Forecasting is Difficult, Especially about the Future: Theory and Methods in Forecasting Conflict

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Forecasting conflict: Aspirations and motivation

- Forecasting prominent aspiration in study of conflict, yet existing applications generally seen as disappointing
- Why is forecasting important:
- 1. Potential practical implication of predictions for preventive measures or contingency planning
- a. Costs of conflict since 1960 estimated at USD 10.4 trillion, global GDP in 2007 16.4% higher (Bozzoli et al. 2011)
- b. Responses to conflict and mitigation strategies often very slow and ad hoc, possible benefits of better contingency planning
- c. Recent research finds peacekeeping efforts generally effective in preventing recurrence (Collier, Chauvet & Hegre 2008)

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Forecasting conflict: Aspirations and motivation

- 2. Prediction for theory evaluation and development
- Conventional approaches in conflict studies test propositions on material used to develop them
- Risk of overfitting to idiosyncracies in observed samples
- Out-of-sample prediction/model validation may help improve theory evaluation and theory development
- To what extent can we claim to understand conflict if we cannot predict out of sample?
- Varieties of conflict forecasts and their problems

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A. Informal expert forecasts

- Informal “crystal ball” gazing by experts/pundits on future events
- Overconfidence, low precision, underlying theory often unclear (see Tetlock 2007)
- Foxes vs. hedgehogs
- Hedgehogs appeal to media, but often overly conservative or excessively confident about dramatic changes
  - “. . . the belief that the Soviet Union may disintegrate . . . contradicts all we know about revolution and national integration” (Hough 1991)
  - *Coming war with Japan* (Friedman and Lebard 1991)
- Invoking exogenous shocks: “I was wrong, but for the right reasons”

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B. Game theoretic approaches to individual events

- Combine game-theoretic solution concepts with expert information on relevant actors, preferences, and power from experts (e.g., Bueno de Mesquita 2010)
- Some evidence of predictive success and commercial applications (POLICON)
- However, short time horizon, applied to ongoing crises and negotiations (i.e., issues and actors known), less helpful for longer risk forecasts
- Case specific applications, less helpful for general theory building
- Actual predictions often classified, post-event publication bias?

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C. Aggregate forecasts

- Conflict time series, overall distributions, periodicity (Hegre et al. 2011; Cederman 2003; Miranda, Perondi & Gleditsch 2011)
- Some evidence of regularities and predictive success
- Focus on “coarse” aggregate predictions, less insight into where and how conflicts may break out, little guidance for action
- Applications often weakly related to theory

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D. Structural statistical models

- Statistical models of risk of conflict by dyad/country periods (e.g., years)
- e.g., CIA sponsored State Failure/Political Instability Task Force, 1955 - present, based on a series of covariates (economic, political, and social factors)
- SFTF intended to to generate forecasts of states at risk, but no actual out of sample forecast or validation
- All statistical models of interstate disputes (e.g., Oneal & Russett 2001) or intrastate conflicts (e.g., Fearon & Laitin 2003; Collier & Hoeffler 2004) imply predictions, given specific covariate values
- Proposed models have disappointing predictive ability out-of-sample (Ward, Greenhill & Bakke 2010; Ward, Siverson & Cao 2007)

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Improving methods

- Conventional models tend to rely on generalized linear regression models
- Some researchers have looked to alternative methods to improve forecasts, possibly more complex and non-linear relationships
- E.g., Beck, King, & Zeng (2000): neural networks applied to Oneal & Russett (1997) model of interstate disputes, some increase in predictive ability
- But alternative methods yield at best marginally better performance
- Methods per se may be wrong diagnosis, more helpful to focus on information on *why* states (or actors) may resort to violence

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Conventional models of interstate disputes

- Most work on forecasting Militarized Interstate Disputes (MIDs) follow work on liberal peace, especially Oneal & Russett (2001)
- $P(MIDA, B) \sim f$(distance A,B, power ratio, alliance, *min*(democracy), trade, IGOs, previous interactions)
- Note this is a model to investigate various factors believed to make conflict *less likely*, essentially black-boxes motives for conflict
- Model unlikely to provide good basis for forecasting MIDs
- Similar problems pertain to many other models focusing exclusively on opportunities for conflict rather than potential motives

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Contentious issues in interstate disputes

- Formal representations of conflict focus on incompatibilities in dyadic interactions
- Violence ensues if parties unable to agree on settlement
- Existing work focuses on features influencing ability to avoid conflict, based on insights from bargaining theory, but deemphasizes issues or incompatibilities
- Alternative tradition focuses on issues in conflict (Mansbach & Vasquez 1981; Diehl 1992)
- Possible to identify potential issues *ex ante*, helpful for forecasting interstate conflict?

