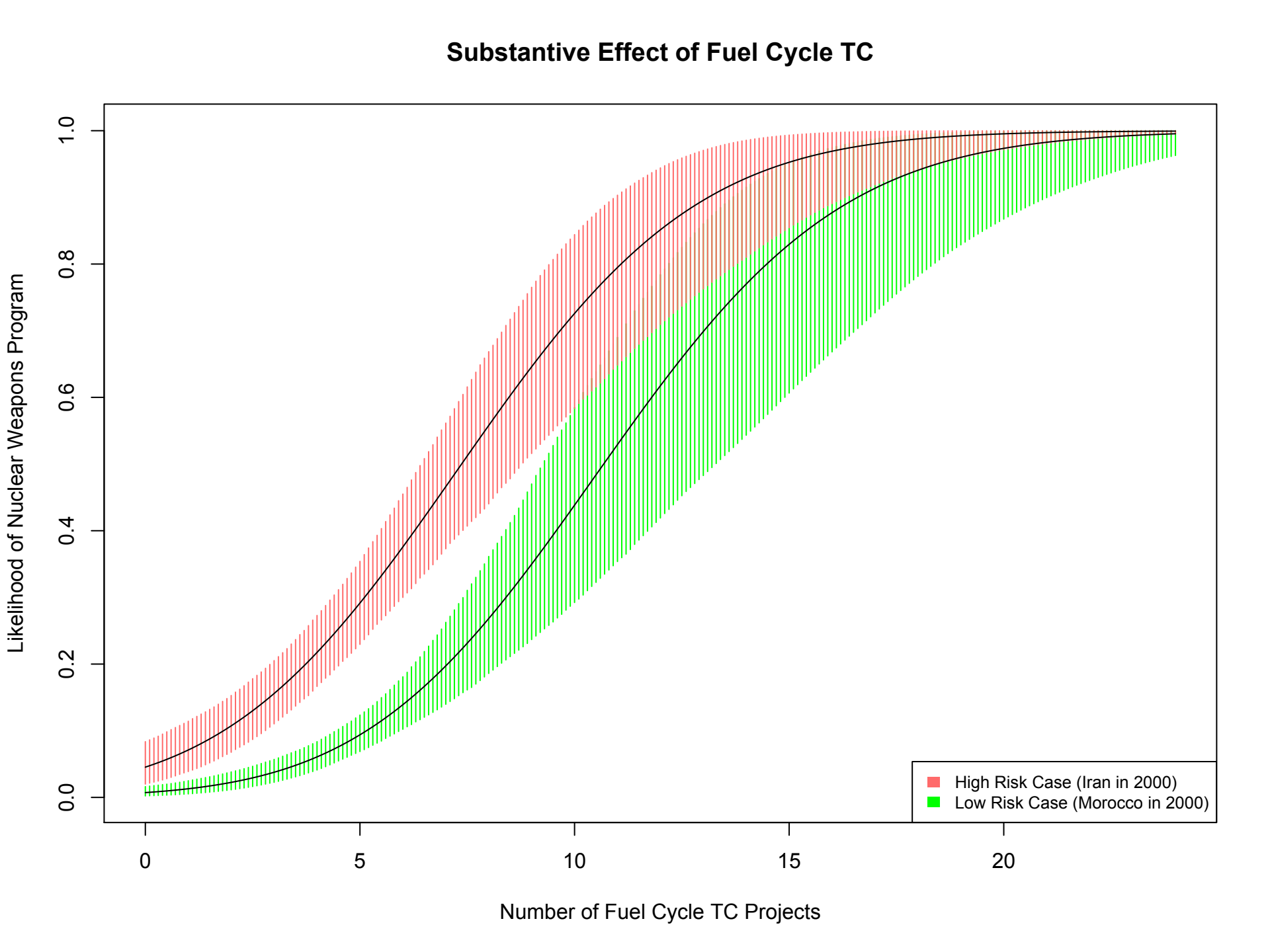

Iran
Number of Fuel Cycle TC Projects
0
2
4
6
8
10
1970
1980
1990
2000
2010


Pakistan
Number of Fuel Cycle TC Projects
0
2
4
6
8
10
1970
1980
1990
2000
2010

Quantitative test of hypothesis

- Using data on all TC projects from 1971 to 2000
- Key explanatory variable: count of fuel cycle-related TC projects in a given year
- Outcome variable: nuclear weapons program status
- Test includes standard set of factors that might drive proliferation
  - Nuclear motive: nuclear umbrella, conventional threats, presence of a nuclear rival
  - Nuclear means and opportunity: bilateral nuclear assistance, economic capacity, nuclear capacity, knowledge diffusion
- Controls for level of nuclear progress/interest (overall TC participation and nuclear energy production)


