

Connecting Theory to Policy with Forecasting

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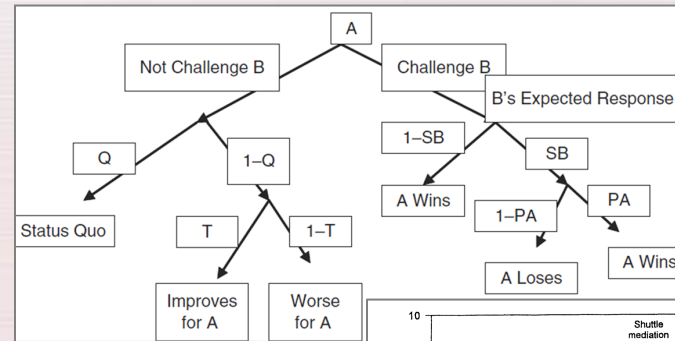
Ways to Use Forecasts of Violence

- Point predictions built from theory
- Evaluate policy relevance of theory



Three Kinds of Forecasts

- Game Theoretic



- Time Series

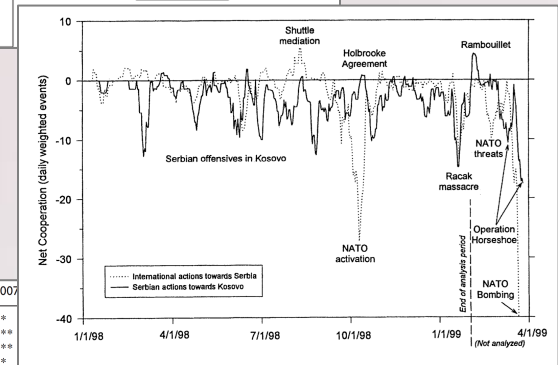


Table 1. Logit model of transnational terrorist incidents, 1968–2007

Polity Score Target	0.031**	
Polity Score Origin	-0.024***	
Target GDP (logged)	0.352***	
Target Logged Population	0.267**	
Target Major Power	-0.104	(0.288)
Origin Major Power	0.604**	(0.204)
Colonial Tie	1.248***	(0.122)
Ethnic Tie	0.152	(0.298)
Ethnic × Post Cold War	-0.241	(0.313)
Ethnic × Post-9/11	0.034	(0.645)
Dyadic Alliance	0.670**	(0.209)
Alliance × Post Cold War	0.061	(0.231)
Dyadic Rivalry	0.708***	(0.168)
Post-Cold War Era	-0.577***	(0.175)
Post-9/11 Era	-1.550**	(0.521)
Log of Distance	-0.291***	(0.024)
Peace Years Spline 1	-0.293***	(0.026)
Peace Years Spline 2	2.005***	(0.302)
Peace Years Spline 3	-4.347***	(0.769)
Peace Years Spline 4	3.099***	(0.755)
Constant	-9.833***	(1.545)
Observations	632,058	

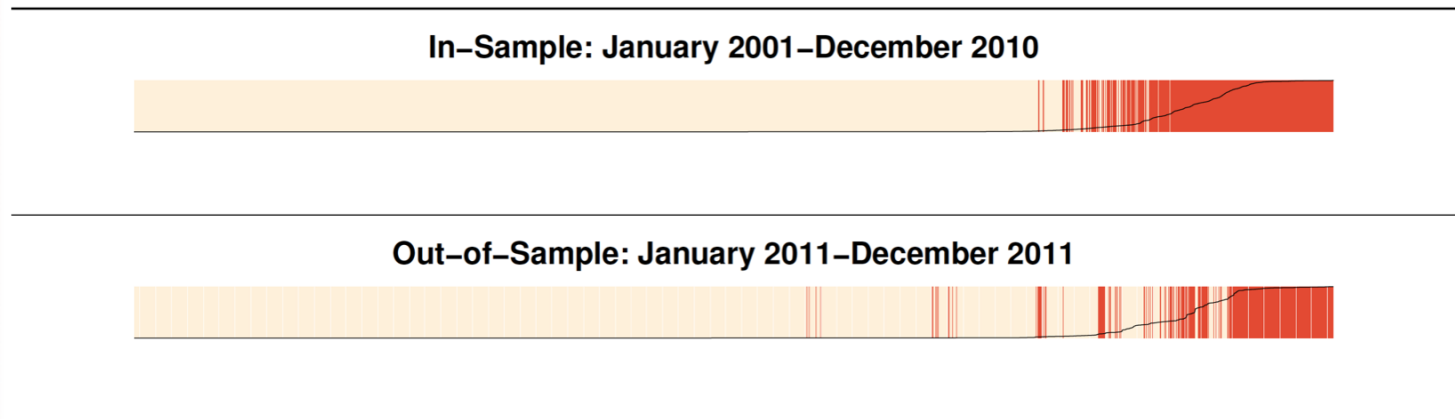
*p < 0.05, **p < 0.01, ***p < 0.001.

