Do Expert Panelists Herd? Evidence from FDA Committees

Melissa Newham (joint work with Rune Midjord)

MOTIVATION

- **Expert committees** and advisory boards are commonly used to help with making difficult and important decisions
- A formal **vote** is often used to gauge the collective information held by the individual members
- How do **different voting procedures** affect vote outcomes? Which procedures best **aggregate information** from multiple experts?

THIS PAPER

- We consider **FDA Advisory Committees** which vote on yes/no questions related to new drug applications
- **Change in procedure** in 2007: sequential voting → simultaneous, due to concerns of "herding"
- If members engage in **herd behavior** (i.e. swayed by observing preceding votes) information contained in vote may be compromised

RESEARCH QUESTIONS

We develop and estimate a **structural model of voting behavior** to answer the following questions:

1. Do expert panelists in FDA Committees engage in herd behavior? If yes, what proportion of votes are herd votes?
2. Are some types of experts more likely to herd?
3. Which voting procedure, simultaneous or sequential, leads to better information aggregation?

CONTRIBUTION

- This paper contributes to the **empirical** literature on herd behavior
- Other empirical papers have studied herding in different settings e.g. restaurant dining (Cai et al., 2009), presidential primaries (Knight and Schiff, 2010), stock market trading (Cipriani and Guarino, 2014)
- We are the first to estimate **herd-voting in committees**
- Our empirical estimation strategy, making use of a **natural experiment**, is unique

DATA

- Data source: full set of meeting transcripts downloaded via www.fda.gov from 1996 to Aug. 2014
- **10,466 yes/no votes with full voting profiles** (813 questions)
- **Voter characteristics:** Regular or temporary member, consumer or patient representative, educational background, gender, conflict of interest waiver
- **Vote question characteristics:** FDA reviewer score, priority review, question type, drug or biologic, application type, and committee (e.g. Oncologic)
- Note: Recommendations from committee are non-binding

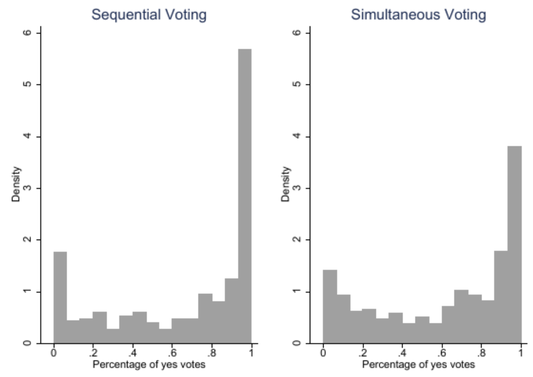


Figure 1: Agreement of Votes for FDA Advisory Committees

OVERVIEW OF THE MODEL

- Members vote on yes/no questions
- Voting procedure: $\xi \in \{simultaneous, sequential\}$
- For each question there is an **unobserved state** $\Theta \in \{0, 1\}$
- $Pr(\Theta = 1) \equiv \mu_0 \in (0, 1)$ is **common prior** belief that the correct answer is 1 or "yes"
- Each member *i* receives a **private signal** s_i which depends on Θ and **precision of information** τ (following Cipriani and Guarino, 2014):

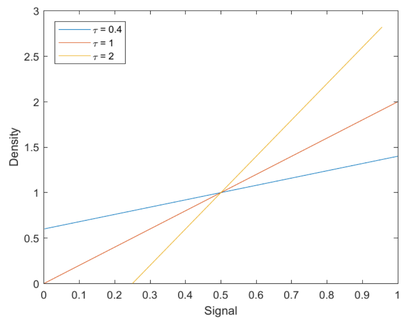


Figure 2: Probability Density Function of Private Signals $|\theta = 1$

- **Types**: Expressive (t=E) or herd type (t=H), types are private information
- Expressive type relies only on his/her own signal, herd type additionally uses **vote-history** h_i
- With probability λ a committee member is the herd type
- Two variants: 1) Herd types are fully **Bayesian**, 2) Herd types are **"naive"** (following Eyster and Rabin, 2010)
- Experts want their vote to match the true state and can be more or less **cautious**, $\pi \in (0, 1)$

$$Payoffs = \begin{cases} 0, & \text{if } v_i = \theta \\ -\pi, & \text{if } v_i = 1 \text{ and } \theta = 0 \\ -(1-\pi), & \text{if } v_i = 0 \text{ and } \theta = 1 \end{cases}$$