Fuel Cycle TC and Proliferation
Nuclear Assistance
Fuel cycle TC projects
Bilateral nuclear cooperation
Level of Nuclear Development
TC projects (all categories)
Nuclear energy production
Nuclear Motive
Nuclear umbrella
Conventional threat
Nuclear rivalry
Nuclear Means and Opportunity
Nuclear capacity
Economic capacity
Knowledge diffusion
-1.0
-0.5
0.0
0.5
1.0
Change in Likelihood of Nuclear Weapons Program

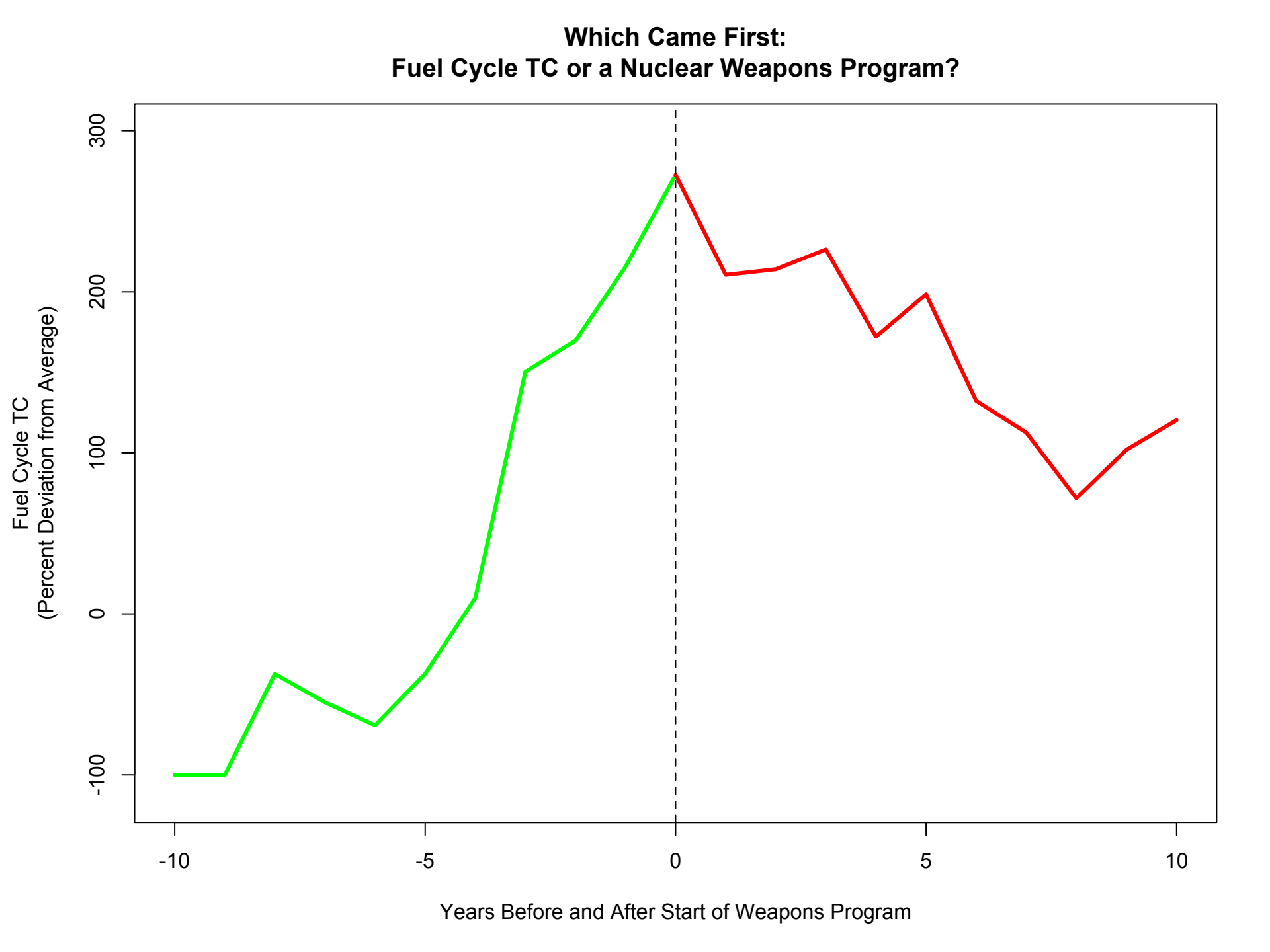

Substantive Effect of Fuel Cycle TC
Likelihood of Nuclear Weapons Program
0.0
0.2
0.4
0.6
0.8
1.0
0
5
10
15
20
Number of Fuel Cycle TC Projects
High Risk Case (Iran in 2000)
Low Risk Case (Morocco in 2000)

Two possible explanations

- We have identified a strong statistical association between fuel cycle-related TC and nuclear weapons programs
- We can explain this association in two ways

1. Fuel cycle-related TC makes states more likely to engage in nuclear weapons programs
2. States engaged in nuclear weapons programs are more likely to seek out fuel cycle-related TC

- The explanation we choose has important policy implications


Which Came First:
Fuel Cycle TC or a Nuclear Weapons Program?
Fuel Cycle TC
(Percent Deviation from Average)
300
200
100
0
-100
-10
-5
0
5
10
Years Before and After Start of Weapons Program

Two possible explanations

1. Fuel cycle-related TC makes states more likely to engage in nuclear weapons programs
2. States engaged in nuclear weapons programs are more likely to seek out fuel cycle-related TC

- There are some good reasons to believe explanation 1
  - TC use precedes weapons programs
  - Other statistical techniques
- But even if you don't believe explanation 1, both these possibilities suggest fuel cycle-related TC may make a useful indicator of proliferation risk

Predicting proliferation with the TC model

- Use data from 1971-1980 to train the model
- Test predictions using data from 1981-2000
- There are several useful ways to evaluate predictive success (overall accuracy is not one of them)
- Positive predictive value or true positive rate = percent of yes guesses that are correct
- How helpful are each of the factors in predicting proliferation?

TC as an indicator of proliferation risk

- If, in 1980, we had used this model to predict proliferation behavior for the next 20 years...

TC as an indicator of proliferation risk

- If, in 1980, we had used this model to predict proliferation behavior for the next 20 years...

		Actual	
		Yes	No
Predicted	Yes	262	105
	No	11	3133

True positive rate: 71.4%

(Without fuel cycle TC Measure)

TC as an indicator of proliferation risk

- If, in 1980, we had used this model to predict proliferation behavior for the next 20 years...

