Integration of Formal Theory and Quantitative Methods

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Methods Workshop

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Links to Discussed Works

Click the titles below to link to electronic versions of these works.

Note: Links work as of 2/4/2017...

- Clarke and Primo (2007). "Modernizing Political Science: A Model Based Aproach"
- Clarke and Primo (2012). *A Model Discipline*
- Humphreys and Jacobs (2016). "Qualitative Inference from Causal Models"
- Eggers (2016). "Quality-Based Explanations of Incumbency Effects"
- López-Moctezuma (2016). "Sequential Deliberation in Collective Decision-making: The Case of the FOMC"

Motivation

Motivation

- "Fetishized" paper in political science (these days):
  1. Some formalized theory (often decision or game theoretic), perhaps relegated to appendix
  2. An empirical exercise identifying some type of ATE, ITT, LATE, or ATT, ideally related to the model
- But it is not clear that this research model is as natural of a fit as we may desire
  - What can we learn from the integration of formal models and quantitative methods?
  - Examine some more novel recent attempts to integrate the two.

A Hypothetical Example

- Lots of foundational work in distributive politics/political economy on who gets the pork
  - Swing/core debate
  - Competitiveness or bias is the fundamental thing that drives distribution in many foundational models
- Say I also want to consider incumbent partisanship in this setting
  - Hard to randomize "partisanship" so let's do an RD
  - Forcing variable: Margin of victory
  - Forcing variable implies conditioning on competitiveness

A Hypothetical Example, ctd.

- Effect of incumbent partisanship on some politically-motivated transfer in a pork-y place

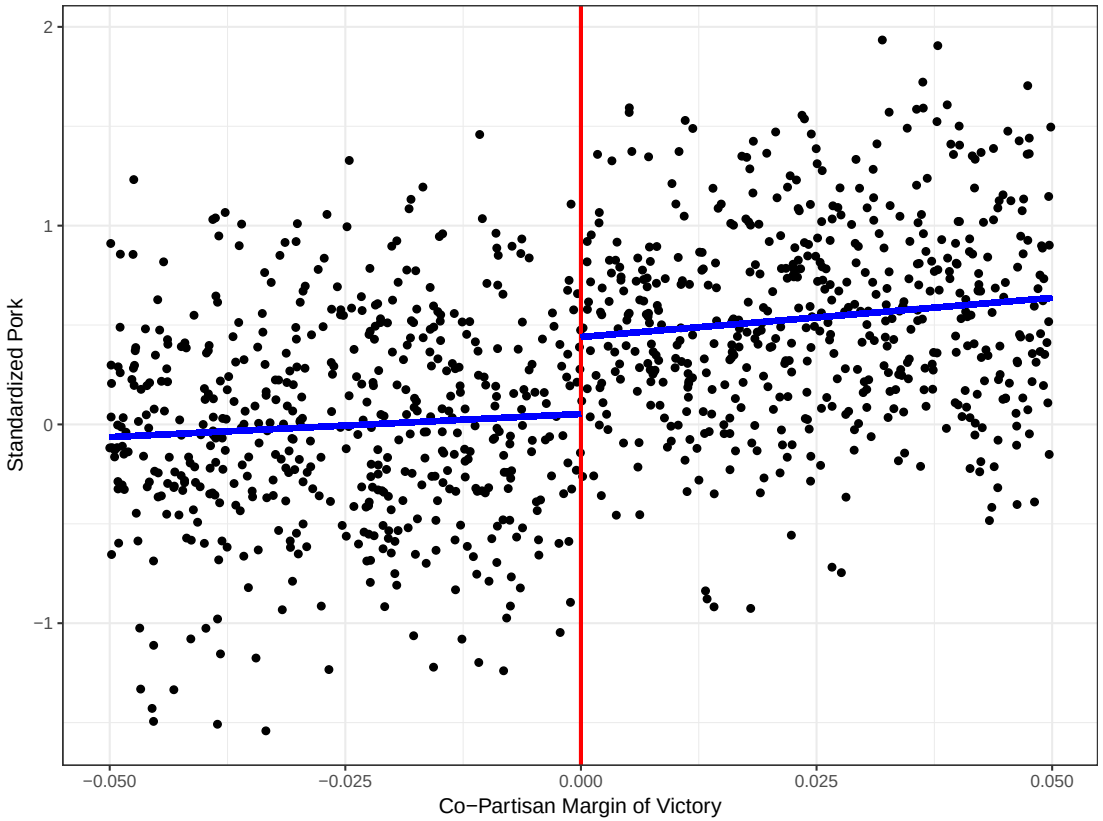
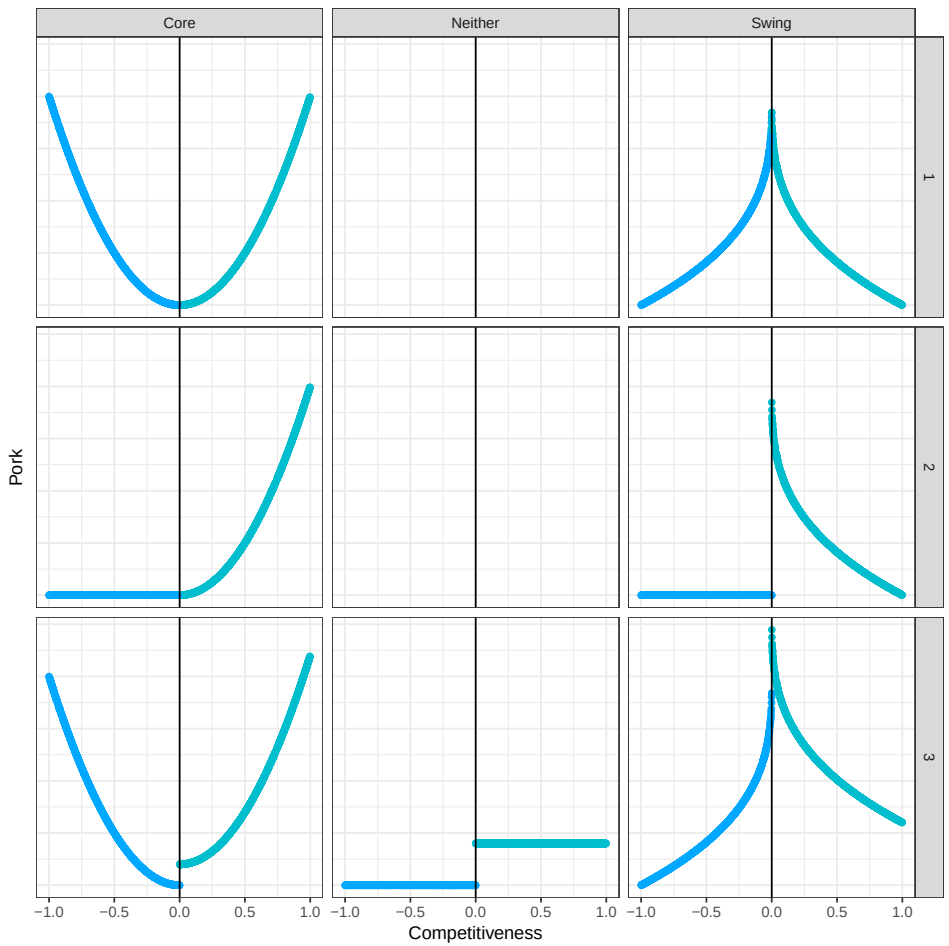


