Appendix

Explaining state participation in ten universal WMD treaties: A survival analysis of ratification decisions

Jan Karlas

I. Descriptive statistics

Table A1: Descriptive statistics (AT)

Variable	Observations	Mean	St.dev.	Min.	Max.
Ratification	8550	0.01	0.08	0.00	1.00
Weapons	8550	0.04	0.21	0.00	1.00
LH order	8069	-0.22	0.80	-2.44	2.71
Development	8343	8.15	1.19	4.89	13.40
Regional ratifications	8550	11.30	20.80	0.00	100.00
Democracy	7149	-0.32	7.02	-10.00	10.00
Population	8342	8.24	1.96	2.20	13.80
Domestic conflicts	8372	0.22	0.55	0.00	5.60
IO membership	8367	48.00	19.10	0.00	105.00
Legislative constraints	8055	0.56	0.50	0.00	1.00
Warsaw Pact	8550	0.01	0.10	0.00	1.00
Later independence	8550	0.32	0.47	0.00	1.00

Table A2: Descriptive statistics (BWC)

Variable	Observations	Mean	St.dev.	Min.	Max.
Ratification	2850	0.06	0.25	0.00	1.00
Weapons	2850	0.06	0.24	0.00	1.00
LH order	2606	-0.16	0.83	-2.36	2.70
Development	2706	7.88	1.12	4.89	13.20
Regional ratifications	2850	47.80	30.60	0.00	100.00
Democracy	2306	-2.10	6.42	-10.00	10.00
Population	2705	8.14	2.07	2.20	13.80
Domestic conflicts	2730	0.27	0.61	0.00	5.60
IO membership	2730	44.00	19.10	1.00	107.00
Legislative constraints	2545	0.57	0.50	0.00	1.00
Warsaw Pact	2850	0.01	0.07	0.00	1.00
Later independence	2850	0.18	0.39	0.00	1.00

Table A3: Descriptive statistics (CTBT)

Variable	Observations	Mean	St.dev.	Min.	Max.
Ratification	2029	0.09	0.28	0.00	1.00
Weapons	2029	0.11	0.31	0.00	1.00
LH order	1922	-0.35	0.89	-2.06	3.00
Development	1981	8.26	1.17	4.89	11.20
Regional ratifications	2029	34.00	32.80	0.00	100.00
Democracy	1648	1.50	6.53	-10.00	10.00
Population	1981	8.52	2.39	2.20	14.10
Domestic conflicts	1983	0.32	0.75	0.00	6.80
IO membership	1983	57.50	19.20	3.00	127.00
Legislative constraints	1894	0.51	0.50	0.00	1.00
Warsaw Pact	NA	NA	NA	NA	NA
Later independence	NA	NA	NA	NA	NA

Table A4: Descriptive statistics (CWC)

Variable	Observations	Mean	St.dev.	Min.	Max.
Ratification	1369	0.14	0.35	0.00	1.00
Weapons	1369	0.18	0.38	0.00	1.00
LH order	1264	-0.26	0.91	-2.06	3.00
Development	1338	8.17	1.22	4.89	11.20
Regional ratifications	1369	34.10	35.30	0.00	100.00
Democracy	1083	0.94	6.55	-10.00	10.00
Population	1338	8.30	2.19	2.20	14.00
Domestic conflicts	1340	0.29	0.59	0.00	5.60
IO membership	1340	52.70	19.30	3.00	122.00
Legislative constraints	1276	0.58	0.49	0.00	1.00
Warsaw Pact	NA	NA	NA	NA	NA
Later independence	NA	NA	NA	NA	NA

Table A5: Descriptive statistics (MT)

Variable	Observations	Mean	St.dev.	Min.	Max.
Ratification	7374	0.00	0.05	0.00	1.00
Weapons	7374	0.07	0.25	0.00	1.00
LH order	7080	-0.16	0.87	-2.28	3.00
Development	7213	8.48	1.27	4.89	11.50
Regional ratifications	7374	5.41	11.30	0.00	100.00
Democracy	6118	2.14	7.00	-10.00	10.00
Population	7212	8.48	2.14	2.20	14.10
Domestic conflicts	7237	0.22	0.58	0.00	6.80
IO membership	7233	59.00	21.50	2.00	132.00
Legislative constraints	6916	0.57	0.50	0.00	1.00
Warsaw Pact	7374	0.01	0.09	0.00	1.00
Later independence	7374	0.15	0.36	0.00	1.00

Table A6: Descriptive statistics (NPT)

Variable	Observations	Mean	St.dev.	Min.	Max.
Ratification	1774	0.11	0.31	0.00	1.00
Weapons	1774	0.20	0.40	0.00	1.00
LH order	1549	-0.04	0.93	-2.25	2.70
Development	1662	8.27	1.21	5.73	13.40
Regional ratifications	1774	51.40	32.90	0.00	100.00
Democracy	1544	-1.94	7.21	-10.00	10.00
Population	1662	8.74	2.20	2.77	14.00
Domestic conflicts	1662	0.42	0.98	0.00	6.80
IO membership	1662	39.50	20.90	0.00	122.00
Legislative constraints	1649	0.50	0.50	0.00	1.00
Warsaw Pact	1774	0.01	0.09	0.00	1.00
Later independence	1774	0.18	0.38	0.00	1.00

Table A7: Descriptive statistics (OST)

Variable	Observations	Mean	St.dev.	Min.	Max.
Ratification	5064	0.02	0.15	0.00	1.00
Weapons	5064	0.03	0.18	0.00	1.00
LH order	4730	-0.18	0.75	-2.25	2.71
Development	4868	8.12	1.16	4.89	13.40
Regional ratifications	5064	39.70	24.30	0.00	100.00
Democracy	4024	-0.46	6.96	-10.00	10.00
Population	4867	7.88	2.00	2.20	13.80
Domestic conflicts	4892	0.21	0.49	0.00	5.40
IO membership	4892	46.20	19.00	0.00	93.00
Legislative constraints	4597	0.59	0.49	0.00	1.00
Warsaw Pact	5064	0.00	0.04	0.00	1.00
Later independence	5064	0.33	0.47	0.00	1.00