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Contentious claims and conflict management

- Issue Correlates of War: data on territorial, river, and maritime claims, as well as settlement attempts for Western Hemisphere (Hensel, Mitchell)
- Compare conventional structural model of disputes with "conflict history" against model with claims and settlement attempts
- Estimation sample 1900 – 1989, predict to 1990 – 2001
- Despite limited data, encouraging results
- Potential "proof of concept" that can be generalized to other incompatibilities

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Table: In-sample estimates

Variable	Model 1		Model 2		Model 3	
	Coef.	SE	Coef.	SE	Coef.	SE
Intercept	-4.598	0.167	-1.477	0.735	-2.587	0.78
Previous MID	1.657	0.185	2.274	0.177	1.533	0.196
py	-0.168	0.025	-0.23	0.025	-0.187	0.026
py^2	0.004	0.001	0.006	0.001	0.005	0.001
py^3	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Territorial claim	1.247	0.193	—	—	1.122	0.195
River claim	0.823	0.309	—	—	0.658	0.322
Maritime claim	0.563	0.205	—	—	0.512	0.211
Settlement attempt	2.336	0.571	—	—	2.446	0.573
Terr. claim $\times$ set. att.	-0.971	0.550	—	—	-1.078	0.555
Mar. claim $\times$ set. att.	-0.492	0.374	—	—	-0.528	0.38
River claim $\times$ set. att.	-1.671	0.539	—	—	-1.546	0.546
Lower democracy score	—	—	0.007	0.014	-0.021	0.015
Balance ratio	—	—	-0.058	0.287	-0.298	0.316
ln(distance)	—	—	-0.312	0.086	-0.237	0.092
Observations	24,792		22,230		22,230	
LR-χ^2	799.00 (df=11)		682.1 (df=8)		803.7 (df=14)	

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Table: Actual by predicted disputes, in-sample

	Model 1		Model 2		Model 3	
	$\hat{p} < 0.25$	$\hat{p} > 0.25$	$\hat{p} < 0.25$	$\hat{p} > 0.25$	$\hat{p} < 0.25$	$\hat{p} > 0.25$
No dispute	21,922	81	21,974	29	21,912	91
Dispute	182	45	219	8	181	46

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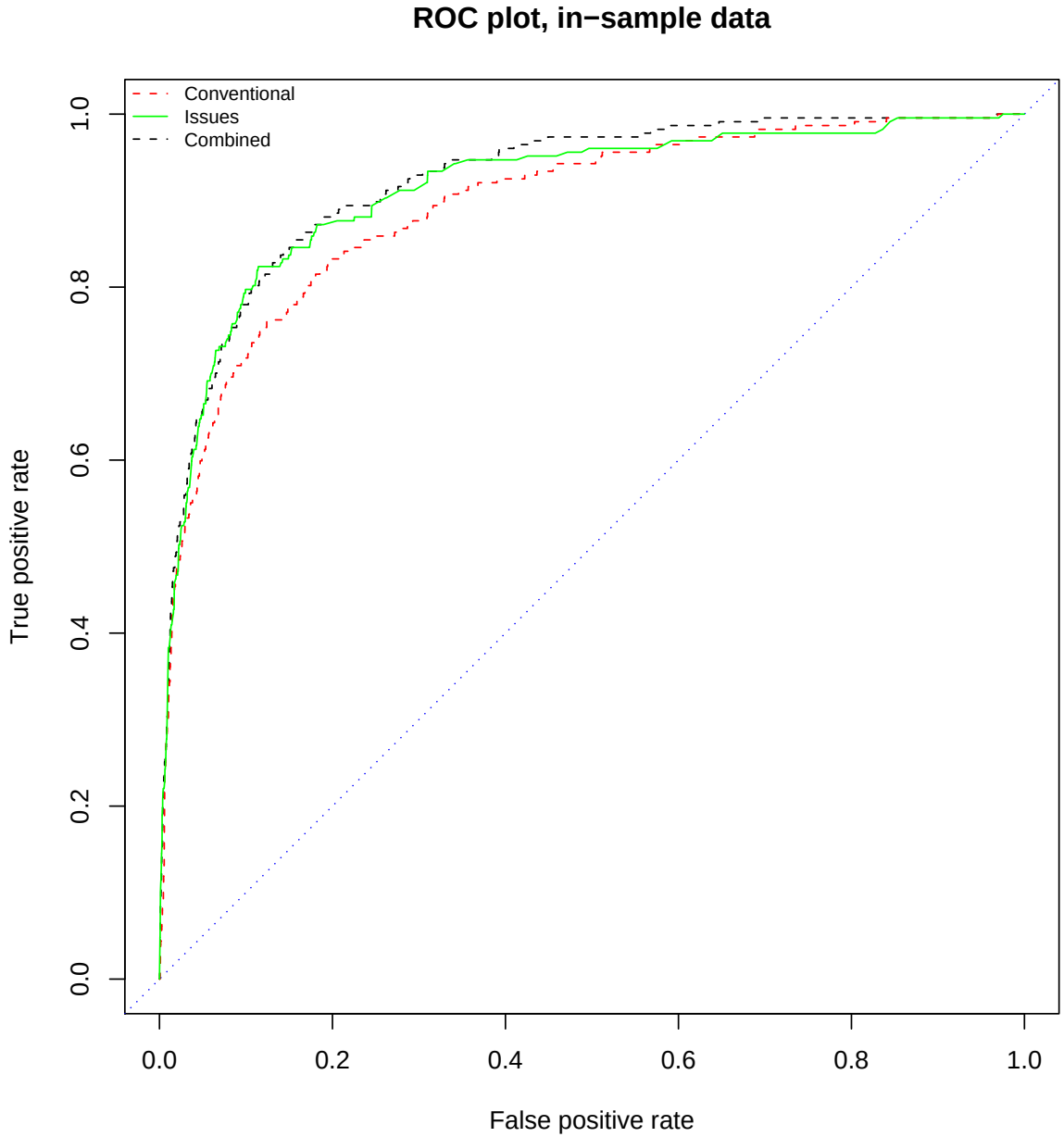