Figure 1

Hypothetical relationships–Identifiable by RDD?

- Given some (here hypothetical) theoretical relationship, can we actually generate an estimate of what we want to estimate via RDD?



A Critique

Hypothetico-Deductivism

- Dominant mode of research in our field
- Four steps described by Clarke and Primo (2012, 29):
  1. "Formulate some hypothesis or theory *H*"
  2. "Deduce some prediction or observable claim *P* [testable implication] from *H* with other statements, i.e. initial conditions... and *ceteris paribus* clauses"
  3. "Test P" (experimentally or observationally)
  4. "Judge whether *H* is confirmed or disconfirmed depending on the nature of *P* and whether *P* turned out to be true or false"
     - Note difference between 'true' and 'false' and conventional hypothesis tests.

But...

Table reproduced from Clarke and Primo (2007, 745):

	State 1	State 2
Assumptions	True	False
Predictions	True	True/False
Connections between model and truth of prediction:	Logical Necessity	None
Informativeness of data analysis for "truth"	Uninformative	Uninformative

Table 1

- View models as neither true or false; judge based on "usefulness"

Theoretical + Empirical Models

- Theoretical model (typically general)
- Empirical model $\Rightarrow$ not the theoretical model with an error term!
  - Some basis in theory
  - Features of the data
- As such we are employing two different models, not necessarily testing one
- Usefulness criteria is rather vague; typology of uses of theoretical/empirical models in the book version

DAGs and Formal Models

DAGs and Formal Models

- DAGs may be useful in mapping causal theories (formal models) into implied empirical models
- Humphreys and Jacobs (2016/in progress) provides first treatment that I have seen
- Some question about what should be mapped into a DAG:
  - Extensive form (+ solution concept)
  - Equilibrium conditions
- Simple model proposed by Humphreys and Jacobs/associated DAGs

Model

- Nature determines:
  - Freedom of the press: $X \in \{0, 1\}$
  - Whether government is sensitive $S \in \{0, 1\}$
- Government chooses to engage in corruption not
- Press reports or doesn't report on corruption
- Voters remove or don't remove the government from office
- Utilities realized