Table A8: Descriptive statistics (PTBT)

Variable	Observations	Mean	St.dev.	Min.	Max.
Ratification	3725	0.03	0.18	0.00	1.00
Weapons	3725	0.06	0.24	0.00	1.00
LH order	3392	-0.21	0.84	-2.42	2.71
Development	3521	8.25	1.23	5.73	13.00
Regional ratifications	3725	56.10	27.50	0.00	100.00
Democracy	2737	-1.59	6.96	-10.00	10.00
Population	3520	7.81	2.26	2.20	14.10
Domestic conflicts	3547	0.17	0.44	0.00	5.40
IO membership	3546	43.20	21.20	0.00	132.00
Legislative constraints	3313	0.52	0.50	0.00	1.00
Warsaw Pact	3725	0.00	0.06	0.00	1.00
Later independence	3725	0.46	0.50	0.00	1.00

Table A9: Descriptive statistics (SBT)

Variable	Observations	Mean	St.dev.	Min.	Max.
Ratification	5140	0.02	0.13	0.00	1.00
Weapons	5140	0.06	0.24	0.00	1.00
LH order	4838	-0.23	0.77	-2.32	2.71
Development	4952	8.15	1.18	4.89	13.30
Regional ratifications	5140	35.70	23.80	0.00	100.00
Democracy	4190	-0.04	6.83	-10.00	10.00
Population	4951	8.26	2.10	2.20	13.90
Domestic conflicts	4976	0.24	0.55	0.00	5.60
IO membership	4976	50.40	20.20	0.00	132.00
Legislative constraints	4666	0.58	0.49	0.00	1.00
Warsaw Pact	5140	0.00	0.04	0.00	1.00
Later independence	5140	0.21	0.41	0.00	1.00

Table A10: Descriptive statistics (TPNW)

Variable	Observations	Mean	St.dev.	Min.	Max.
Ratification	1016	0.07	0.25	0.00	1.00
Weapons	1016	0.06	0.24	0.00	1.00
LH order	1007	-0.17	0.85	-1.72	2.49
Development	1004	8.72	1.31	5.66	11.50
Regional ratifications	1016	10.10	18.00	0.00	100.00
Democracy	872	3.95	6.21	-10.00	10.00
Population	1004	8.74	2.11	2.30	14.10
Domestic conflicts	1007	0.26	0.63	0.00	4.00
IO membership	1007	68.10	20.50	20.00	130.00
Legislative constraints	960	0.59	0.49	0.00	1.00
Warsaw Pact	NA	NA	NA	NA	NA
Later independence	NA	NA	NA	NA	NA

II. Predicted probabilities

The tables presented below explore the predicted probabilities of ratification at the selected values of the independent variables. To calculate these probabilities, I used the same set of variables as in the main survival models, but in a logit model. To capture the temporal dimension of the ratification processes, I added a cubic time polynomial to the equations. While the use of this model eases the interpretation of substantive effects, it yields essentially identical results as the survival models. For the interval variables, the probabilities were calculated for values corresponding to the 10th and the 90th percentile of the given variable. For the dichotomous variables, the probabilities were calculated for values 0 and 1. In all the models, all the independent variables other than the variable of interest were kept at their mean values.

The columns 10th percentile/0 (%) and 90th percentile/1 (%) provide the information about the probability of ratification at the specified levels of the independent variables. The column Difference measures the difference between the two predicted probabilities and the column Ratio displays the ratio of the two probabilities. The probabilities and their differences generally achieve very low values, but this fully corresponds to the fact a mean probability that a state will ratify a treaty in the given year is only approximately 3%. Given this, it is meaningful to focus on the ratios of probabilities.

Table A11: Predicted probabilities (AT)

Variable	10th percentile/0 (%)	90th percentile/1 (%)	Difference	Ratio
Weapons	0.16	0.26	0.10	1.63
LH order	0.16	0.16	0.00	1.00
Development	0.06	0.49	0.43	8.17
Regional ratifications	0.14	0.22	0.08	1.57
Democracy	0.09	0.29	0.20	3.22
Population	0.06	0.44	0.38	7.33
Domestic conflicts	0.15	0.18	0.03	1.20
IO membership	0.06	0.44	0.38	7.33
Legislative constraints	0.17	0.15	-0.02	0.88
Warsaw Pact	0.16	3.14	2.98	19.63
Later independence	0.15	0.21	0.06	1.40

Table A12: Predicted probabilities (BWC)

Variable	10th percentile/0 (%)	90th percentile/1 (%)	Difference	Ratio
Weapons	5.70	0.34	-5.36	0.06
LH order	5.08	4.52	-0.56	0.89
Development	3.37	8.09	4.72	2.40
Regional ratifications	3.51	6.26	2.75	1.78
Democracy	4.13	5.96	1.83	1.44
Population	3.54	6.17	2.63	1.74
Domestic conflicts	5.30	3.96	-1.34	0.75
IO membership	4.27	5.42	1.15	1.27
Legislative constraints	5.70	4.35	-1.35	0.76
Warsaw Pact	4.80	14.07	9.27	2.93
Later independence	4.70	6.38	1.68	1.36

Table A13: Predicted probabilities (CTBT)