- The voting rule can be characterized as a **cut-off strategy** where $\bar{s}_i$ is the cut-off-signal s.t. $Pr(\Theta = 1 \mid \bar{s}_i) = \pi$
- Expressive types will vote yes if $s_i > \bar{s}_{i,t=E}(\mu_0, \tau, \pi)$
- Herd types will vote yes if $s_i > \bar{s}_{i,t=H}(\mu_0, \tau, \pi, \lambda, h_i)$

EMPIRICAL STRATEGY

- To estimate our model we specify the likelihood of the sequence of votes over the set of voting questions J

$$P(\{v^j\}_{j=1}^J | \Phi) = \prod_{j=1}^{J} P(v^j | \Phi)$$

where Φ is the vector of parameters $\{\mu, \tau, \lambda, \xi, \pi\}$.

- To incorporate heterogeneity we specify λ, π and τ as functions of observable voter characteristics
- The common prior depends on observable characteristics of the vote question via a logit formulation
- We maximize the likelihood function directly using the full set of votes

IDENTIFICATION: INTUITION

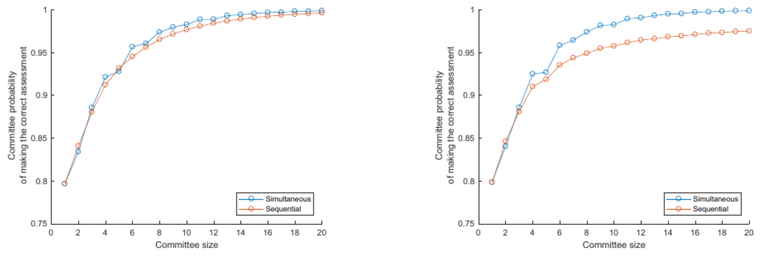
- We rely on the fact that we observe **members voting across multiple voting questions** with different priors
- To identify the proportion of herd types we make use of information on **the exact sequence of votes** under sequential voting
- Importantly, **access to simultaneous data** helps us to get a grip on the key parameters of the model when there are no herd effects at play

QUANTIFYING HERD VOTES

- A herd vote occurs when herd type actually **changes** their vote from what it would have been if they had ignored the vote history
- Using our model and estimated parameters we **simulate** voting, by comparing an individual's simulated vote under both regimes we can directly observe herd votes

INFORMATION AGGREGRATION

- **Our approach**: What is the probability that the committee makes the correct assessment about a drug under each voting procedure?
- The overall assessment is defined as being favorable when the updated belief about the state being "yes" after everyone has voted is greater than one half



(a) Bayesian updating (b) Naïve updating

Figure 3: Committee probability of making the correct assessment

RESULTS

HERD BEHAVIOR

- On average **around half** of committee members **take the vote history into consideration**
- Approx. **9%** of all sequential votes are actual **herd votes**

HETEROGENIETY IN HERD BEHAVIOR

- **Temporary committee members are more prone to herding** than regular members: the share of herd types (λ) among temporary members is 55 % vs. 38% for regular members in the Bayesian model
- Patient rep.'s are the least likely to be influenced by previous votes
- Educational background and gender have little effect

WHICH PROCEDURE IS BEST?

- On average, **simultaneous voting** improves information aggregation given our estimates
- Local herds can form in both the correct and incorrect direction under sequential voting
- Incorrect (albeit rare) local herds drive our result that simultaneous voting outperforms sequential voting
- **Informational inefficiencies** under sequential voting are **more prominent if belief updating is naive**
  - With naïve updating, herd types take the preceding votes at face value, thus belief updating may accelerate faster and it is also harder to overturn beliefs that get off on the wrong foot

OTHER FINDINGS

- **Heterogeneity in members' abilities** (τ): regular members have highest ability on average, consumer and patient rep.'s have less precise information
- On average committee members are slightly **cautious** (π = 0.58)
- Consumer rep.'s are particularly cautious, their standard of proof is 0.67, whereas for patient rep.'s it is 0.49
- Estimated common priors range from 0.44 to 0.84

POLICY IMPLICATION

- Follow the example of the FDA and substitute sequential voting with simultaneous (electronic) voting