Mapping to DAG

Reflects SPNE solution concept

Lower DAG: Backwards induction in a game with 3 players with one move each

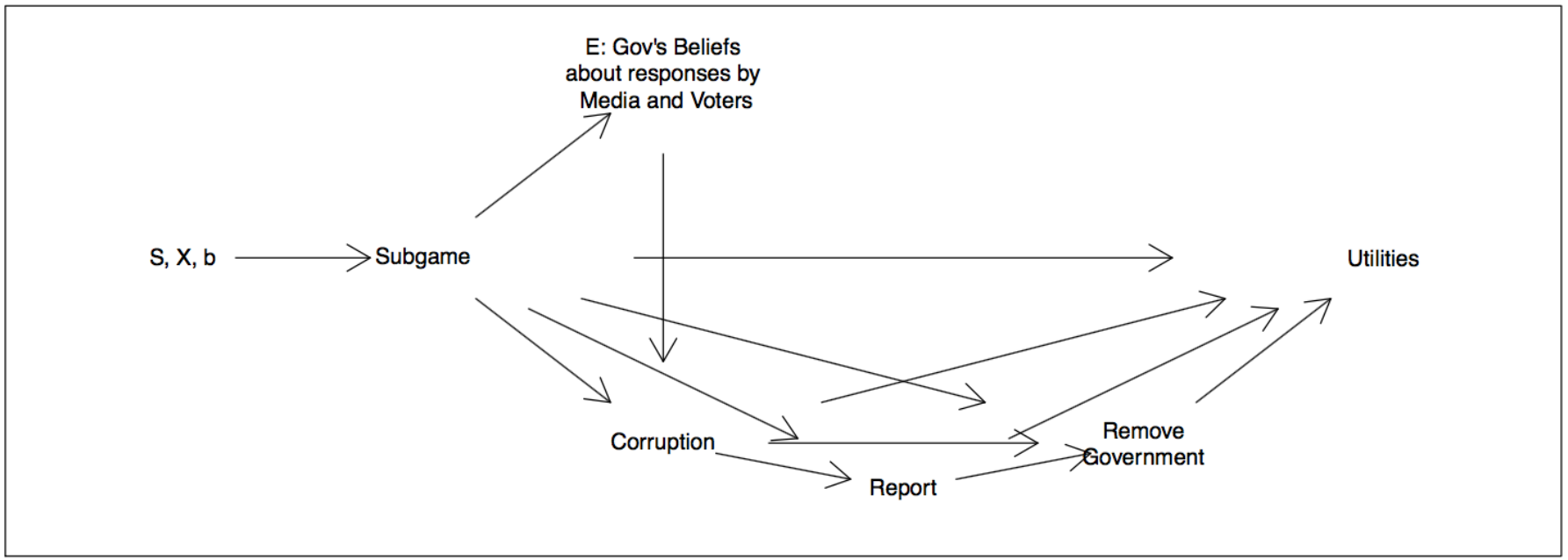


Figure 3

"Lower Level" Theory

In principle, DAG is not specific to the specific actors, actions, or utilities of the game:

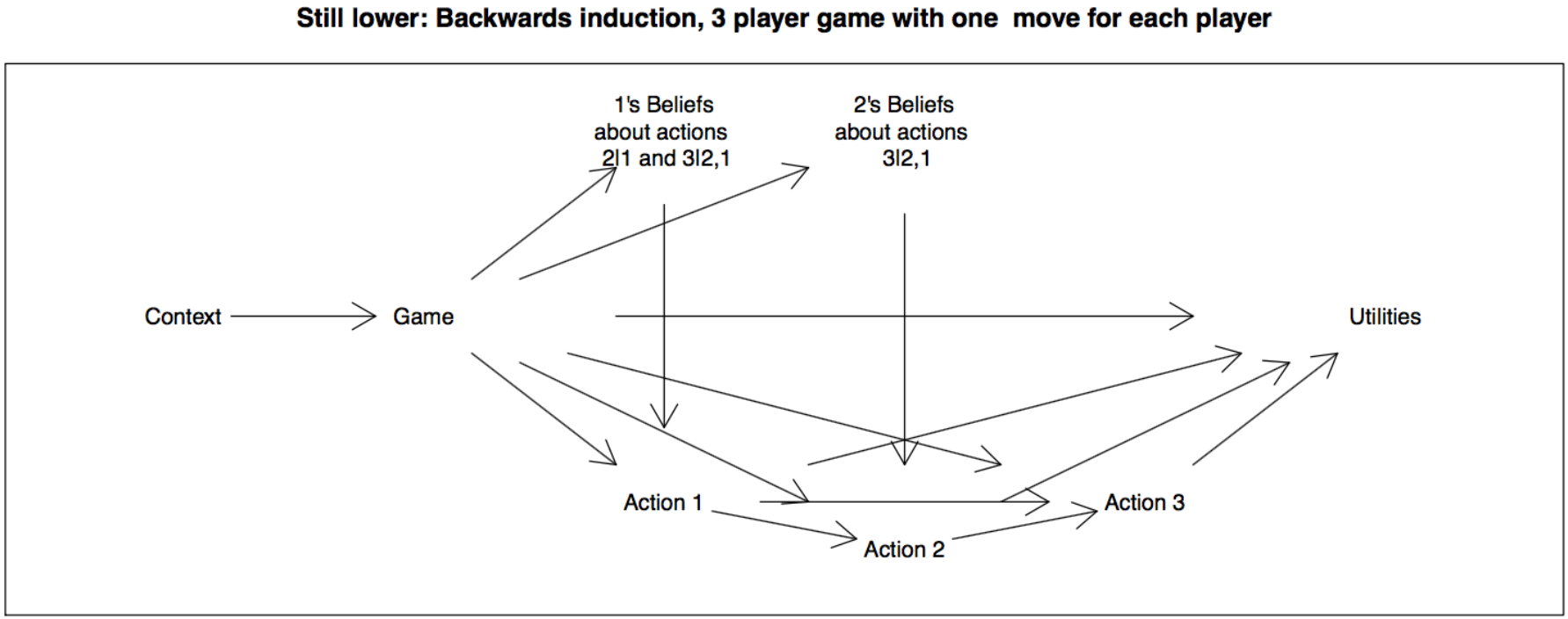


Figure 4

Implications

- Yes, you can map a model into a DAG
- Can we then use the DAG for identification analysis?
  - Perhaps–is adjustment criterion satisfied?
  - (Are the treatment, outcome, and all members of the adjustment set measurable?)
  - What do testable implications tell us about the DAG? About the formal model based on the DAG?

Application 1

Eggers (2016)

- Cottage industry of RDD papers on incumbency (dis)advantage
  - Conflicting results–advantage in some places, disadvantage in others–remains "puzzling"
- Argument about "selection into marginality"
  - All candidates in an RD bandwidth are marginal (by definition)
  - If marginal candidates are stronger (resp. weaker) than the pool, there will be quality-based incumbency advantage or disadvantage
- Contribution:
  - There is always selection into marginality on the basis of: (a) electoral selection; or (b) asymmetries in the distribution of candidate quality

Decision Theoretic Model

- Two parties, $p \in \{a, b\}$
- Voter i's utility for party p:

$$u_i(p) = \underbrace{\theta_p}_{\text{Quality}} + \underbrace{v_i(p)}_{\text{Party valuation}} + \gamma \underbrace{I_p}_{\text{Incumbent}}$$

- Voter votes for a if:

$$\theta_a - \theta_b + v_i(a) - v_i(b) + \gamma(I_a - I_b) > 0$$

- Assume $v_i(p) \sim U[-0.5, 0.5]$
- From best response, vote share for A in election t is:

$$V_t = \frac{1}{2} + \theta_{at} - \theta_{bt} + \gamma(I_{at} - I_{bt})$$

Mapping to the RDD

- Following Lee (2008), we can express the LATE, τ as:

$$\tau = \lim_{V_t \to 0.5^+} \mathbb{E}[V_{t+1}|V_t] - \lim_{V_t \Rightarrow .5^-} \mathbb{E}[V_{t+1}|V_t]$$

- Define p_w as the proportion of marginally-elected candidates that run

$$p_w \equiv \frac{1}{2}\Big(\lim_{V_t \to 0.5^+} \mathbb{E}[I_{a,t+1} - I_{b,t+1}|V_t] - \lim_{V_t \Rightarrow .5^-} \mathbb{E}[I_{a,t+1} - I_{b,t+1}|V_t]\Big)$$

- Combining the expressions from the past two slides (algebra suppressed):

$$\tau = 2(\bar{\theta}_I - \bar{\theta}_C + \gamma p_w)$$

Three Implied Mechanisms

(Schematic by Eggers, colored boxes by me)