Variable	10th percentile/0 (%)	90th percentile/1 (%)	Difference	Ratio
Weapons	6.91	2.88E-07	-6.91	4.17E-08
LH order	0.68	3.74	3.06	5.50
Development	1.11	1.77	0.66	1.59
Regional ratifications	1.02	2.03	1.01	1.99
Democracy	1.47	1.29	-0.18	0.88
Population	1.05	1.70	0.65	1.62
Domestic conflicts	1.55	1.11	-0.44	0.72
IO membership	0.94	1.97	1.03	2.10
Legislative constraints	1.15	1.60	0.45	1.39
Warsaw Pact				
Later independence				

Table A14: Predicted probabilities (CWC)

Variable	10th percentile/0 (%)	90th percentile/1 (%)	Difference	Ratio
Weapons	14.92	3.20	-11.72	0.21
LH order	9.17	14.32	5.15	1.56
Development	7.75	17.38	9.63	2.24
Regional ratifications	9.29	15.16	5.87	1.63
Democracy	10.21	12.16	1.95	1.19
Population	8.31	14.44	6.13	1.74
Domestic conflicts	11.89	9.87	-2.02	0.83
IO membership	8.35	14.59	6.24	1.75
Legislative constraints	13.31	10.01	-3.30	0.75
Warsaw Pact				
Later independence				

Table A15: Predicted probabilities (MT)

Variable	10th percentile/0 (%)	90th percentile/1 (%)	Difference	Ratio
Weapons	0.11	0.07	-0.04	0.64
LH order	0.15	0.07	-0.08	0.47
Development	0.03	0.42	0.39	14.00
Regional ratifications	0.10	0.13	0.03	1.30
Democracy	0.21	0.07	-0.14	0.33
Population	0.04	0.25	0.21	6.25
Domestic conflicts	0.11	0.10	-0.01	0.91
IO membership	0.07	0.17	0.10	2.43
Legislative constraints	0.09	0.12	0.03	1.33
Warsaw Pact	0.13	2.13E-08	-0.13	1.65E-07
Later independence	0.11	0.09	-0.02	0.82

Table A16: Predicted probabilities (NPT)

Variable	10th percentile/0 (%)	90th percentile/1 (%)	Difference	Ratio
Weapons	11.52	0.81	-10.71	0.07
LH order	4.84	11.9	7.06	2.46
Development	9.6	5.32	-4.28	0.55
Regional ratifications	5.76	9.11	3.35	1.58
Democracy	6.03	10.28	4.25	1.70
Population	7.32	7.5	0.18	1.02
Domestic conflicts	8.34	6.44	-1.90	0.77
IO membership	7.08	7.85	0.77	1.11
Legislative constraints	6.95	7.86	0.91	1.13
Warsaw Pact	7.26	48.39	41.13	6.67
Later independence	7.13	9.87	2.74	1.38

Table A17: Predicted probabilities (OST)

Variable	10th percentile/0 (%)	90th percentile/1 (%)	Difference	Ratio
Weapons	1.1	1.34	0.24	1.22
LH order	1.08	1.16	0.08	1.07
Development	0.77	1.71	0.94	2.22
Regional ratifications	0.80	1.41	0.61	1.76
Democracy	1.04	1.19	0.15	1.14
Population	0.63	1.83	1.20	2.90
Domestic conflicts	1.19	0.89	-0.30	0.75
IO membership	0.61	2.03	1.42	3.33
Legislative constraints	1.51	0.93	-0.58	0.62
Warsaw Pact	1.1	9.47	8.37	8.61
Later independence	1.28	0.65	-0.63	0.51

Table A18: Predicted probabilities (PTBT)

Variable	10th percentile/0 (%)	90th percentile/1 (%)	Difference	Ratio
Weapons	0.28	1.29	1.01	4.61
LH order	0.25	0.37	0.12	1.48
Development	0.30	0.29	-0.01	0.97
Regional ratifications	0.22	0.34	0.12	1.55
Democracy	0.24	0.39	0.15	1.63
Population	0.33	0.26	-0.07	0.79
Domestic conflicts	0.27	0.39	0.12	1.44
IO membership	0.16	0.54	0.38	3.38
Legislative constraints	0.34	0.26	-0.08	0.76
Warsaw Pact	0.29	2.11	1.82	7.28
Later independence	0.49	0.13	-0.36	0.27

Table A19: Predicted probabilities (SBT)

Variable	10th percentile/0 (%)	90th percentile/1 (%)	Difference	Ratio
Weapons	0.34	0.29	-0.05	0.85
LH order	0.35	0.33	-0.02	0.94
Development	0.28	0.44	0.16	1.57
Regional ratifications	0.20	0.46	0.26	2.30
Democracy	0.23	0.51	0.28	2.22
Population	0.29	0.40	0.11	1.38
Domestic conflicts	0.36	0.30	-0.06	0.83
IO membership	0.24	0.46	0.22	1.92
Legislative constraints	0.43	0.30	-0.13	0.70
Warsaw Pact	0.34	5.69	5.35	16.74
Later independence	0.41	0.10	-0.31	0.24

Note: Due to fitted probabilities numerically 0 or 1 in the model with a cubic time polynomial, the calculations are based on the model with a quadratic time polynomial.

