Does Polity Score Influence Size of War and Probability of Conflict Escalation?

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Some work, in two directions

I study interstate wars and conflict, and make attempts at seeing how these are influenced by the Polity IV score. For a given conflict, I use

$$\text{demo} = \tfrac{1}{2}\,\text{demo}_1 + \tfrac{1}{2}\,\text{demo}_2$$

as a covariate, in relevant statistical models.

STORY ONE (with Céline Cunen): via Correlates of War (CoW) dataset, we extract

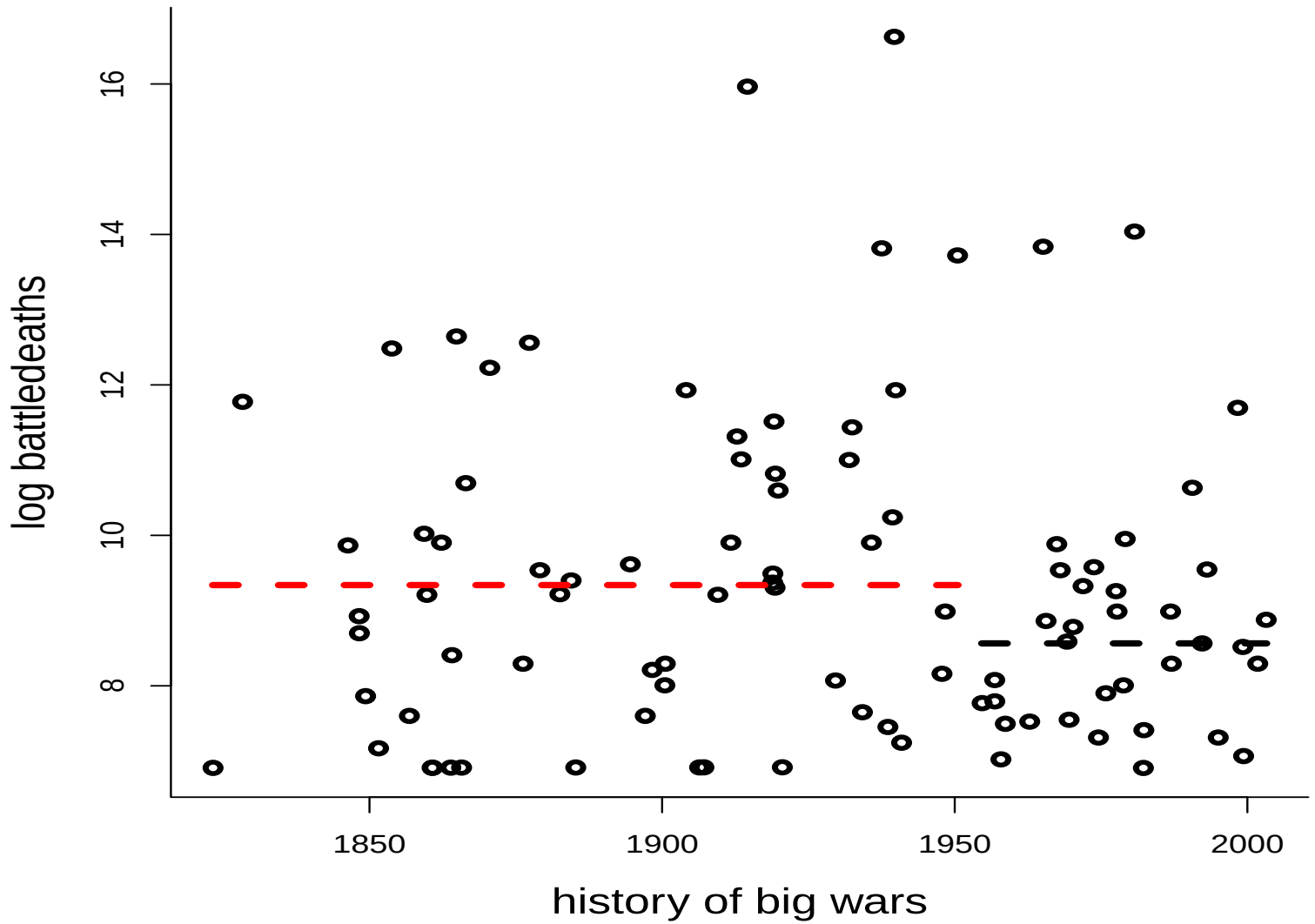
$$(\text{onset}, \text{size}, \text{demo}) = (x, z, w)$$

and examine how w_i influences $f(z_i \mid w_i)$.

