Do Arms Control Treaties Work?

Assessing the Effectiveness of the Nuclear Nonproliferation Treaty

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Supplementary Information

This document reports the results of several additional models.

Interaction Between Regime Type and NPT Ratification. Much of the literature on the effects of international institutions focuses on domestic politics. In many contexts, the extent to which treaty ratification affects national policy may be conditional on regime type. We test for this possibility for estimating models that include an interaction term between NPT RATIFICATION and POLITY. Table A1 provides the results.

Genetic Matching. Many matching algorithms have been proposed. For our main results we used the nearest-neighbor algorithm. We test the robustness of our results to an alternative algorithm by using the genetic matching algorithm proposed by Diamond and Sekhon (2013). To do so, we use the Matching package in the R programming language. Tables A2 and A3 provide the balance statistics from the matching stage. Table A4 demonstrates that using these matched samples we find that the average treatment effect of NPT ratification on both pursuit and program is significant and negative.

NPT Signature and/or Ratification. In some cases, years pass between NPT signature and ratification. In states that have signed but not yet ratified the NPT, it is plausible that NPT signature can reduce the likelihood of nuclear proliferation. To examine this, we construct a new variable NPT SIGNATURE AND/OR RATIFICATION, which is coded as '1' if a country-year has either signed or ratified the NPT, and '0' otherwise. We then use W-NOMINATE to estimate the probability that a country-year signs and/or ratifies the NPT, construct new matched samples based on these probabilities and the other predictors of NPT membership, and re-estimate the logit models of nuclear pursuit and program. The results, provided in Table A5, are consistent with our main results.

Nuclear Cooperation Agreements. When a state ratifies the NPT, this may plausible lead to increases in the extent to which other states are willing to sign NCAs with the new NPT member, although in many cases states do form NCAs with non-members. Our data indicate that NPT non-members have entered into 695 NCAs. We nonetheless estimate robustness tests that exclude NCAs from both the matching stage and the logit models. The results, reported in Table A6, are consistent with our main results.

Nuclear Program Onset. If a state has already established a nuclear program, NPT membership may be less likely to affect the state's nuclear policy going forward. We therefore estimate a robustness test in which we code a variable PROGRAM ONSET as '1' for the first year of a nuclear program, and '0' otherwise. We drop from the sample country-years with ongoing nuclear weapons programs. We then construct matched samples based on this sample and re-estimate our logit models. The results, reported in Table A7, are consistent with our main results.

Models of NPT Ratification. The underlying predictors of NPT ratification are of substantive interest to many scholars. Table A8 provides the results of two models of NPT ratification. Model 1 includes all of the variables include in the matching stage. Model 2 includes only the NPT ratification probabilities estimated using W-NOMINATE as described by Lupu (2013). The comparison between the two models is quite striking. The W-NOMINATE estimate alone correctly predicts 79.473% percent of the outcomes. Adding all of the other variables reduces percent correctly predicted to 79.115%. These results indicate the strength our W-NOMINATE estimates in predicting NPT ratification.

Table A1: Logit Models of Nuclear Proliferation with Polity Interaction Term

DV:	(1) Pursuit	(2) Program
NPT Ratification	-2.537*	-3.249***
	(1.204)	(0.833)
Polity	0.012	0.031
	(0.039)	(0.032)
NPT Ratification * Polity	-0.119	-0.137
	(0.163)	(0.112)
US/USSR Rivalry	1.685***	1.539**
	(0.440)	(0.484)
Nuclear Cooperation Agreements	0.058	0.051*
	(0.033)	(0.021)
Treaty Commitment Preferences	2.901***	2.957***
	(0.738)	(0.649)
MIDs	0.422**	0.496**
	(0.148)	(0.154)
GDP per Capita (logged)	0.025	0.214
	(0.238)	(0.206)
Superpower Alliance	-1.014	-1.124*
	(0.650)	(0.560)
Cold War	-2.576***	-2.078**
	(0.739)	(0.689)
Enduring Rivalry	1.139**	1.693***
	(0.360)	(0.369)
Leader Rebel Experience	2.036***	1.991***
	(0.455)	(0.430)
Personalist Regime	0.216	-0.067
	(0.397)	(0.465)
Year	0.130***	0.143***
	(0.031)	(0.031)
Time	-0.197	-0.228
	(0.182)	(0.175)
$Time^2$	0.055***	0.054***
	(0.015)	(0.015)
$Time^3$	-0.004	-0.004
	(0.002)	(0.002)
Constant	-268.811***	-297.393***
	(60.603)	(61.130)
Observations	1,658	1,768