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Table: Actual by predicted disputes, out-of-sample

	Model 1		Model 2		Model 3	
	$\hat{p}^* < 0.5$	$\hat{p}^* > 0.5$	$\hat{p}^* < 0.5$	$\hat{p}^* > 0.5$	$\hat{p}^* < 0.5$	$\hat{p}^* > 0.5$
No dispute	573	3	379	11	383	4
Dispute	9	10	8	8	8	11

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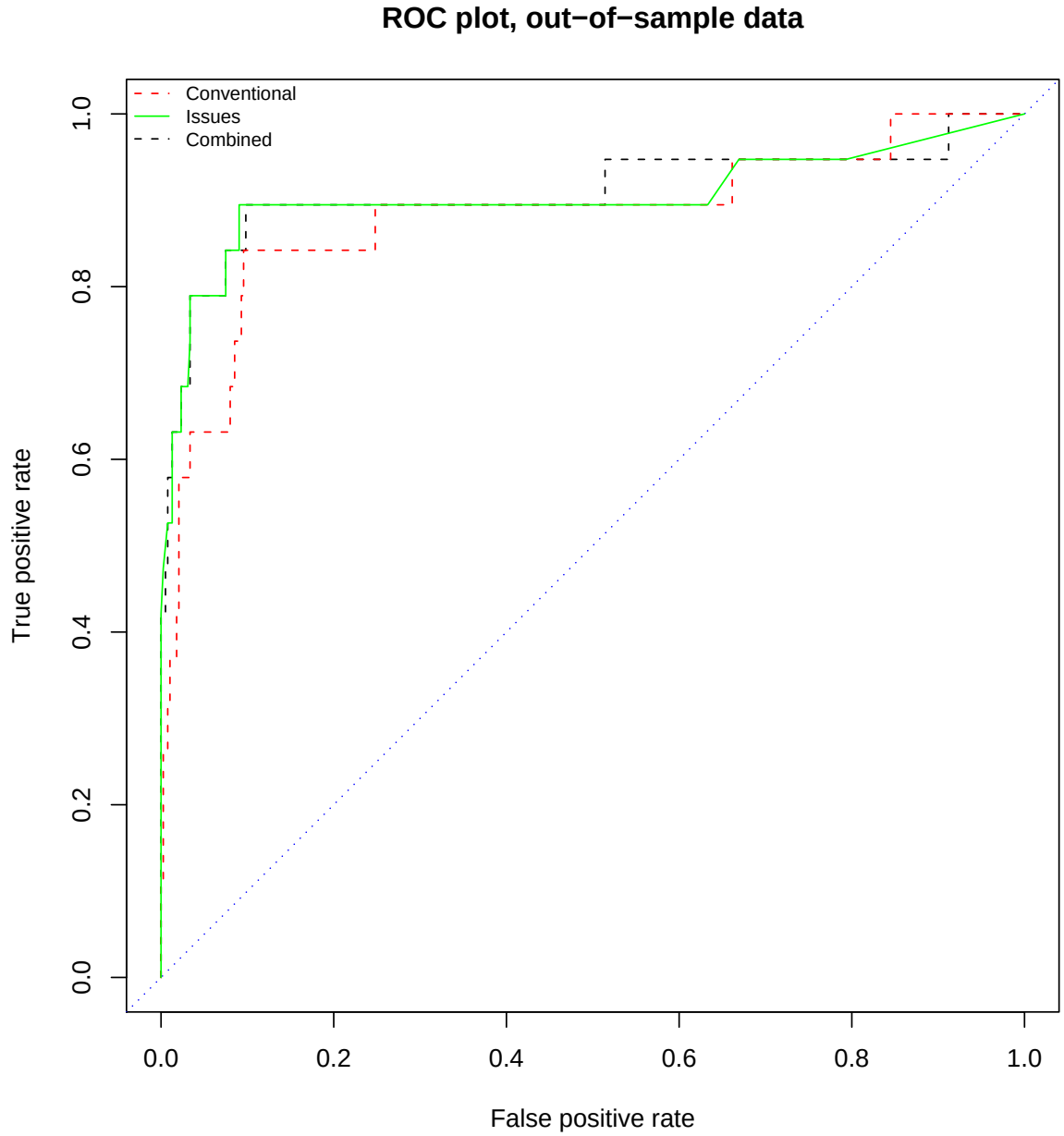

