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Balance of opinions in expert panels

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HIGHLIGHTS

- Develop a simple model of information disclosure to compare the relative performance between diverse expert panels and homogeneous panels.
- Identify a burden-of-proof effect, which favors homogeneous panels.
- Identify a balance-of-opinions effect, which favors diverse panels.
- Diverse panels are optimal if and only if experts are relatively well-informed.

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ABSTRACT

This note develops a simple model of information disclosure to compare the relative performance between diverse expert panels and homogeneous panels. We identify a burden-of-proof effect, which favors homogeneous panels, and a balance-of-opinions effect, which favors diverse panels. Diverse panels are optimal if and only if experts are relatively well-informed.

1. Introduction

Policy/decision makers often consult experts for advice. Common wisdom suggests that diverse expert panels (experts have conflicting biases) perform better than homogeneous panels (experts have similar biases). Indeed, in the real world expert panels are typically diverse. For instance, in a trial the plaintiff and the defendant have opposite interests; in the U.S. Congress, each special committee usually has similar numbers of Democrats and Republicans.[1]

However, in a model of information disclosure, Bhattacharya and Mukherjee (2013, BM hereafter) show that in typical situations homogeneous panels lead to better decision making than diverse panels. Bhattacharya et al. (2018, BGM hereafter) extend BM's analysis to more general settings, and they find that if the correlation between the probabilities that experts are informed is low then homogeneous panels are better, and otherwise diverse panels are better. These two papers share a common feature: an expert either reveals the true state or reveals nothing (partial disclosure is not possible).

This note develops a simple model of information disclosure to reevaluate diverse panels versus homogeneous panels, which differs from BM and BGM in two aspects. First, the same single piece of evidence may arise under multiple underlying states. Second, an expert could have multiple pieces of evidence and partial disclosure is possible.

Specifically, there are two pieces of hard evidence: the positive and the negative evidence; and there are three states: positive, negative, and neutral. In the positive (negative) state, only the positive (negative) evidence exists, while in the neutral state both pieces of evidence exist. Each expert has an independent probability α of being informed. Moreover, experts have extreme biases: an expert with a positive (negative) bias will only disclose the positive (negative) evidence. A diverse panel consists of two experts with opposite biases, while in a homogeneous panel two experts have the same, say positive, bias.

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[1] Ohio's housing committee, which consists of seven members, requires that the number of either Democrats or Republicans be higher than two and lower than five.

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In our model a *balance-of-opinions effect* naturally arises, which favors the diverse panel. In particular, with the homogeneous panel there are only two possible disclosure outcomes (the positive evidence is disclosed or not), which is not able to distinguish three underlying states. In contrast, with the diverse panel there are richer disclosure outcomes, which can potentially distinguish three underlying states. Another effect present in our model is a *burden-of-proof effect* (related to Shin, 1998), which favors the homogeneous panel.

Taken together, the diverse panel performs relatively better if and only if experts are well-informed (α is relatively large). Moreover, the cutoff α that determines which panel is optimal depends on the relative probability of the neutral state, which affects the magnitude of the balance-of-opinions effect (see Section 3 for details).

This note builds on the literature of information disclosure (Milgrom, 1981; Milgrom and Roberts, 1986; Shin, 1994). Shin (1998) compares two opposing experts to one impartial and equally informed judge, and finds that the former performs better. Another related paper is Dewatripont and Tirole (1999) on advocates. They find that it is better to employ two agents, each seeking for one piece of evidence, than to employ a single agent seeking for both pieces of (conflicting) evidence. Different from our setting, in their model agents have no intrinsic interests in the decision, and they need to exert effort to get informed.[2]

2. Model

There are three players: one decision maker (DM) and two experts. The DM takes an action $y \in R$. The underlying state is $\theta \in \{-1, 0, 1\}$, indicating negative, neutral, and positive, state, respectively. $\Pr[\theta = 0] = \pi$, and $\Pr[\theta = -1] = \Pr[\theta = 1] = (1-\pi)/2$, $\pi \in [0, 1)$. There are two pieces of hard and verifiable evidence: the positive evidence E_+ and the negative evidence E_-. When $\theta = 1$, only E_+ exists; when $\theta = -1$, only E_- exists; when $\theta = 0$, both E_+ and E_- exist.

The DM never directly observes the state or evidence. Each expert is either informed, which occurs with probability $\alpha \in (0, 1]$, or uninformed. The events that two experts are informed are independent. If informed, an expert observes the pieces of evidence that are associated with the realized state; otherwise he observes nothing. If informed, for each piece of evidence an expert can either reveal it or conceal it. Note that partial revealing is possible: in the neutral state where both E_+ and E_- exist, an expert can reveal one evidence but conceal the other.