Standard errors in parentheses; * $p<0.05$, ** $p<0.01$, *** $p<0.001$

Table A2: Genetic Matching Balance Statistics - Pursuit

	Treatment Group Mean	Control Group Mean	t-test Difference	eQQ med
US/USSR Rivalry	0.09	0.11	0.004	0.011
Treaty Commitment Preferences	0.76	0.52	0.000	0.223
Nuclear Cooperation Agreements	9.75	5.83	0.000	0.052
MIDs	0.39	0.58	0.000	0.055
GDP Per Capita (Logged)	8.36	8.04	0.000	0.100
Superpower Alliance	0.54	0.24	0.000	0.147
Polity	0.80	-3.54	0.000	0.234
Cold War	0.24	0.09	0.000	0.075
Enduring Rivalry	0.21	0.34	0.000	0.064
Leader Rebel Experience	0.42	0.54	0.000	0.061
Personalist Regime	0.23	0.31	0.000	0.042
Year	1984	1980	0.000	0.153
n	903	903		

Table A3: Genetic Matching Balance Statistics - Program

	Treatment Group Mean	Control Group Mean	t-test Difference	eQQ med
US/USSR RIVALRY	0.09	0.11	0.000	0.065
TREATY COMMITMENT PREFERENCES	0.78	0.55	0.000	0.210
NUCLEAR COOPERATION AGREEMENTS	9.81	6.30	0.000	0.040
MIDs	0.45	0.69	0.000	0.042
GDP PER CAPITA (LOGGED)	8.41	8.08	0.000	0.093
SUPERPOWER ALLIANCE	0.53	0.23	0.000	0.152
POLITY	1.05	-2.75	0.000	0.201
COLD WAR	0.24	0.11	0.000	0.065
ENDURING RIVALRY	0.25	0.39	0.000	0.066
LEADER REBEL EXPERIENCE	0.41	0.54	0.000	0.064
PERSONALIST REGIME	0.21	0.29	0.000	0.037
YEAR	1984	1981	0.000	0.136
n	974	974		

Table A4: Average Treatment Effects of NPT Ratification - Genetic Matching Result

DV:	(1) Pursuit	(2) Program
NPT Ratification	-0.101***	-0.159***
	(0.007)	(0.009)
n	1806	1948

Note: Estimates are average treatment effects rather than regression coefficients.

Table A5: Logit Models of Nuclear Proliferation - Effects of Signature and/or Ratification

	(1)	(2)
DV:	PURSUIT	PROGRAM
NPT SIGNATURE AND/OR RATIFICATION	-3.381***	-3.285***
	(0.433)	(0.410)
US/USSR RIVALRY	0.520	0.773
	(0.431)	(0.416)
NUCLEAR COOPERATION AGREEMENTS	0.064*	0.056
	(0.026)	(0.030)
TREATY COMMITMENT PREFERENCES	8.272*	4.182**
	(4.052)	(1.473)
MIDs	0.459	0.576***
	(0.284)	(0.152)
GDP PER CAPITA (LOGGED)	0.194	0.289
	(0.272)	(0.218)
SUPERPOWER ALLIANCE	-1.196	-1.113
	(0.783)	(0.687)
POLITY	-0.007	0.009
	(0.040)	(0.033)
COLD WAR	-2.937***	-2.391***
	(0.864)	(0.696)
ENDURING RIVALRY	1.543***	1.928***
	(0.433)	(0.380)
LEADER REBEL EXPERIENCE	1.979***	1.597***
	(0.472)	(0.453)
PERSONALIST REGIME	0.675	0.391
	(0.443)	(0.405)
YEAR	0.177***	0.187***
	(0.036)	(0.035)
TIME	-0.080	-0.190
	(0.155)	(0.160)
TIME^2	0.048***	0.053***
	(0.014)	(0.014)
TIME^3	-0.005*	-0.004*
	(0.002)	(0.002)
CONSTANT	-369.719***	-384.907***
	(72.476)	(68.690)
Observations	1,204	1,366