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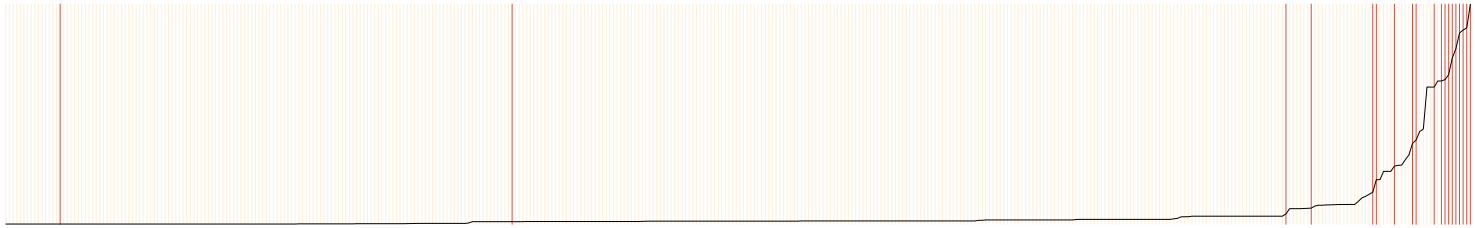
(a) Model 1: Contentious issues



(b) Model 2: Conventional structural model

(c) Model 3: Combined model

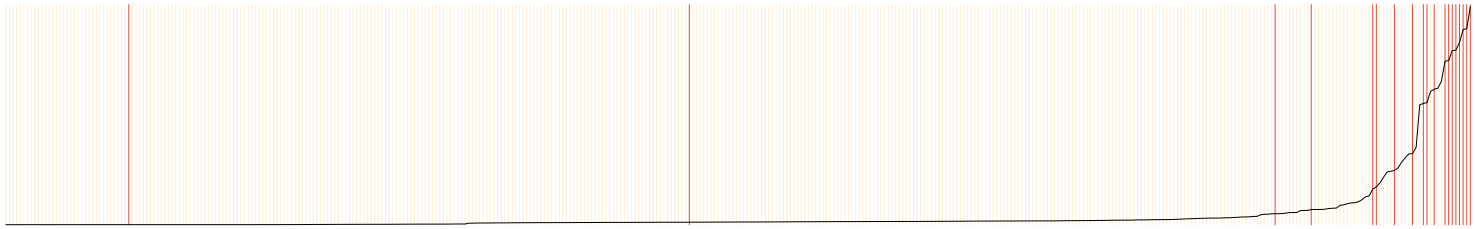


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Table: Actual versus predicted dispute dyads, out-of-sample

