Online Appendix to "How Uncertainty about War Outcomes Affects War Onset"

Measure Properties

Alternatives for p

Other alternatives for this parameter include the variance of the Bernouilli trial, $p' = \frac{C_A C_B}{(C_A+C_B)^2}$, and the entropy of the Bernoulli distribution, $p'' = -\frac{C_A}{(C_A+C_B)} * (\log_2(C_A) - \log_2(C_A + C_B)) - \frac{C_B}{(C_A+C_B)} * (\log_2(C_B) - \log_2(C_A + C_B))$. In our data set, these three alternatives result in very similar uncertainty measures – with a correlation of around .99 for each pair, and our substantive results remain the same.

Limiting Cases

Perfect parity: All the non-diagonal cells of matrix P_d will be equal to .5. This limiting case, E_1= N/2 - .5 (due to the fact that we set the diagonal entries to 0). This is the largest value E_1 can take, call it $\bar{E}_1$.

Complete hierarchy: Assume that there is a complete hierarchy between the states in the relevant set, in the sense that when states are ranked based on their capabilities, $p_{ij} = 0$. In this limiting case, all the cells of matrix P_d will be equal to 0, and E_1= 0. For a given N, this particular scenario gives the minimum value E_1 can take, call it $\underline{E}_1$.

Weighting Construction

In our empirical analyses, we calculated $\underline{C}_{ij}$ and $\bar{C}_{ij}$ separately for each year. Our substantive results remain the same if instead a single maximum and a minimum are defined for the whole range of our data set.

Robustness to Measurement Error

Another advantage of the measure is its robustness to measurement error. Measurement error in independent variables is an important source of bias and inconsistency in coefficient estimates in a regression model, and the bias gets more severe as the variance of the measurement error in an independent variable increases. If state capabilities are measured with random error for a relevant set of size $N > 2$, the variance of the error in our uncertainty measure will be smaller compared to the dyadic balance of capabilities measure.

Addition of New States

How does the measure behave when a new state is added to the relevant set? This ultimately depends on how strong the joiner state is relative to the existing states. If a very weak or strong state joins the set, our measure is expected to go down, as an average dyad against this state will be asymmetric, and the corresponding cells of matrix P will be closer to 0. On the other hand, the measure will most likely go up if the joiner state is close to many other states in the set in terms of military capabilities.[1]

[1]Due to the average joiner being weaker than most existing states, there is a -.27 correlation between the number of states in the system and the uncertainty measure. When measuring the relationship between the rates of change—annual change in number of states and annual change in the uncertainty score—the correlation is only -.02.

Table 1: Summary Statistics

	Mean	Min	Max
Binary Outcome Models: Dyad Year			
Outcome Variable			
Conflict Onset	0.02	0	1
Explanatory Variable			
System *Uncertainty*	0.25	0.20	0.37
System *Uncertainty*^{W}	0.28	0.19	0.51
System *Uncertainty*^{WS}	0.29	0.18	0.52
System *Uncertainty*^{WD}	0.29	0.20	0.52
Region *Uncertainty*^{W}	0.30	0.19	0.68
Region *Uncertainty*^{WS}	0.32	0.19	0.72
Region *Uncertainty*^{WD}	0.31	0.20	0.70
Control Variable			
Dyad *Uncertainty*	0.10	0.00	0.50
Contiguity	4.79	1	6
Joint Democracy	0.12	0	1
Rivalry	0.07	0	1
Alliance	3.57	1	4
Peace Years	26.16	0	184
Count Outcome Models: System Year			
Outcome Variable			
System Conflict Count	6.86	0	34
Explanatory Variable			
System *Uncertainty*$^{\bar{W}}$	0.33	0.19	0.51
Control Variable			
Joint Democracy	0.07	0.00	0.27
Number Great Powers	5.85	4	8
Number Dyads	454.96	113	1,564
Count Outcome Models: Region Year			
Outcome Variable			
Region Conflict Count	0.97	0	22
Explanatory Variable			
Region *Uncertainty*$^{\bar{W}}$	0.49	0.28	0.95
Control Variable			
Joint Democracy	0.07	0.00	0.73
Number Great Powers	1.17	0	6
Number Dyads	37.64	0	230