The DM's utility function takes a quadratic loss form: $U_{DM} = -(y-\theta)^2$. Thus her optimal action is the posterior of θ. Experts' preferences are state independent and exhibit extreme biases. Specifically, for a positively (negatively) biased expert, denoted as X_+ (X_-), his incentive is to maximize (minimize) y. We consider two panels: a diverse panel in which two experts have opposite biases (one X_+ and one X_-), and a homogeneous panel in which both experts are positively biased (two X_+'s).[3]

As to the timing, first both experts independently learn the evidence associated with the underlying state, then they simultaneously disclose evidence to the DM, and finally the DM takes an action.

Since experts have extreme biases, their optimal disclosure strategies are sanitization strategies (Shin, 1994): an X_+ will always reveal E_+ but conceal E_-, and vice versa for an X_-. Intuitively, revealing the positive (negative) evidence increases (decreases) the DM's belief about θ. Let D be the set of possible disclosure outcomes, and d an element of D. Denote $\mu_+(d)$, $\mu_0(d)$, and $\mu_-(d)$ as the DM's posterior belief that $\theta = 1, 0, -1$, respectively, given d.

3. Diverse versus homogeneous panels

First consider the diverse panel. Since experts adopt sanitization strategies and have opposite biases, there are four possible disclosure outcomes: $D = \{E_+, E_-, E_+E_-, \Phi\}$, where E_+E_- denotes both pieces of evidence are disclosed and Φ denotes nothing is disclosed. By Bayes rule, the DM's posterior beliefs are

$$\begin{aligned}
\mu_+\{E_+\} &= \frac{1-\pi}{2\pi(1-\alpha)+(1-\pi)},\\
\mu_0\{E_+\} &= \frac{2\pi(1-\alpha)}{2\pi(1-\alpha)+(1-\pi)};\\
\mu_-\{E_-\} &= \frac{1-\pi}{2\pi(1-\alpha)+(1-\pi)},\\
\mu_0\{E_-\} &= \frac{2\pi(1-\alpha)}{2\pi(1-\alpha)+(1-\pi)};\\
\mu_0\{E_+E_-\} &= 1;\\
\mu_0\{\Phi\} &= \frac{\pi(1-\alpha)}{\pi(1-\alpha)+(1-\pi)},\\
\mu_+\{\Phi\} &= \mu_-\{\Phi\} = \frac{(1-\pi)/2}{\pi(1-\alpha)+(1-\pi)}.
\end{aligned}$$

Correspondingly, the DM's optimal action $y(d)$ is

$$y(E_+) = \frac{1-\pi}{2\pi(1-\alpha)+(1-\pi)},\quad y(E_-) = \frac{-(1-\pi)}{2\pi(1-\alpha)+(1-\pi)},$$
$$y(E_+E_-) = y(\Phi) = 0.$$

Denote the DM's ex ante expected loss under the diverse panel as L_D, which can be computed as

$$\begin{aligned}
L_D &= \pi\alpha(1-\alpha)[(y(E_+))^2 + (y(E_-))^2]\\
&\quad + \frac{1-\pi}{2}[\alpha(-1-y(E_-))^2 + (1-\alpha)(-1-y(\Phi))^2]\\
&\quad + \frac{1-\pi}{2}[\alpha(1-y(E_+))^2 + (1-\alpha)(1-y(\Phi))^2]\\
&= (1-\pi) - \frac{(1-\pi)^2\alpha}{2\pi(1-\alpha)+(1-\pi)}.
\end{aligned}\tag{1}$$

Next consider the homogeneous panel (of two X_+'s). In this case, as the negative evidence will never be revealed, there are only two possible disclosure outcomes: $D = \{E_+, \Phi\}$. By Bayes rule, the DM's posterior beliefs are

$$\begin{aligned}
&\mu_+(E_+) = \frac{1-\pi}{1+\pi},\quad \mu_0(E_+) = \frac{2\pi}{1+\pi};\\
&\mu_0\{\Phi\} = \frac{2\pi(1-\alpha)^2}{(1+\pi)(1-\alpha)^2+(1-\pi)},\\
&\mu_+\{\Phi\} = \frac{(1-\pi)(1-\alpha)^2}{(1+\pi)(1-\alpha)^2+(1-\pi)},\\
&\mu_-\{\Phi\} = \frac{1-\pi}{(1+\pi)(1-\alpha)^2+(1-\pi)}.
\end{aligned}$$

Correspondingly, the DM's optimal action $y(d)$ is

$$y(E_+) = \frac{1-\pi}{1+\pi},\quad y\{\Phi\} = \frac{(1-\pi)[(1-\alpha)^2-1]}{(1+\pi)(1-\alpha)^2+(1-\pi)}.$$

[2] Dziuda (2011) develops an information disclosure model in which the numbers of positive and negative arguments are random variables. But there is only one expert in his model. Kartik et al. (2017) endogenize experts' incentives to acquire information before they play a disclosure game.

[3] Since states −1 and 1 are symmetric, a homogeneous panel with two negatively biased experts leads to the same performance as the one with two positively biased experts.