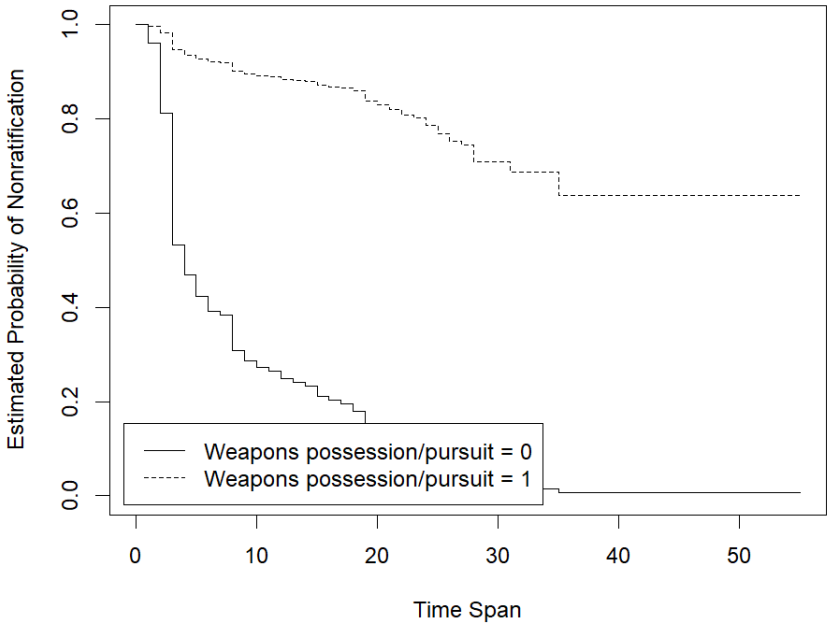
Table A20: Predicted probabilities (TPNW)

Variable	10th percentile/0 (%)	90th percentile/1 (%)	Difference	Ratio
Weapons	3.02	5.66E-06	-3.02	1.87E-06
LH order	7.26	0.28	-6.98	0.04
Development	2.47	1.47	-1.00	0.60
Regional ratifications	1.47	3.13	1.66	2.13
Democracy	0.86	2.95	2.09	3.43
Population	3.32	1.17	-2.15	0.35
Domestic conflicts	2.13	1.36	-0.77	0.64
IO membership	1.01	4.03	3.02	3.99
Legislative constraints	1.55	2.17	0.62	1.40
Warsaw Pact				
Later independence				

III. Estimated survival functions

To illustrate further the substantive effects of the major explanatory variables, the below presented graphs display estimated survival functions related to a set of selected treaties (BWC, CTBT, CWC, NPT, OST, SBT). The functions were calculated on the basis of the Cox proportional hazard models from the main analysis. In the calculations underlying the graphs, the values of the explored interval variable always switched from the 10^{th} to the 90^{th} percentile. When the explored variable was dichotomous, they switched from 0 to 1. All the covariates other than the variable of interest were fixed at their average values.

NPT


Estimated Probability of Nonratification
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0.2
0.4
0.6
0.8
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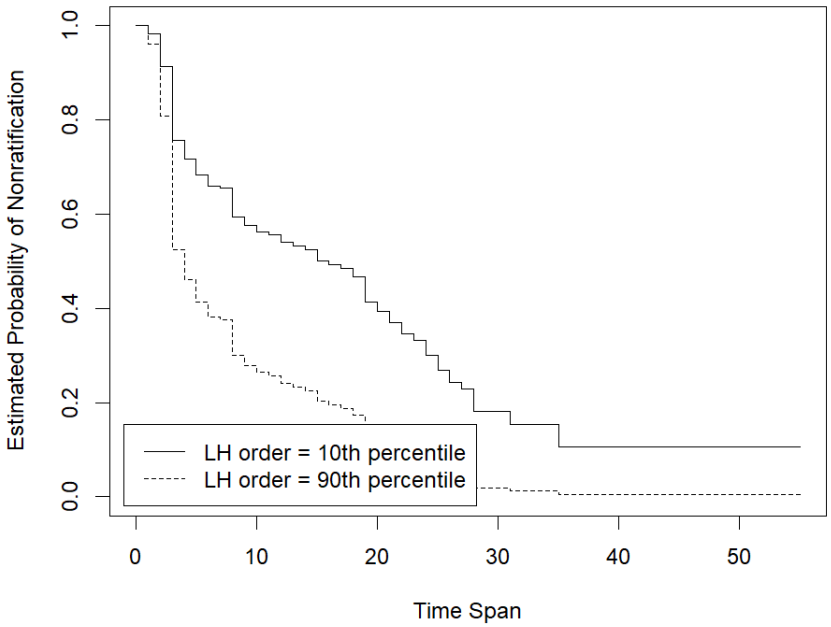
0
10
20
30
40
50
Time Span
Weapons possession/pursuit = 0
Weapons possession/pursuit = 1