- Structural

Blending Time-Series and Structural Approaches

- Ward et. al (2013) monthly civil war onset, 1997-2011
- Structure, behavior, and country intercepts

FIGURE 1. Separation plots for CRISP Model Prediction of UCDP Data



Building Policy Relevant Structural Models

- Muchlinski et. al. (2016) on annual civil war onset 1945-2000
- Coefficients vs. random forests for rare events

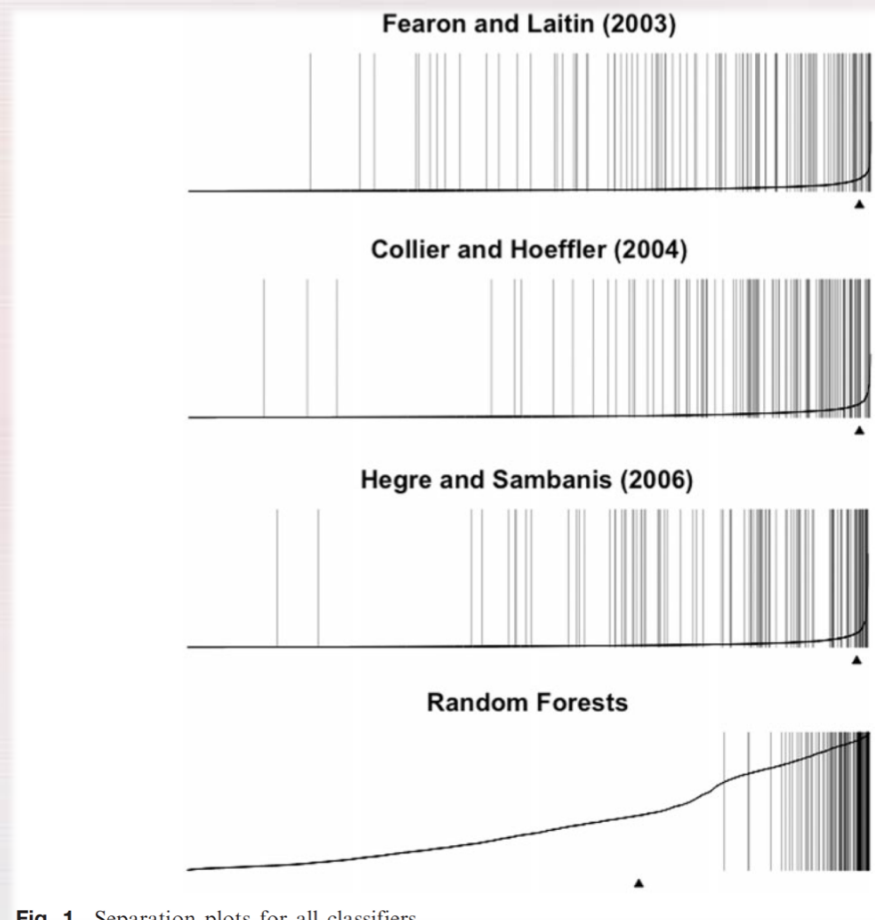


Fig. 1 Separation plots for all classifiers.