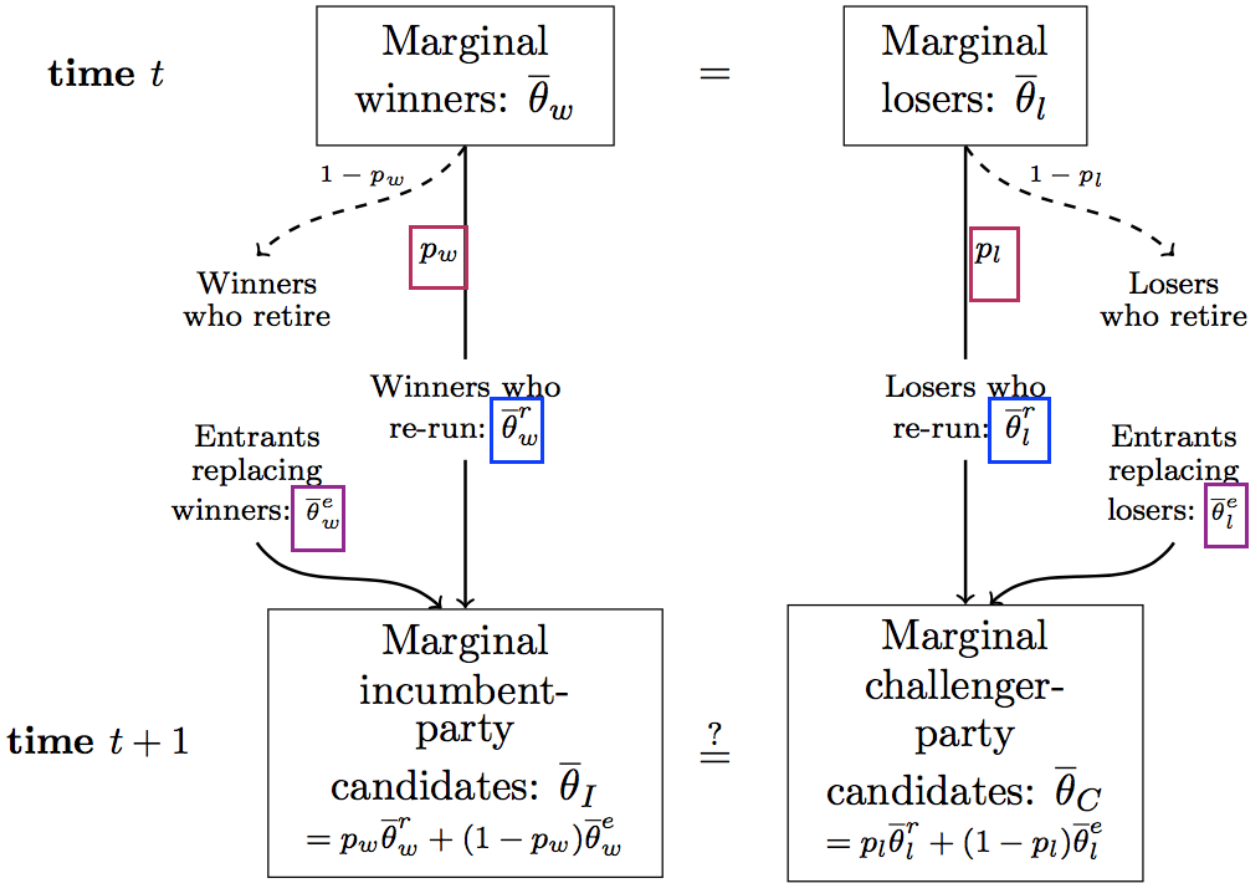


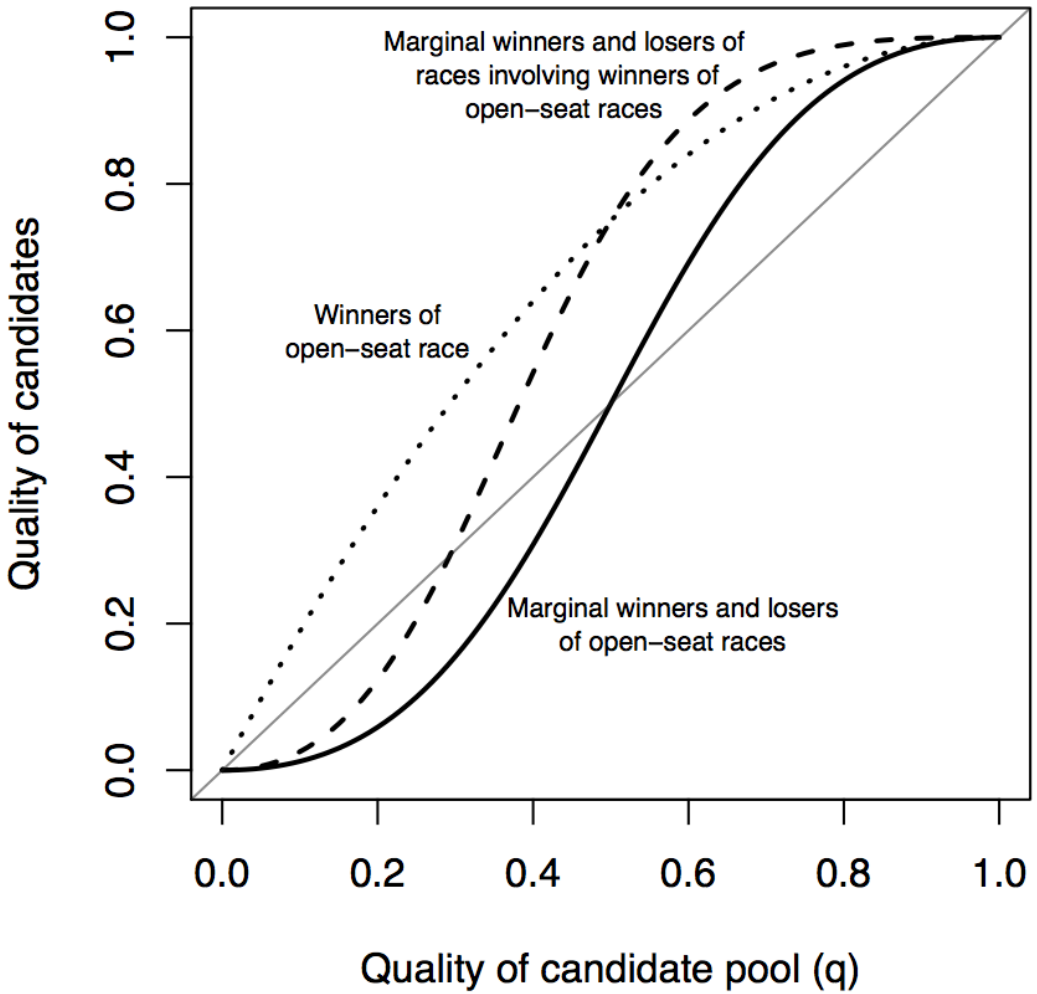
Figure 5

Results

- Focus only on differential rates of replacement by winning/losing status, p_w and p_l from last slide
  - Symmetry in the pdf of candidate quality, $g(\theta)$, in an open seat contest is sufficient for the assumption that marginal winners of open seat winners have the same average quality of the candidate pool.
  - If candidates are drawn from some non-degenerate $g(\theta)$, then there can be balance on quality following open-seat elections or following winners of open-seat elections, but not both.
    - Follows from a straightforward (but not obvious) application of Bayes' rule–see proof in manuscript
- Indicates quality differences persist even under the literature's favorite "scare-off" mechanism

Results-binary case

- $g(\theta) \sim$ Bernoulli(q), where q is Pr($\theta =$ "strong")



Discussion

- Provides a unifying theoretical approach to multiple existing studies
- Utilities are general across races (regardless of margin of victory)
- But, **theoretical results** are scoped to the RDD bandwidth
  - Is this satisfying?
  - Nice example of empirically-motivated deductive theory
  - Hard to distinguish between mechanisms empirically

Application 2

López-Moctezuma (2016)

- What is the effect of deliberation (the process) on collective decision making?
- Many models of deliberation, scant empirical evidence because it's hard to do!