Estimated Probability of Nonratification
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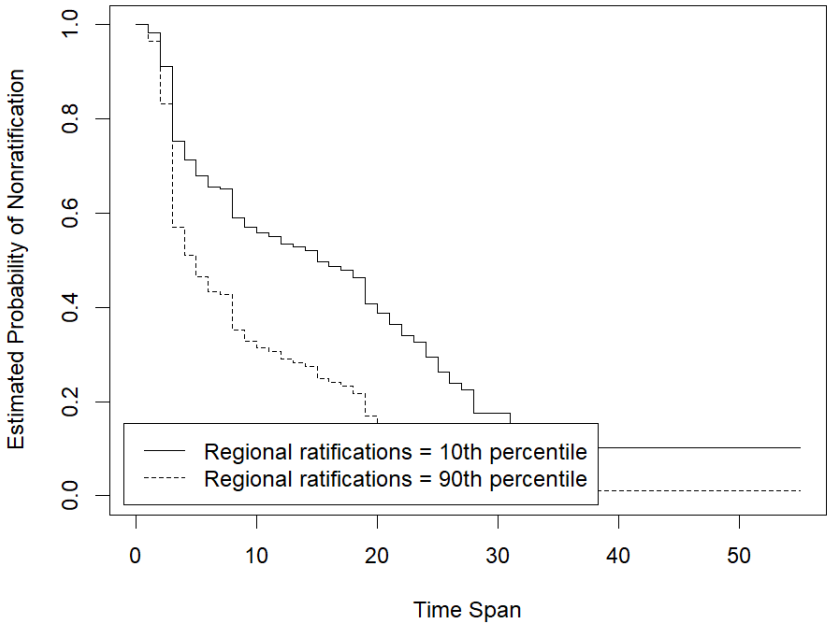
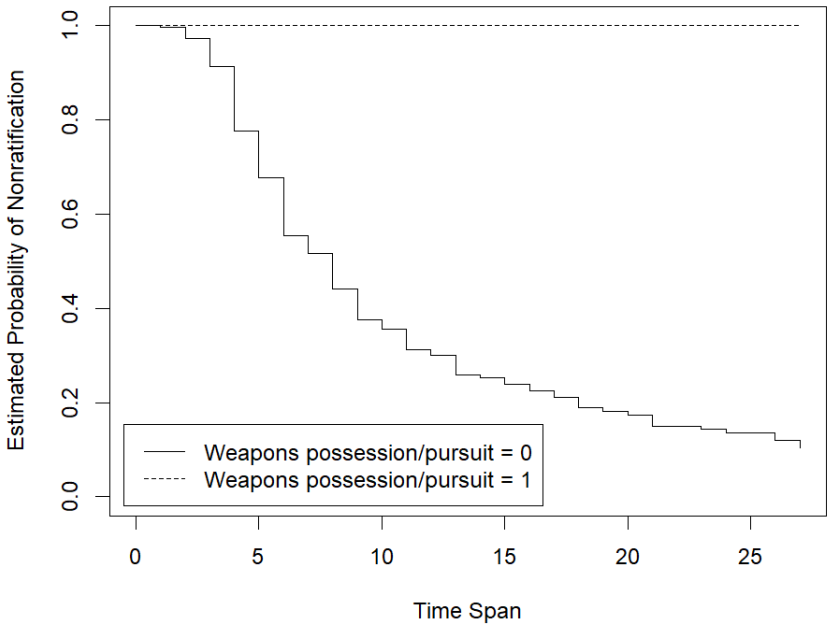
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
50
Time Span
LH order = 10th percentile
LH order = 90th percentile


Estimated Probability of Nonratification
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
50
Time Span
Regional ratifications = 10th percentile
Regional ratifications = 90th percentile

CTBT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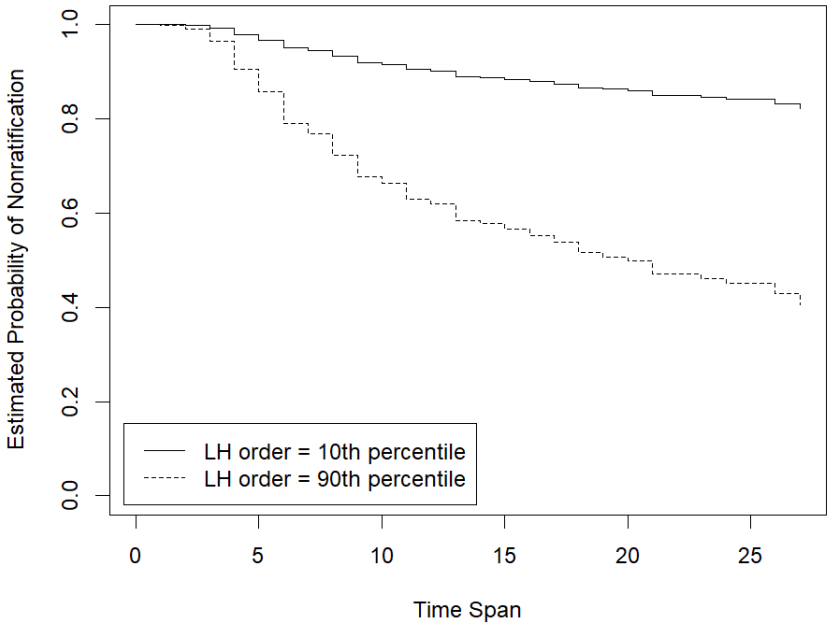
0.2
0.4
0.6
0.8
1.0
0
5
10
15
20
25
Time Span
Weapons possession/pursuit = 0
Weapons possession/pursuit = 1


Estimated Probability of Nonratification
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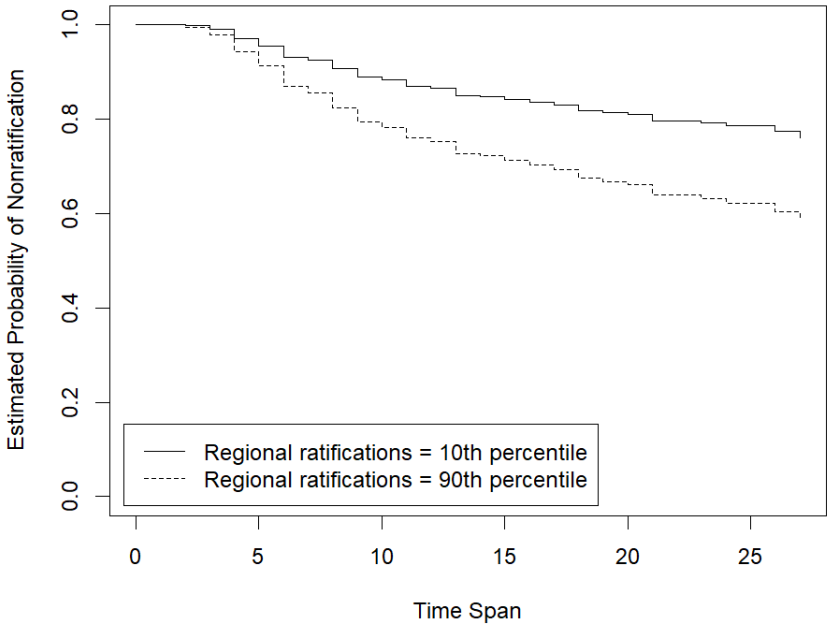
0.2
0.4
0.6
0.8
1.0
0
5
10
15
20
25
Time Span
LH order = 10th percentile
LH order = 90th percentile