STORY TWO (with Jens Kristoffer Haug): via Militarized Interstate Dispute (MID) dataset, we extract lots of pairs of level-of-conflict Markov time series, $y_1, y_2, \ldots \in \{0, 1, 2\}$. How do w_i and other covariates influence $\Pr(y_{t+1} = 2 \mid y_t = 1)$?

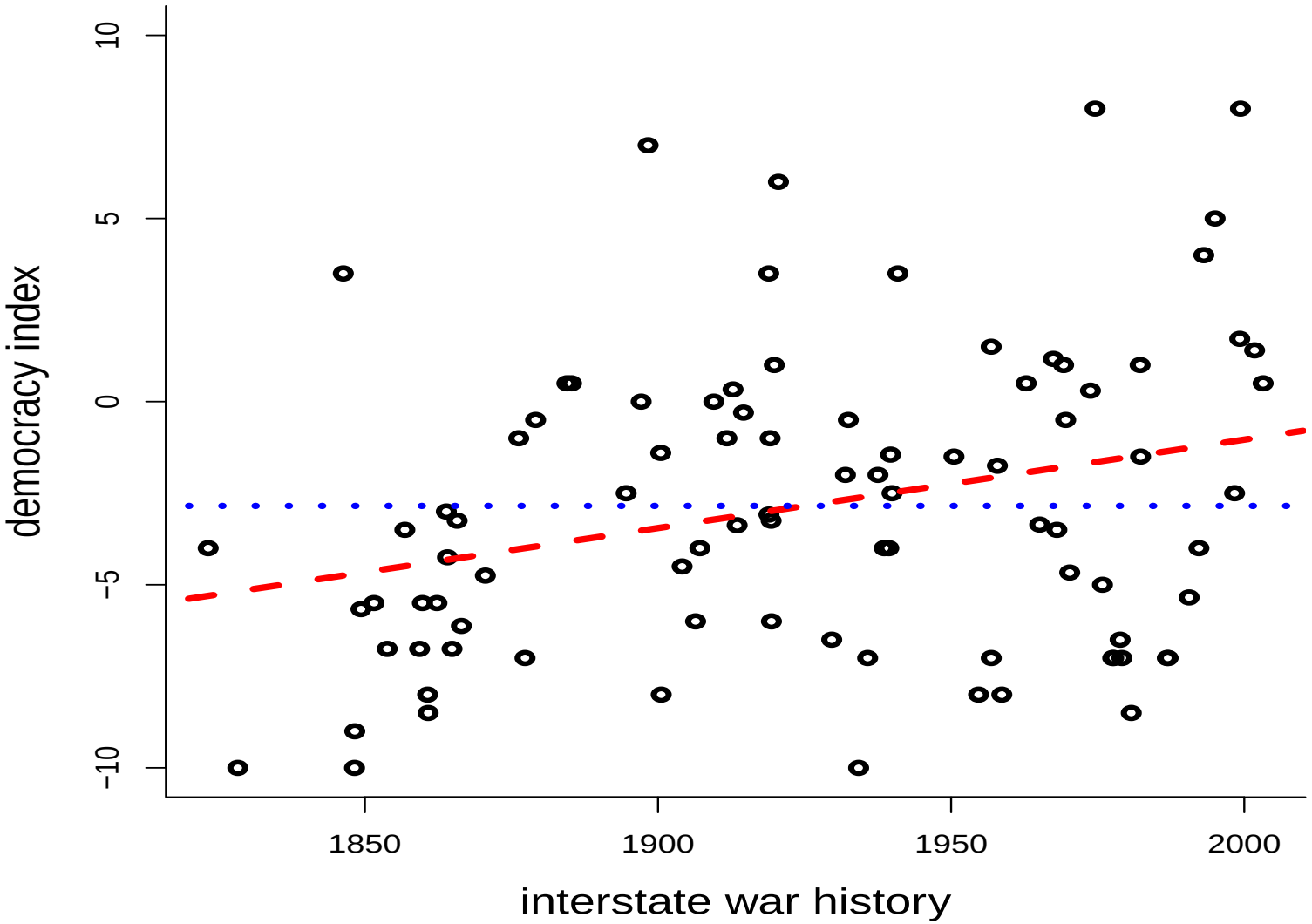
STORY ONE: Battle deaths, 1823 to 2003

Cunen, Hjort, Nygård (JPR 2020): the World of Wars is not quite stationary; various tests give $p \doteq 0.04$; median left-of-Korea (11,375) bigger than median right-of-Korea (5,240), etc.



Polity IV scores

We have such scores w_i for 90 of the 95 wars. The demo score is slowly climbing through time (but also for warring nations):



Modelling the sizes of wars (with changepoint and covariates)

Céline-Nils invented his three-parameter model, for the distribution of battledeaths above 1000:

$$F(z) = \Pr(Z \le z) = \left[\frac{\{(z-1000)/\mu\}^\theta}{1+\{(z-1000)/\mu\}^\theta}\right]^\alpha \quad \text{for } z \ge 1000.$$

There is power-law behaviour for z becoming large, $F(z) \doteq 1 - \alpha(\mu/z)^\theta$.