Policy Relevant Structural Forecasts

- Muchlinski et. al. (2016)
- Random forest solves rare events problem

Table 1 Predicted probability of civil war onset: Logistic Regression and Random Forests

<i>Models and predicted probability of civil war onset</i>				
<i>Civil war onset</i>	<i>Fearon and Laitin (2003)</i>	<i>Collier and Hoeffler (2004)</i>	<i>Hegre and Sambanis (2006)</i>	<i>Random Forests</i>
Afghanistan 2001	0.01	0.01	0.01	0.09
Angola 2001	0.04	0.01	0.01	0.13
Burundi 2001	0.00	0.00	0.00	0.05
Guinea 2001	0.00	0.00	0.01	0.22
Rwanda 2001	0.02	0.00	0.00	0.56
Uganda 2002	0.03	0.05	0.00	0.81
Liberia 2003	0.01	0.03	0.00	0.94
Iraq 2004	0.04	0.01	0.00	0.68
Uganda 2004	0.02	0.01	0.02	0.52

Identifying Policy Relevance of Theory

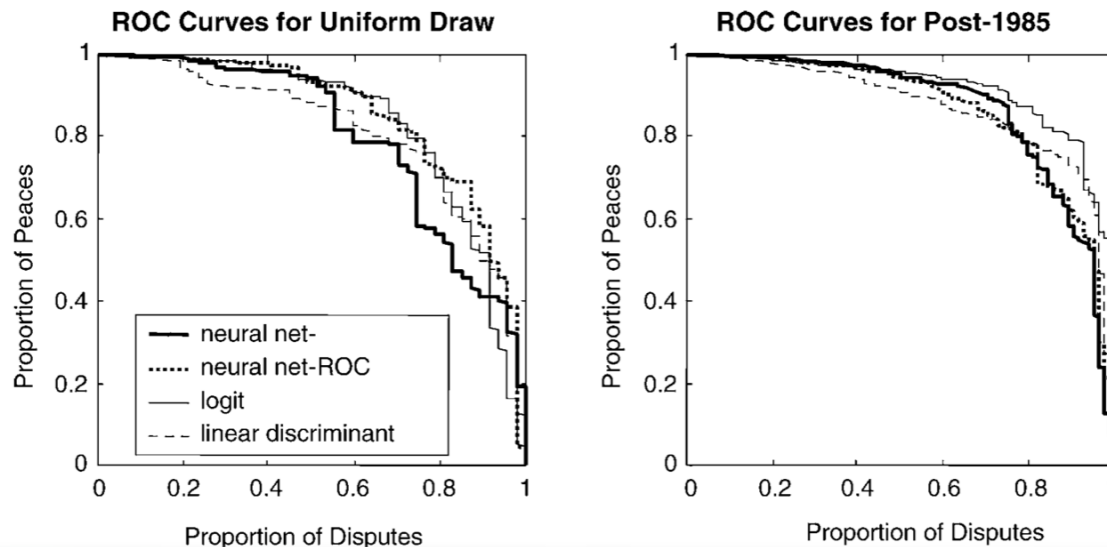
- Over-fitting & excessive complexity
- Over generalization of models
- Substantive significance
- Unrealistic marginal effects