Standard errors in parentheses; * $p<0.05$, ** $p<0.01$, *** $p<0.001$

Table A6: Logit Models of Nuclear Proliferation: NCAs Excluded

DV:	(1) PURSUIT	(2) PROGRAM
NPT RATIFICATION	-2.350***	-2.802***
	(0.401)	(0.432)
US/USSR RIVALRY	1.153**	0.319
	(0.405)	(0.448)
TREATY COMMITMENT PREFERENCES	4.134***	4.293***
	(0.668)	(0.695)
MIDS	0.616***	0.560**
	(0.157)	(0.172)
GDP PER CAPITA (LOGGED)	-0.012	0.164
	(0.250)	(0.210)
SUPERPOWER ALLIANCE	0.043	0.083
	(0.526)	(0.501)
POLITY	0.040	0.023
	(0.033)	(0.029)
COLD WAR	-2.773***	-2.343**
	(0.773)	(0.715)
ENDURING RIVALRY	0.826*	1.412***
	(0.358)	(0.362)
LEADER REBEL EXPERIENCE	1.587***	1.335**
	(0.428)	(0.413)
PERSONALIST REGIME	0.750	0.823
	(0.430)	(0.444)
YEAR	0.157***	0.178***
	(0.033)	(0.032)
TIME	-0.317*	-0.235
	(0.124)	(0.138)
TIME^2	0.049***	0.053***
	(0.014)	(0.013)
TIME^3	-0.003	-0.003*
	(0.002)	(0.002)
CONSTANT	-323.319***	-365.274***
	(65.554)	(64.137)
Observations	1,736	1,844

Standard errors in parentheses; * $p<0.05$, ** $p<0.01$, *** $p<0.001$

Table A7: Logit Model of Nuclear Program Onset

	(1) PROGRAM ONSET
DV:	
NPT RATIFICATION	-1.340*
	(0.623)
US/USSR RIVALRY	1.309
	(1.107)
NUCLEAR COOPERATION AGREEMENTS	0.036**
	(0.011)
TREATY COMMITMENT PREFERENCES	1.415
	(0.902)
MIDs	1.016*
	(0.435)
GDP PER CAPITA (LOGGED)	-0.068
	(0.593)
SUPER POWER ALLIANCE	-2.192
	(1.703)
POLITY	0.129
	(0.068)
ENDURING RIVALRY	0.056
	(0.784)
LEADER REBEL EXPERIENCE	1.531
	(0.928)
PERSONALIST REGIME	-0.908
	(1.465)
TIME	-10.633*
	(5.403)
TIME^2	-1.649
	(0.915)
TIME^3	-0.081
	(0.052)
CONSTANT	-27.295
	(14.161)
Observations	1460

Standard errors in parentheses
The Cold War variable is excluded because the
matched sample contains zero program onsets during the Cold War.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A8: Logit Models of NPT Ratification

	(1) NPT Ratification	(2) NPT Ratification
Treaty Commitment Preferences	2.129***	2.689***
	(0.147)	(0.117)
Nuclear Cooperation Agreements	-0.033***	——
	(0.004)	
MIDs	-0.096	——
	(0.063)	
GDP Per Capita (logged)	-0.096	——
	(0.054)	
Superpower Alliance	0.514***	——
	(0.122)	
Polity	0.052***	——
	(0.008)	
US/USSR Rivalry	-0.219	——
	(0.164)	
Cold War	0.535**	——
	(0.176)	
Enduring Rivalry	-0.306**	——
	(0.111)	
Leader Rebel Experience	-0.022	——
	(0.099)	
Personalist Regime	0.288**	——
	(0.106)	
Year	0.052***	——
	(0.008)	
Constant	-103.370***	-0.656***
	(15.639)	(0.086)
Observations	3,931	3,931
AIC	0.859	0.934
BIC	-29078.953	-28850.480
PCP	79.115	79.473

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$