Initial Task: we look for a potential changepoint, τ, with $(\mu_L, \theta_L, \alpha_L)$ to the left of τ and $(\mu_R, \theta_R, \alpha_R)$ to the right of τ.

Result: Korea 1950 is the best changepoint candidate: 60 wars to the left have a stochastically larger distribution than the 35 to the right. In our JPR paper we have more, and a confidence curve, etc.

With Polity IV entering the model

With w_i the Polity IV (or any other relevant covariate), we let

$$F_i(z) = \Pr(Z_i \le z_i) = \left[\frac{\{(z_i - 1000)/\mu_i\}^{\theta_i}}{1 + \{(z_i - 1000)/\mu_i\}^{\theta_i}}\right]^{\alpha} \quad \text{for } z_i \ge 1000,$$

with

$$\mu_i = \begin{cases} \mu_{L,0} \exp(\beta_L w_i) & \text{if } i \le \tau, \\ \mu_{R,0} \exp(\beta_R w_i) & \text{if } i > \tau. \end{cases}$$

Also, θ_i is some θ_L for $i \le \tau$ and some θ_R for $i > \tau$. That is, we attempt to read off how Polity IV influences F via the basic level parameter μ_i. Results:

(i) Korea 1950 is again the best changepoint candidate;

(ii) β_L is slightly negative (ok);

(iii) β_R is significantly negative (good news).

Interpretation & checking via quantiles

For any quantile level q, like $q = 0.50$ for the median:

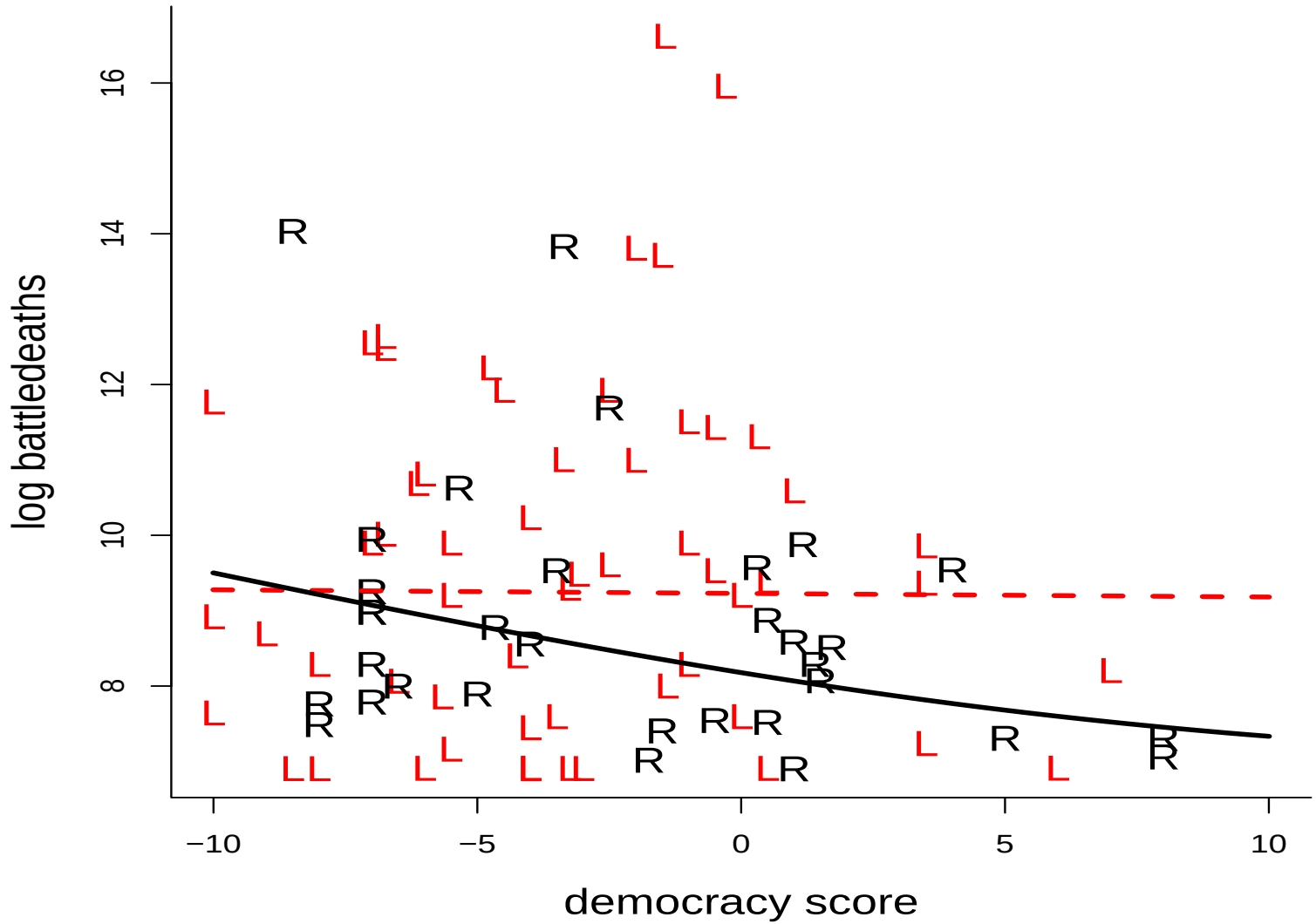
$$\phi(q) = F^{-1}(q) = 1000 + \mu\left(\frac{q^{1/\alpha}}{1 - q^{1/\alpha}}\right)^{1/\theta}.$$

So can study quantile as function of $w \in (-10, 10)$, Polity IV:

$$F^{-1}(q \mid w) = \begin{cases} 1000 + \mu_{0,L} \exp(\beta_L w)\left(\frac{q^{1/\alpha}}{1-q^{1/\alpha}}\right)^{1/\theta_L} & \text{before 1950} \\ 1000 + \mu_{0,R} \exp(\beta_R w)\left(\frac{q^{1/\alpha}}{1-q^{1/\alpha}}\right)^{1/\theta_R} & \text{after 1950.} \end{cases}$$