	$\hat{p}^* < 0.5$	$\hat{p}^* > 0.5$
No dispute	(573 dyads)	USA-Nicaragua USA-Panama Chile-Argentina
Dispute	USA-Haiti (4016) Haiti-Dominican Republic (4016) Belize-Guatemala (4014, 4015, 4150, 4151, 4152) El Salvador-Nicaragua (4153) USA-Venezuela (4261) Trinidad-Venezuela (4149, 4154, 4155) USA-Peru (3550) Haiti-Argentina (4016)	USA-Canada (3972, 4183) USA-Cuba (3950, 4196) Honduras-El Salvador (4010) Honduras-Nicaragua (3988, 4011, 4012, . . . 4327) Nicaragua-Costa Rica (4146, 4147) Nicaragua-Colombia (4145, 4263) Colombia-Venezuela (4009, 4172, 4219, 4262) Venezuela-Guyana (4260) Guyana-Suriname (4156, 4157) Ecuador-Peru (3987, 4013, 4143, 4144, 4189)

Numbers in parentheses indicate MID dispute numbers

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Forecasting interstate disputes: Summary and extensions

- Results suggest prospects for forecasting may be less dim than suggested by conventional wisdom
- Focus on incompatibilities/theories of motivations can help forecasting and improve theories and conflict
- E.g., sources of rivalries (territory vs. separatism) and effects of agreements (Schultz 2010)
- Possible to identify broader set of incompatibilities/proxies for incompatibilities, and better information on conflict management?
- Helpful to consider incompatibilities to identify risk set, look at interaction/events to update forecast
- Use better inputs with alternative methods

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Forecasting intrastate disputes

- Research on intrastate conflict many parallels to research on interstate disputes
- Predictive ability of existing models poor, focus on *opportunities* for conflict rather than *motivation* for conflict (Collier & Hoeffler 2004; Fearon & Laitin 2003)
- Possible to identify potential incompatibilities and motives *ex ante*?
- Recent research focusing on disaggregation suggest some possible indicators of incompatibilities or motivation
- Buhaug, Cederman & Gleditsch: political exclusion/downgraded, group inequality (horizontal inequality), direct comparison to conventional model (measures of vertical inequality: gini, elf)

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Civil war, country level

Table 1. Determinants of civil war onset, 1960–2005

	(1)	(2)	(3)		
	All civil wars	All civil wars	Eth. terr.	Eth. gov.	Non-eth.
ELF	1.148**	0.974*	1.713	1.623	0.394
	(0.424)	(0.428)	(0.977)	(0.892)	(0.521)
GINI	-0.005	-0.004	-0.039	-0.029	0.024*
	(0.010)	(0.010)	(0.025)	(0.025)	(0.011)
LDG		1.288**	-0.219	3.476**	0.666
		(0.346)	(0.830)	(0.626)	(0.588)
Downatall		0.860**	1.391**	0.944	0.422
		(0.255)	(0.418)	(0.526)	(0.448)
PHI		-0.045	-0.036	-0.810	0.045
		(0.175)	(0.252)	(0.857)	(0.246)
NHI		0.321**	0.497**	-0.082	0.201
		(0.119)	(0.161)	(0.388)	(0.215)
Power sharing		-0.029	-0.769	0.862*	0.062
		(0.221)	(0.484)	(0.438)	(0.314)
Democracy	0.176	0.350	1.374*	-0.091	-0.157
	(0.319)	(0.345)	(0.607)	(0.819)	(0.452)
Population	0.249**	0.234**	0.408**	0.067	0.167
	(0.069)	(0.079)	(0.123)	(0.184)	(0.101)
GDP capita	-0.382**	-0.432**	-0.773*	-0.405	-0.188
	(0.140)	(0.147)	(0.329)	(0.305)	(0.194)
Civil War lag	0.161	-0.026	0.193	-1.022	0.168
	(0.279)	(0.298)	(0.466)	(0.992)	(0.357)
Constant	-5.968**	-6.311**	-8.511**	-4.729*	-7.216**
	(0.782)	(0.850)	(1.729)	(2.043)	(1.095)
Pseudo R^2		0.08		0.11	
Observations	5,219	5,219		5,219	

Note: Binary (1 & 2) and multinomial (3) logit coefficients with standard errors clustered on countries in parentheses. DV outcome categories for Model 3 are i) ethnic territorial civil war; ii) ethnic governmental civil war; iii) non-ethnic civil war. LDG = largest discriminated group; PHI = positive horizontal inequality; NHI = negative horizontal inequality. ** p<0.01, * p<0.05