		Actual	
		Yes	No
Predicted	Yes	262	105
	No	11	3133

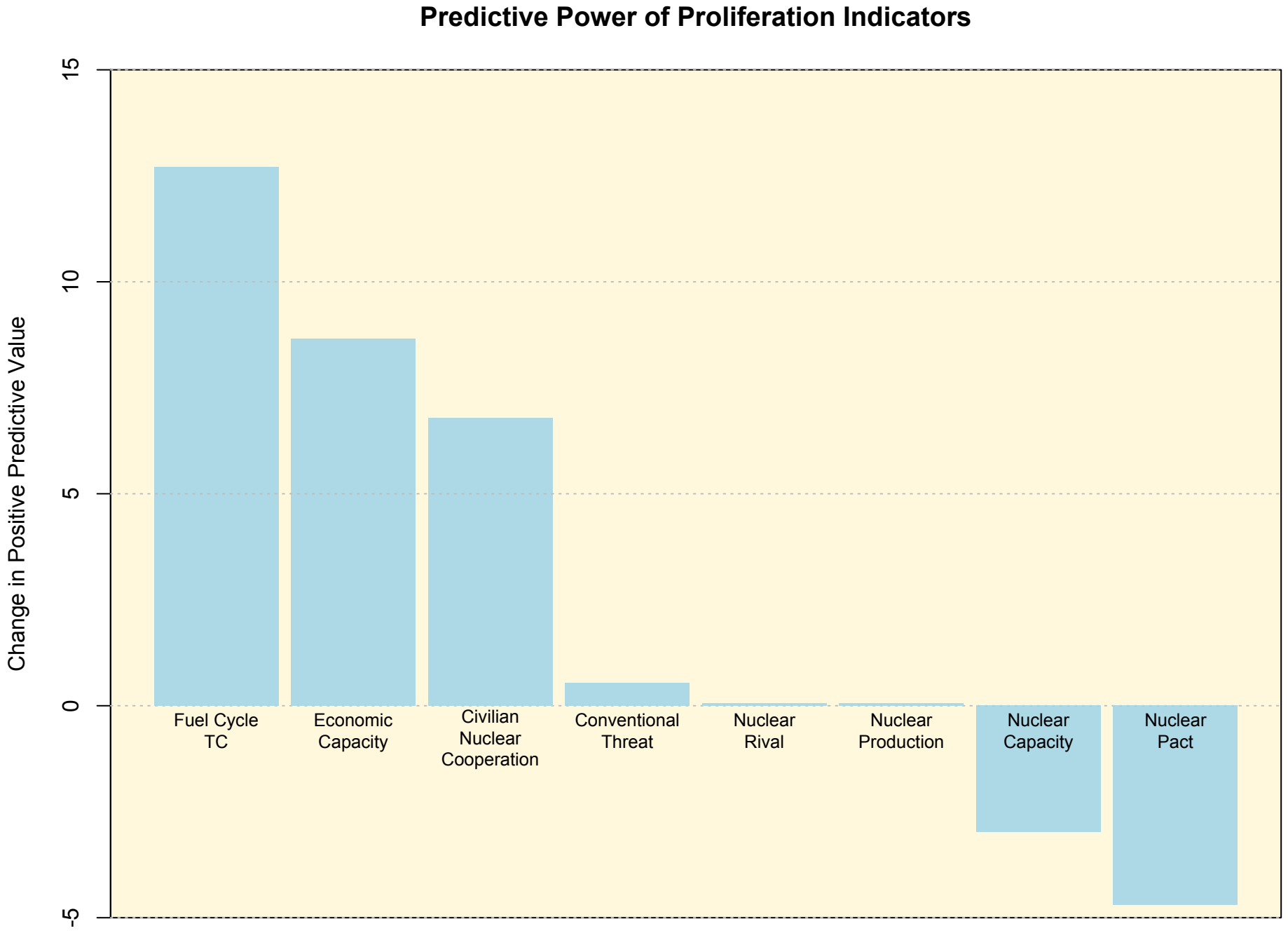
True positive rate: 71.4%

(Without fuel cycle TC Measure)

		Actual	
		Yes	No
Predicted	Yes	259	49
	No	14	3189

True positive rate: 84.1%

(With fuel cycle TC Measure)


Predictive Power of Proliferation Indicators
Change in Positive Predictive Value
15
10
5
0
-5
Fuel Cycle TC
Economic Capacity
Civilian Nuclear Cooperation
Conventional Threat
Nuclear Rival
Nuclear Production
Nuclear Capacity
Nuclear Pact

Conclusions: What is to be done?

- This research shows that fuel cycle-related TC is strongly associated with nuclear weapons programs
- If you believe our preliminary finding that fuel cycle-related TC increases proliferation risk, then you should be stopping these projects for high risk countries
  - Unlike bilateral nuclear cooperation, this is an area where the US and its partners have leverage
  - This study can help provide ammunition
- Even if you are not convinced that fuel cycle-related TC leads to proliferation, it seems clear that this makes a useful indicator
  - We should be deploying this measure to improve our assessments of proliferation risk

Thank you!

Jeff Kaplow
University of California, San Diego
jkaplow@ucsd.edu

Robert L. Brown
Temple University
brownrl@temple.edu