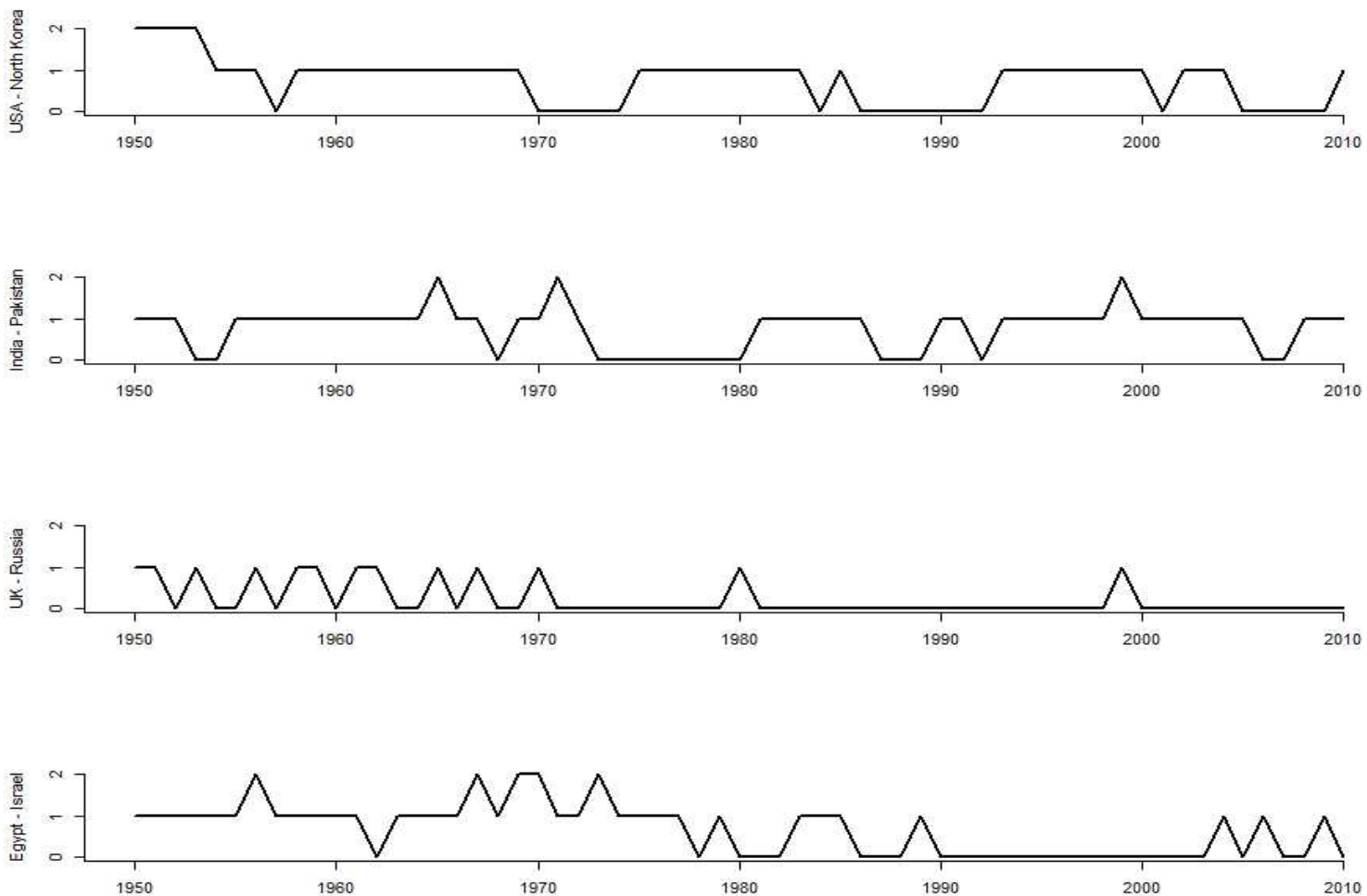
There is a slight quantile decrease before Korea 1950,
but a clear significant decrease after Korea 1950.

Lots of wars L before 1950, R after 1950, by log battledeaths.
After 1950: predicted medians go down with more democracy;
before 1950: not so much.