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Classification table

Table 2. Classification table for out-of-sample prediction, 2000–09

	VI model		HI model	
	Predicted no onset	Predicted onset	Predicted no onset	Predicted onset
Observed no onset	94	10	95	9
Observed onset	22	4	18	8

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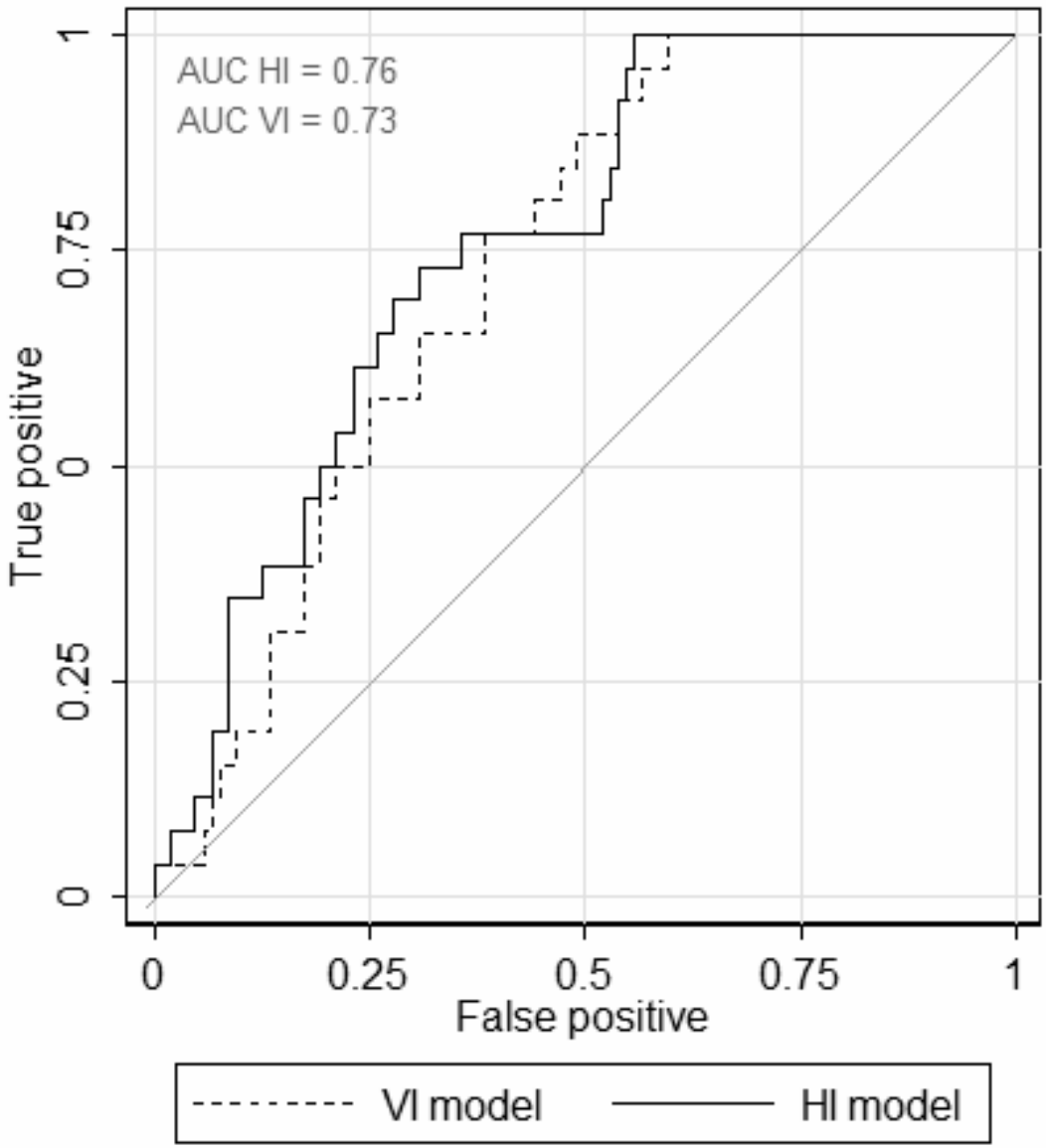
ROC for HI vs. VI, out-of-sample



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Forecasting conflict: Theory and methods

- Greater attention to motivation can help improve civil war forecasts and advance theories of conflict
- Expanding data sources on incompatibilities alternative methods with more
- Helpful to consider incompatibilities to identify risk set, look at interaction/events to update forecast
- Use better inputs with alternative methods

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