- Specifies a theoretical model of deliberation
- Uses minutes from the Federal Open Market Committee (FOMC) at the Fed to compute a structural model
- Compares model fit from his theory to existing theories to justify this approach

Model

- Nature specifies inflation state $\omega_t \in \{0, 1\}$ (low or high); unobserved to committee members
- T monetary policy meetings, indexed $t = 1, ..., T$
- N committee members at each meeting offering policy recommendation $r_{it} \in \{0, 1\}$ to chairman
- Chairman proposes a policy directive (on interest rates), $d_t \in \{0, 1\}$
- Utilities to committee members:

$$u_i(d_t, \omega_t) = \begin{cases} 0 & \text{if } \omega_t = d_t \\ -\pi_i & \text{if } \omega_t = 1, d_t = 0 \\ -(1 - \pi_i) & \text{if } \omega_t = 0, d_t = 1 \end{cases}$$

Sequence

1. Inflation state ω_t released; Order of speech exogenously given to FOMC members
2. Member i forms belief:
   - Common prior: $\rho_t \equiv Pr[\omega_t = 1]$
   - Private signal: $s_{it}|\omega_t \sim \mathcal{N}(\omega_t, \sigma_i^2)$
   - History of recommendations: $x_{n(i)_t,t} = (r_{1,t}, ..., r_{n(i)_t-1,t}) \in \{0,1\}^{n(i)_t-1}$
3. Strategy for member i is mapping $\gamma(s_{it} = Pr(r_{it} = 1|s_{it})$; equilibrium strategies as cutpoints
4. Chairman observes private signal and s_{Ct} and full vector of reports $x_{Ct} = (r_{1t}, ...r_{Nt})$ and makes policy directive d_t