Estimated Probability of Nonratification
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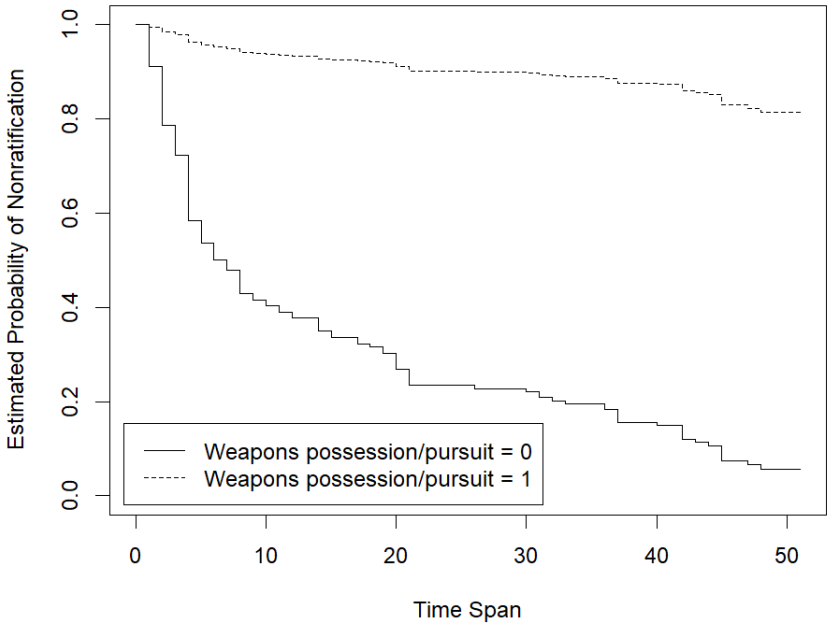
0.2
0.4
0.6
0.8
1.0
0
5
10
15
20
25
Time Span
Regional ratifications = 10th percentile
Regional ratifications = 90th percentile

BWC


Estimated Probability of Nonratification
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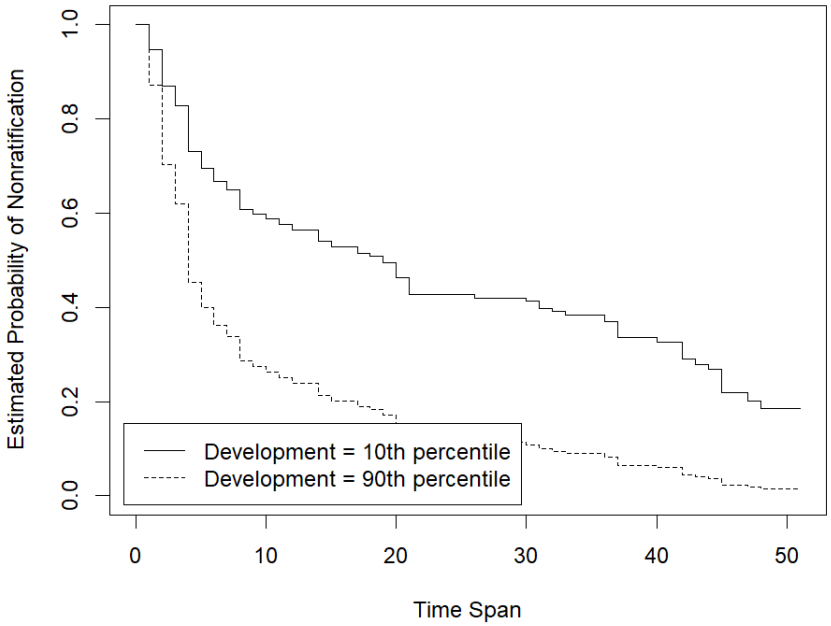
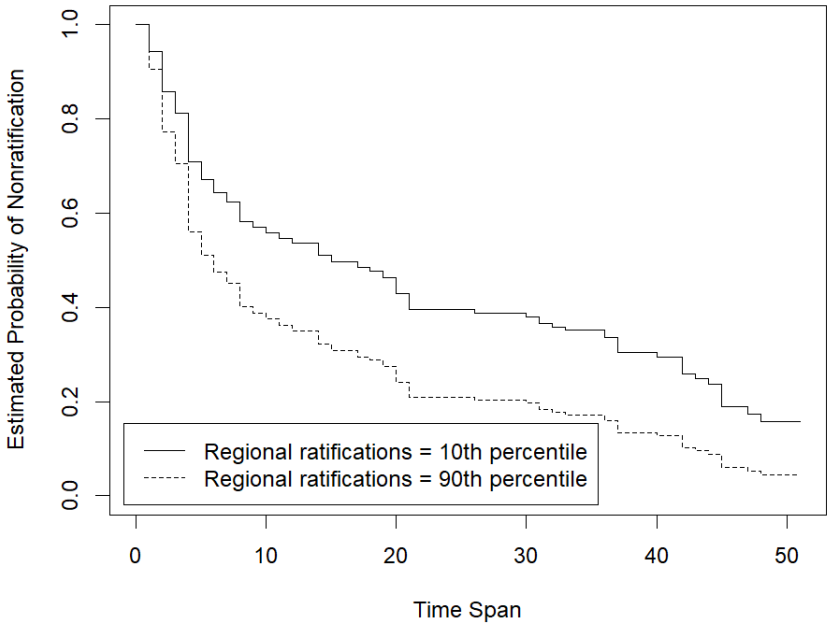
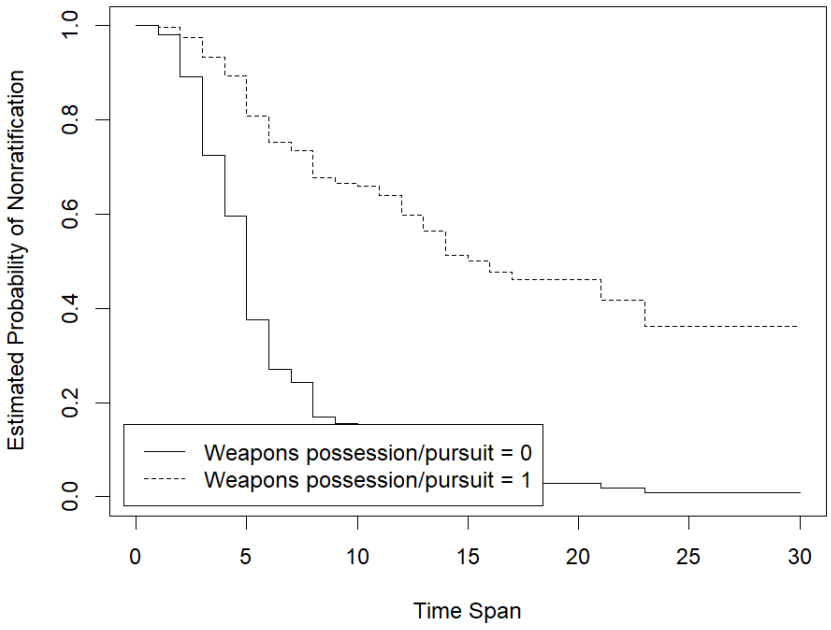
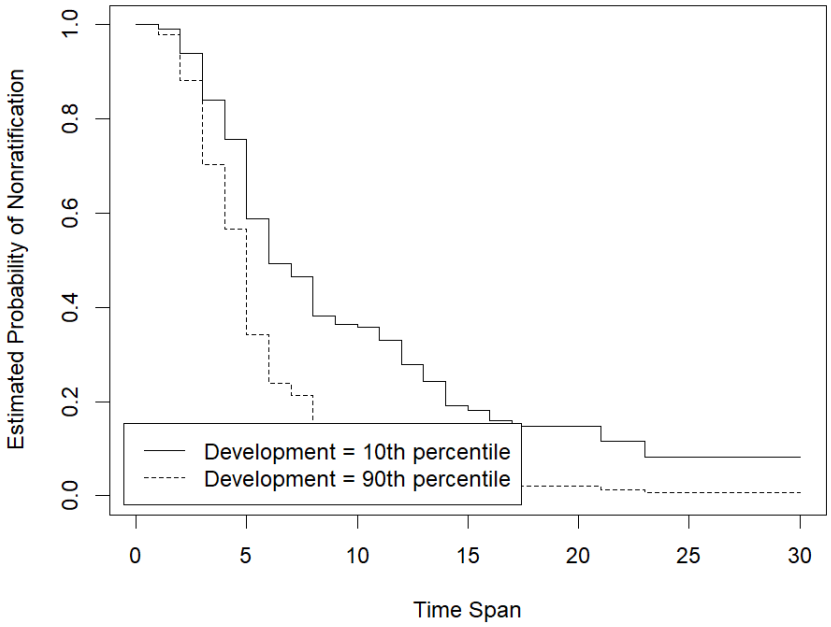
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
50
Time Span
Weapons possession/pursuit = 0
Weapons possession/pursuit = 1