STORY TWO: Markov chains for levels of conflict 0, 1, 2

Consider two nations in conflict over time,
$Y_1, Y_2, Y_3, \ldots \in \{0, 1, 2\}$ with
0 = relative peace, 1 = conflict, 2 = very serious conflict.



We model such a series as Markov chains, with 3×3 transition probabilities for Y_t given what has happened up to $t-1$:

$$P(t) = \begin{pmatrix} \pi_{00}(t),\ \pi_{01}(t),\ \pi_{02}(t) \\ \pi_{10}(t),\ \pi_{11}(t),\ \pi_{12}(t) \\ \pi_{20}(t),\ \pi_{21}(t),\ \pi_{22}(t) \end{pmatrix}.$$

We use Dynamical Multinomial Regression Models for these, with covariates $x(t)$ at time t. For row 0:

$$\pi_{00}(t) = \frac{1}{1 + \exp(x(t)^{\mathrm{t}}\beta_{01}) + \exp(x(t)^{\mathrm{t}}\beta_{02})},$$

$$\pi_{01}(t) = \frac{\exp(x(t)^{\mathrm{t}}\beta_{01})}{1 + \exp(x(t)^{\mathrm{t}}\beta_{01}) + \exp(x(t)^{\mathrm{t}}\beta_{02})},$$

$$\pi_{02}(t) = \frac{\exp(x(t)^{\mathrm{t}}\beta_{02})}{1 + \exp(x(t)^{\mathrm{t}}\beta_{01}) + \exp(x(t)^{\mathrm{t}}\beta_{02})},$$

and similarly for rows 1, 2. Of brutal importance:

$$\begin{aligned} \pi_{12}(t) &= \Pr(Y_t = 2 \,|\, Y_{t-1} = 1) \\ &= \frac{\exp(x(t)^{\mathrm{t}}\beta_{12})}{1 + \exp(x(t)^{\mathrm{t}}\beta_{11}) + \exp(x(t)^{\mathrm{t}}\beta_{12})}. \end{aligned}$$

Lots o' work

(i) Need to extract conflict level time series $Y_1, Y_2, \ldots \in \{0, 1, 2\}$, for pairs of nations, from MID data.

(ii) Need relevant covariates $x(t) = (x_1(t), \ldots, x_p(t))$, with Polity IV one of these (demo-low, demo-high, their average).

(iii) Then fit the models; log-likelihood can be worked with, but not easy.

(iv) Then select among candidate models – JK Haug constructed a FIC (Focused Information Criterion) in his thesis.