Equilibrium

- Equilibrium cutpoint, s_{it}^*, above which $r_{it} = 1$ and $r_{it} = 0$ otherwise
  - Relatively "ugly," but follows straightforwardly from normal pdf
- With cutoff pinned, s_{it}^* we can write the probability of $r_{it} = 1$ given the state ω_t
- With this probability, we can calculate "value" of deliberation for each member–which comes from the signals in preceding reports
- Construct likelihood of observing the full vector of recommendations at a meeting, t (includes Chairman's recommendation)

Structural Estimation

- Goals:
  - Simulate counterfactuals, i.e. what is the value of deliberation?
  - Comparison across theoretical models (vis a vis earlier models of FOMC behavior)
- Data from FOMC meeting minutes
- Using STAN–Bayesian approach seems novel
- Model is done sequentially at every meeting t on the basis of speaking order
- Think in terms of two loops:
  - Inner loop: computes equilibrium condition $\rightarrow$ likelihood
  - Outer loop: Given likelihood function, estimate posterior distribution of parameters

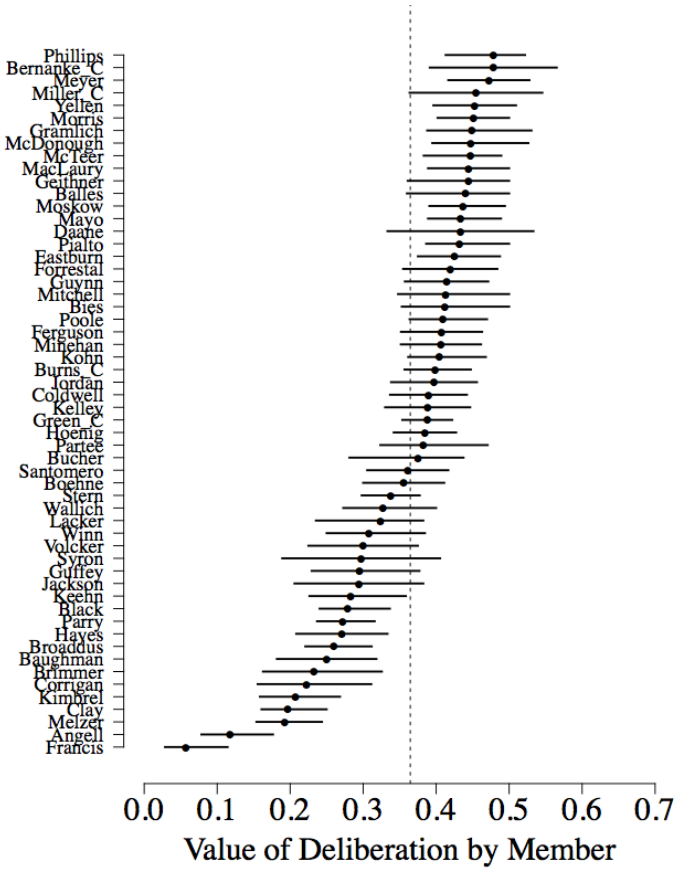
Value of Deliberation→ Clarification

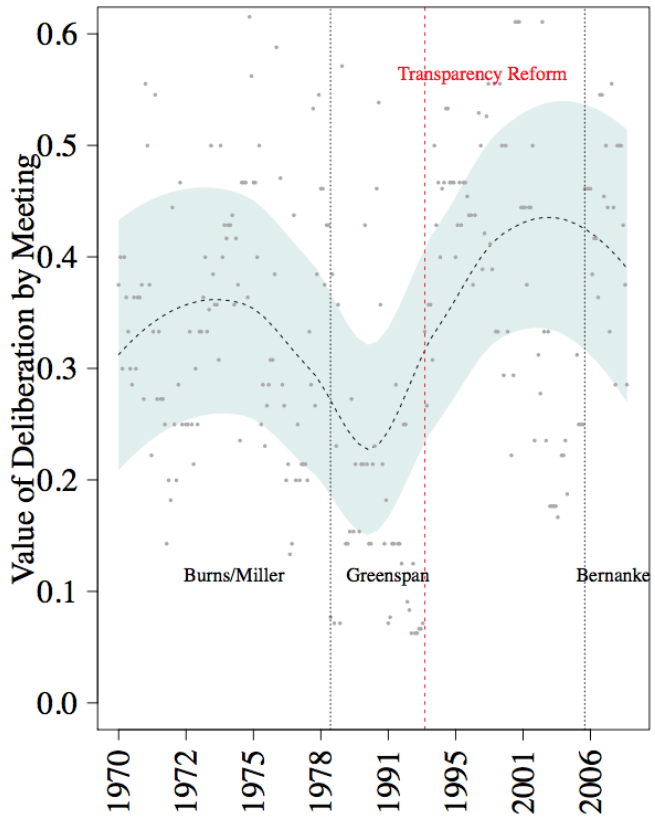
Main result is on value of deliberation, calculated:

- No deliberation condition:
  - Define equilibrium cutpoint s_{it}^{**} as a function of only bias (π_i), expertise (σ_i), and the prior ρ_t
- Deliberation condition:
  - Define equilibrium cutpoitn s_{it}^{*} as in model, incorporating above parameters as well as history of recommendations ($\mathbf{x}_{it}$) and pivotality consideration PIV_t^i
- Value of deliberation is the probability that decision w/ deliberation $\neq$ decision w/o deliberation
  - Odd quantity because the histories are of different lengths depending on enforced but not randomly assigned order

Results

- Simulated value of deliberation + posterior IQR





Value of Deliberation by Member

Value of Deliberation by Meeting

Figure 7

Results 2

- Correlates of value of deliberation; right panel is counterintuitive to me

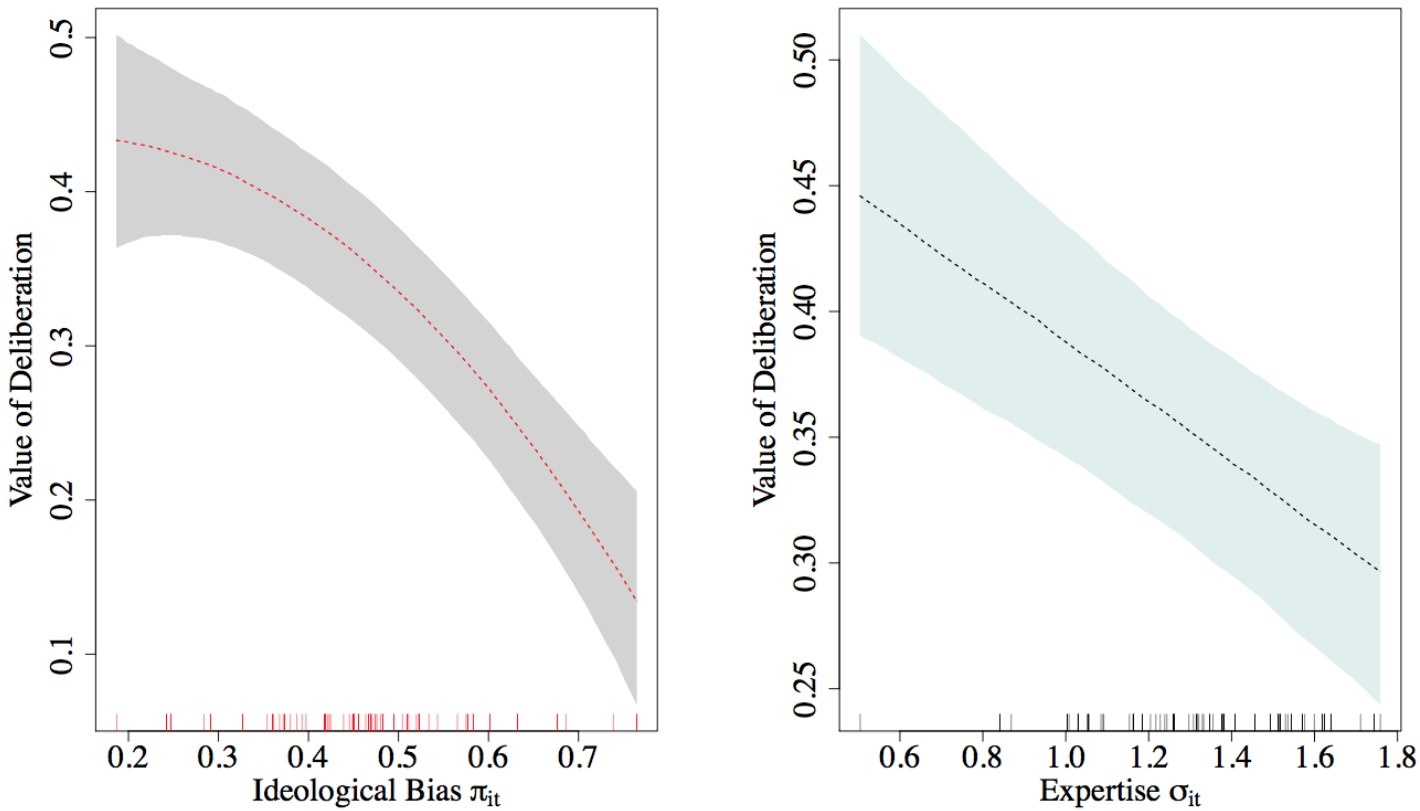


Figure 8

Discussion

- Innovative application of structural estimation
- Model is in some ways quite simple, scoped quite tightly to the data
    - What is the scope for such models in political science generally?
- To what extent is the model comparison helpful?
- Samii (2016) endorses pushing structural estimation further in political science
- Seems like STAN makes such models somewhat easier(?) than conventional methods of structural estimation