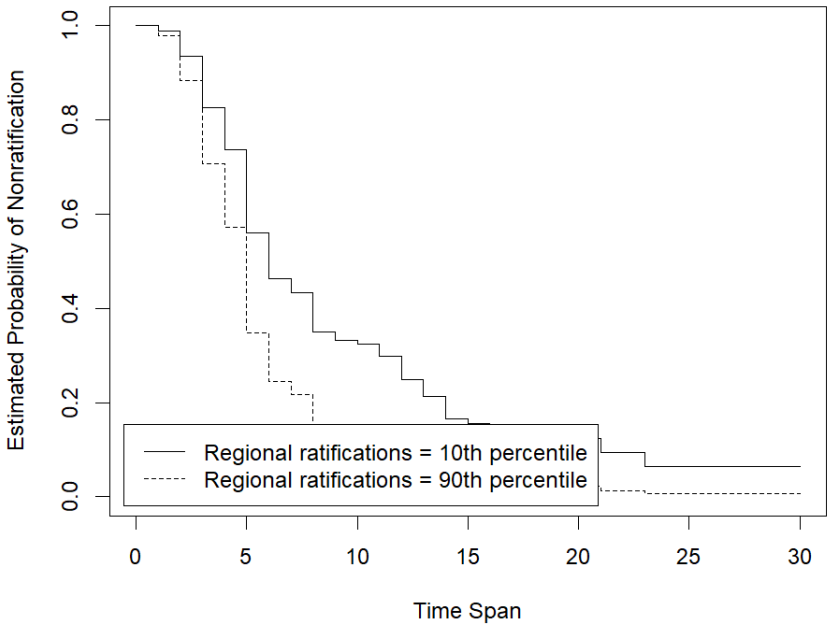

Estimated Probability of Nonratification
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
50
Time Span
Development = 10th percentile
Development = 90th percentile


Estimated Probability of Nonratification
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
50
Time Span
Regional ratifications = 10th percentile
Regional ratifications = 90th percentile