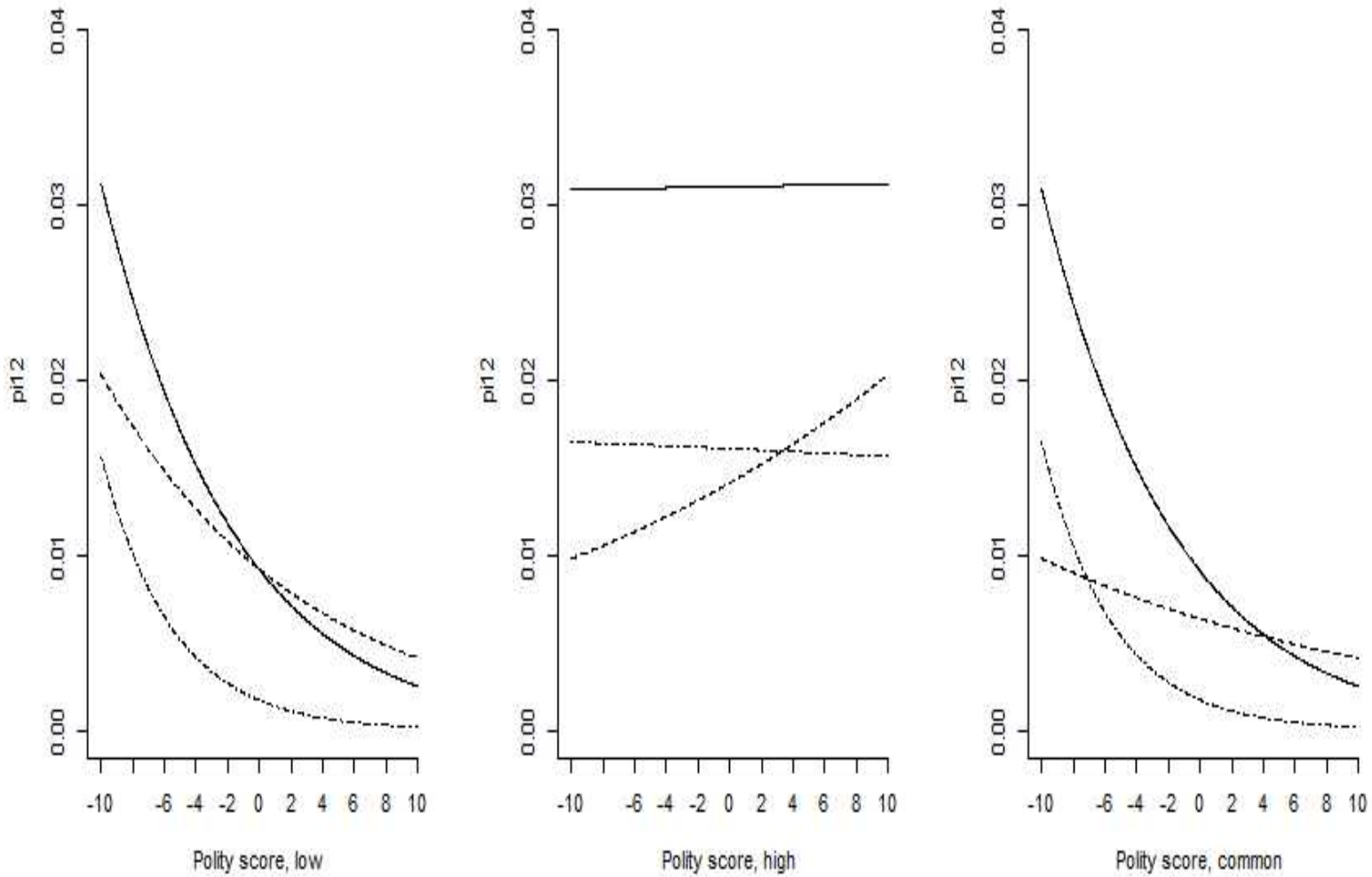
(v) For the best models, estimate, assess, test, degreee of confidence, interpret, predict.

(vi) In particular, examine influences of democracy, like Polity IV.