Identifying Excessive Complexity

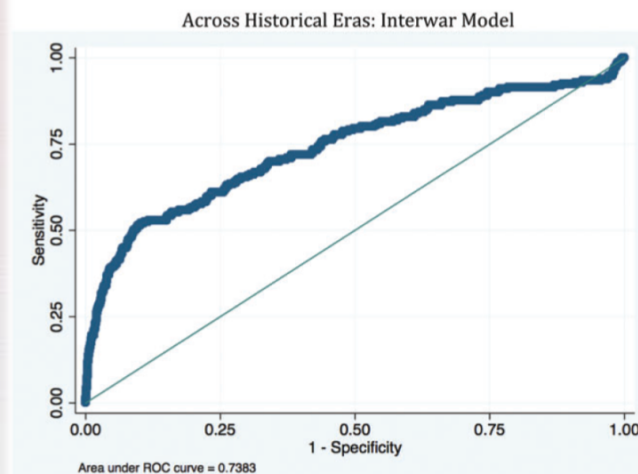
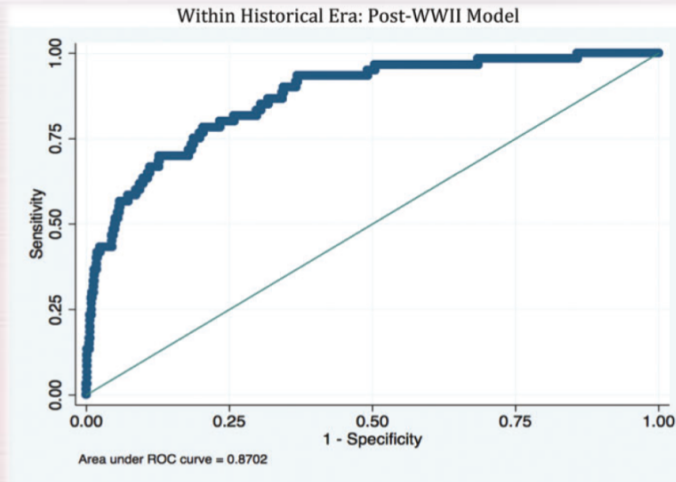
- deMarchi et. al. (2004) MID onset 1945-1989
- Simple logit vs. complex neural network
 - What about a random forest?

FIGURE 1. ROC Curves for Neural Network, Logit, and Linear Discriminant Estimators across Uniform Draw and Post-1985 Test Sets