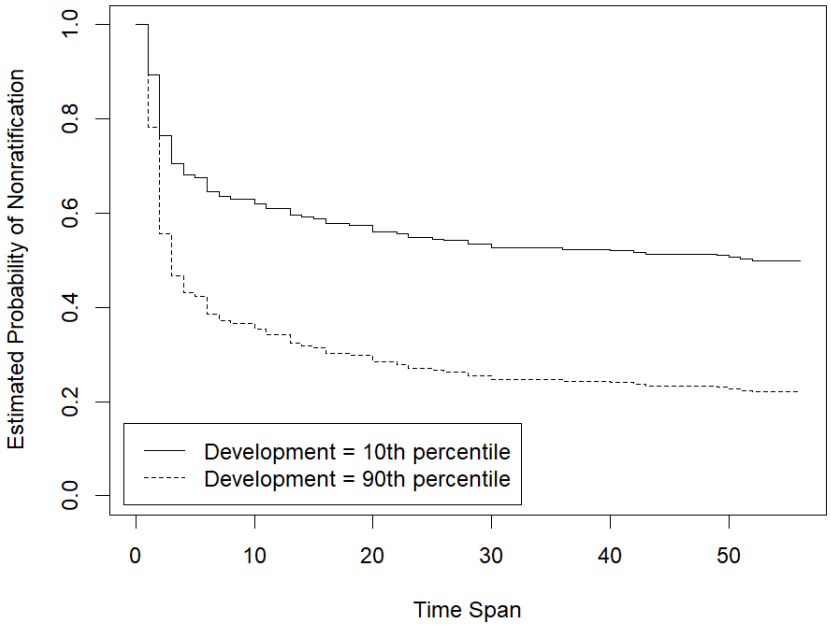
CWC

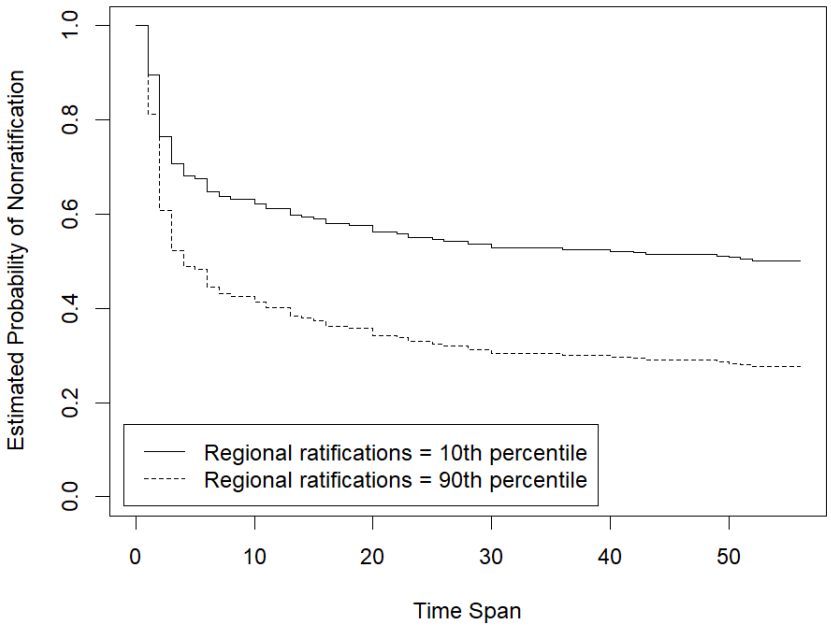

Estimated Probability of Nonratification
0.0
0.2
0.4
0.6
0.8
1.0
0
5
10
15
20
25
30
Time Span
Weapons possession/pursuit = 0
Weapons possession/pursuit = 1


Estimated Probability of Nonratification
0.0
0.2
0.4
0.6
0.8
1.0
0
5
10
15
20
25
30
Time Span
Development = 10th percentile
Development = 90th percentile

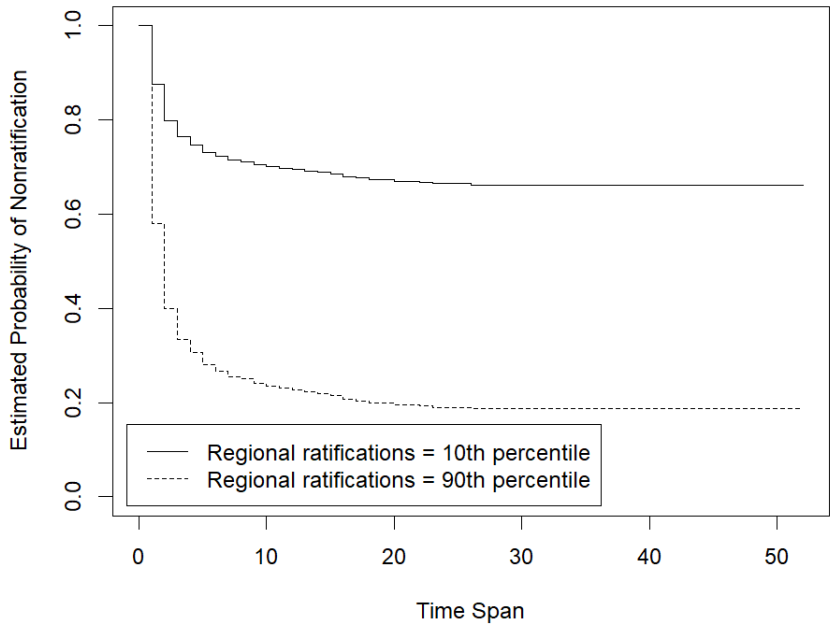

Estimated Probability of Nonratification
0.0
0.2
0.4
0.6
0.8
1.0
0
5
10
15
20
25
30
Time Span
Regional ratifications = 10th percentile
Regional ratifications = 90th percentile

OST


Estimated Probability of Nonratification
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
50
Time Span
Development = 10th percentile
Development = 90th percentile


Estimated Probability of Nonratification
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
50
Time Span
Regional ratifications = 10th percentile
Regional ratifications = 90th percentile

SBT


Estimated Probability of Nonratification
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
50
Time Span
Regional ratifications = 10th percentile
Regional ratifications = 90th percentile