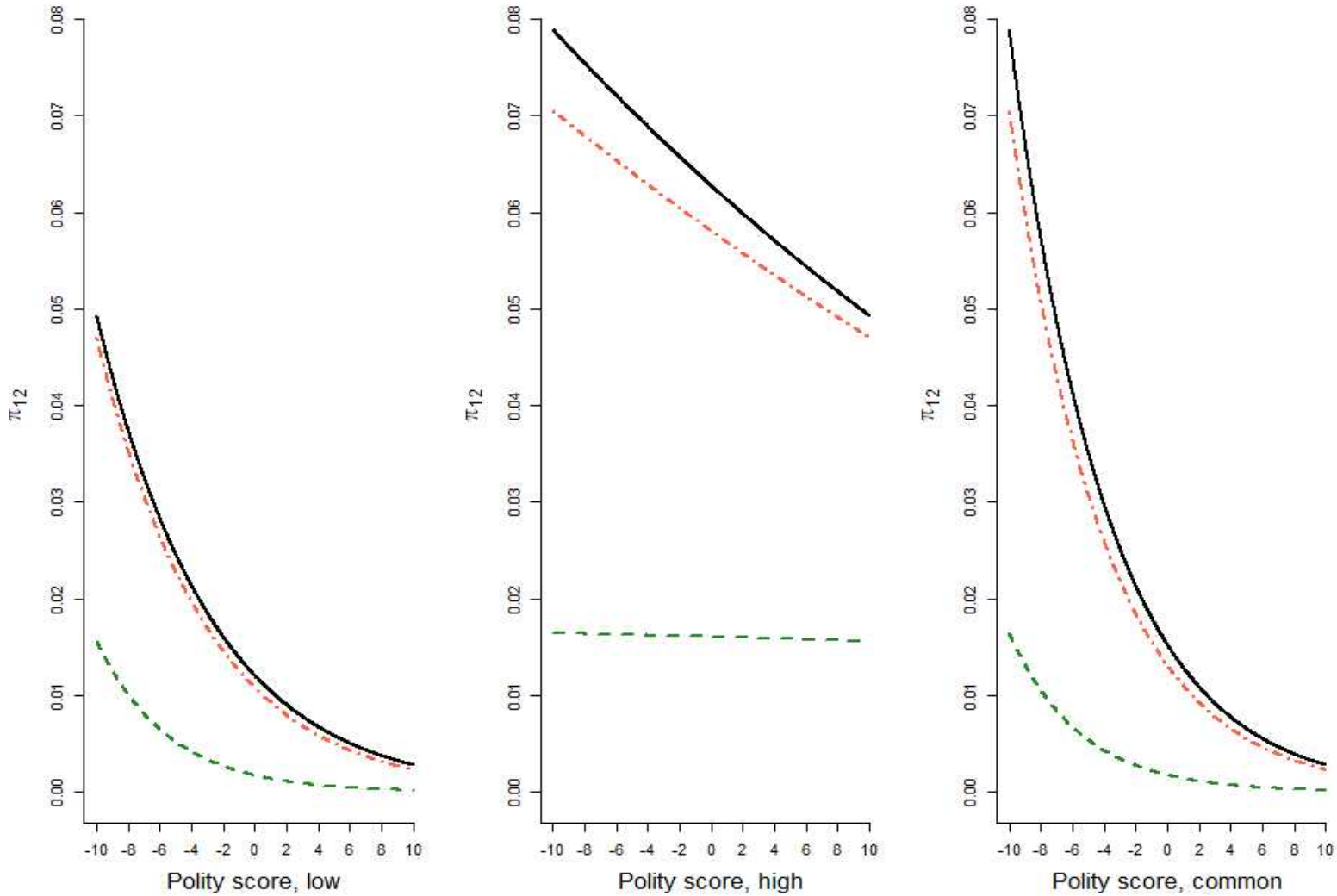
(Brageløfte: Haug + Hjort write a paper after the summer: modelling and selection methodology for regression Markov chains; applied to conflict chains with Polity IV.)

How does $\Pr(1 \to 2)$ vary with Polity IV?

Estimated $\pi_{12}(t \mid w)$, for Polity IV level $w \in (-10, 10)$, other covariates held fixed.



Again, but different basis scenario: Estimated $\pi_{12}(t \mid w)$, for Polity IV level $w \in (-10, 10)$, other covariates held fixed.



Remarks

- We're creating a versatile toolbox for analysing single, multiple, many chains of conflict over time. We may examine influences of particular covariates; we have confidence bands around pertinent curves; we may predict under given sets of circumstances.
- There are variations in the parametric modelling of $F(z) = \Pr(Z \leq z)$, with essentially similar results regarding influence of Polity IV: (i) changepoint (more or less) 1950; (ii) democracy not significant before 1950; (iii) democracy helps, in the sense of smaller wars, after 1950.
- The conflict chains $Y_1, Y_2, \ldots$ have lots of zeroes (luckily). Might construct different types of models to reflect this.

- Lots o' work with all the regression models for Markov chains.
- Should run the best models with different democracy indexes – different components tell different stories.
- Interaction between Markov chains: more modelling.
- Most crucial transition is $\pi_{12}(t) = \Pr(Y_t = 2 \mid Y_{t-1} = 1)$, but also descalation $2 \to 1$ is crucial – perhaps with different covariates being more important.

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