Table 2: System Uncertainty: Multilevel Model

	(1) *Uncertainty*	(2) *Uncertainty*^{W}
Year Level Predictors		
System *Uncertainty*	-9.698***	-2.766***
	(1.529)	(0.693)
Dyad-Year Level Predictors		
Dyadic *Uncertainty*	0.149	0.135
	(0.360)	(0.358)
Contiguity	-0.255	-0.257***
	(0.025)	(0.025)
Joint Democracy	-0.635***	-0.593***
	(0.166)	(0.166)
Rivalry	1.562***	1.548***
	(0.115)	(0.115)
Alliance	0.046	0.038
	(0.036)	(0.036)
ln(Peace Years)	-3.613***	-3.743***
	(0.845)	(0.846)
ln(Peace Years^2)	6.534***	6.768***
	(1.782)	(1.784)
ln(Peace Years^3)	-3.314***	-3.427***
	(0.913)	(0913)
Constant	-0.684	-2.293***
	(0.403)	(0.260)
Random Parameters		
Between-Year Variation	0.295	0.349
	(0.543)	(0.591)
Between-Dyad Variation	0.949	0.954
	(0.974)	(0.977)
N	77,710	77,710

Multilevel logistic regression.

77,710 dyad-year observations nested within 185 years and 1,678 dyads.

Standard errors in parentheses.

$^*p < 0.05,^{**}\ p < 0.01,^{***}\ p < 0.001$

Table 3: System Year: Alternative Outcomes

	(1) New MIDs	(2) All Force
System *Uncertainty*^{W}	-6.782***	-9.459***
	(1.196)	(1.244)
Joint Democracy	1.567	0.531
	(1.219)	(1.398)
Number Major Powers	0.307***	0.382***
	(0.079)	(0.080)
Number Dyads	0.001*	0.000
	(0.000)	(0.000)
Constant	2.005***	2.662***
	(0.345)	(0.320)
lnalpha	-1.380***	-1.317***
	(0.216)	(0.198)
N	185	185
Log Lik.	-519.312	-522.722

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

Notes: Negative binomial regression with system year as unit of observation. Robust standard errors in parentheses. Outcome variable "New MIDs" counts all new MIDs regardless of hostility level. Outcome variable "All Force" counts all MIDs with the use of force, regardless of originator or joiner status.

Table 4: Uncertainty, Conflict Expansion, and Conflict Fatalities

	System		Region	
	(1)	(2)	(3)	(4)
	Fatalities	Joiners	Fatalities	Joiners
System/Regional *Uncertainty*	2.23**	2.96***	1.05	1.81***
	(0.98)	(0.90)	(0.95)	(0.69)
Dyadic *Uncertainty*	0.21	0.26	0.16	0.14
	(0.50)	(0.39)	(0.48)	(0.38)
Contiguity	-0.03	0.10***	0.02	0.17***
	(0.03)	(0.03)	(0.04)	(0.03)
Joint Democracy	-0.27	-0.25	-0.25	-0.21
	(0.22)	(0.21)	(0.22)	(0.22)
Rivalry	0.74***	0.03	0.79***	0.09
	(0.17)	(0.13)	(0.17)	(0.13)
Alliance	0.09*	-0.05	0.12**	-0.02
	(0.05)	(0.08)	(0.05)	(0.08)
Constant	-0.13	1.74***	-0.17	1.56***
	(0.30)	(0.36)	(0.43)	(0.36)
N	1,014	1,255	1,014	1,255

$^{*}p < 0.10,^{**}p < 0.05,^{***}p < 0.01$

Notes: Sample is restricted to those dyad-years where force was used. Models use uncertainty scores weighted by capabilities and report OLS results with standard errors clustered on the dyad. The *Joiners* outcome variable reflects the total number of conflict participants. The *Fatalities* outcome variable is an ordinal variable for total conflict fatalities. Ordered logistic regression provides substantively similar results for specifications using the fatalities outcome variable. Temporal controls are not shown.