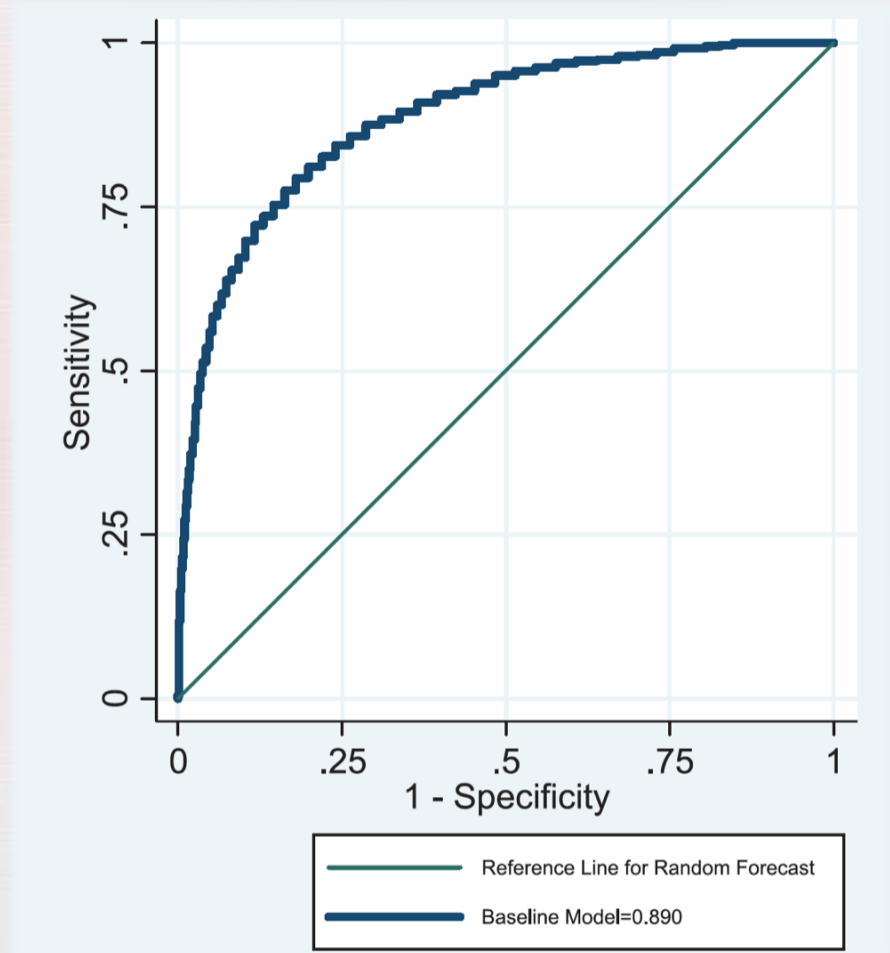
Over Generalization of Effects

- Jenke and Gelpi (2016) MID onset 1945-1992
- Forecasting models trained on 1945-1992 vs. 1914-1945
- AUC 0.87 vs. 0.74



Unrealistic Extrapolation of Effects: Democracy and Terrorism

- Gelpi and Avdan (2015) transnational terrorist attacks 1968-2007
- Baseline model out of sample AUC = 0.89



Democracy, Wealth & Terrorism

- Gelpi and Avdan (2015)
- With democracy AUC = 0.89, without = 0.886

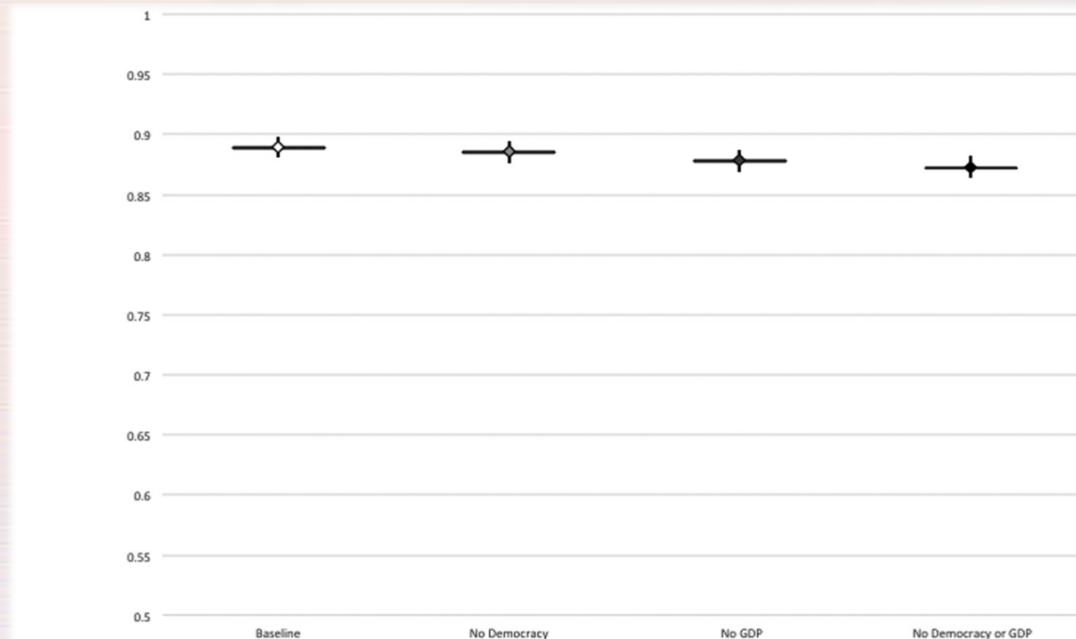


Figure 2. Estimated areas under the ROC curve for models deleting democracy and wealth.

Forecasting Integrates Theory and Policy

- Structural models make relevant predictions
- Forecasting disciplines policy relevance of theory
- Limitation: causal impact
- Complement with causal inference designs



References

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- Jenke, Libby and Christopher Gelpi. "Theme and Variations: Historical Contingencies in the Causal Model of Inter-State Conflict." *Journal of Conflict Resolution*. (2016) Online First 1/6/2016
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