Table 5: System Year Likelihood Ratio Test Models

	(1) Baseline	(2) Unc^W
System *Uncertainty*		-10.563***
		(1.323)
Joint Democracy	5.722***	0.481
	(1.458)	(1.330)
Number Major Powers	0.003	0.395***
	(0.060)	(0.071)
Number Dyads	0.001***	0.000
	(0.000)	(0.000)
Constant	0.639	2.594***
	(0.390)	(0.376)
lnalpha	-0.620***	-1.199***
	(0.150)	(0.188)
N	185	185
Log Lik.	-497.691	-468.770
LR Test	—	$p < 0.001$

$^{*}p < 0.05,^{**}\, p < 0.01,^{***}\, p < 0.001$

Notes: Negative binomial regression with system year as unit of observation. Robust standard errors in parentheses.

Table 6: Dyad Year Likelihood Ratio Test Models

	(1) Baseline	(2) Unc^W
System *Uncertainty*		-2.476***
		(0.511)
Relative Capabilities	0.029	0.090
	(0.443)	(0.431)
Contiguity	-0.210***	-0.201***
	(0.029)	(0.030)
Joint Democracy	-0.598**	-0.664***
	(0.186)	(0.185)
Rivalry	1.228***	1.323***
	(0.147)	(0.140)
Alliance	0.050	0.080
	(0.044)	(0.044)
Constant	-2.507***	-2.023***
	(0.203)	(0.231)
N	77710	77710
Log Lik.	-5135.990	-5111.816
LR Test	—	$p < 0.001$

$^{*}p < 0.05$,** $p < 0.01$,*** $p < 0.001$

Notes: Logistic regression with dyad year as unit of observation. Standard errors clustered on the dyad in parentheses. Temporal controls not shown.

Table 7: Dyad Year Vuong Test Models

	(1) Unc^W	(2) Dispersion	(3) Polarity	(4) Unc^W
System *Uncertainty*	-2.476***			
	(0.511)			
Dispersion		1.929*		
		(0.893)		
Bipolarity			0.121	
			(0.123)	
Multipolarity			-0.244	
			(0.134)	
Regional *Uncertainty*				-0.813
				(0.599)
Relative Capabilities	0.090	0.046	0.084	0.101
	(0.431)	(0.437)	(0.431)	(0.440)
Contiguity	-0.201***	-0.206***	-0.202***	-0.229***
	(0.030)	(0.029)	(0.029)	(0.031)
Joint Democracy	-0.664***	-0.643***	-0.639***	-0.620***
	(0.185)	(0.182)	(0.184)	(0.184)
Rivalry	1.323***	1.250***	1.291***	1.238***
	(0.140)	(0.141)	(0.139)	(0.149)
Alliance	0.080	0.058	0.075	0.054
	(0.044)	(0.044)	(0.044)	(0.044)
Constant	-2.023***	-3.906***	-2.616***	-2.199***
	(0.231)	(0.668)	(0.227)	(0.304)
N	77710	77710	77710	77710
Log Lik.	-5111.816	-5131.452	-5120.246	-5133.779
Vuong Test	—	$p < 0.01$	$p < 0.001$	$p < 0.001$

$^{*}p < 0.05,^{**}p < 0.01,^{***}p < 0.001$

Notes: Logistic regression with dyad year as unit of observation. Standard errors clustered on the dyad in parentheses. Temporal controls not shown.

Table 8: Comparison of 1868 UK-US and 1982 UK-Argentina Dyads

Variable	UK-US	UK-Argentina
System *Uncertainty*^{W} (Percentile)	89th	12th
Contiguity	No	No
Rivalry	Yes	Yes
Joint Democracy	No	No
Alliance	No	No
Dyadic *Uncertainty* (Percentile)	88th	83rd
Peace Years	6	5