Communication in Committees

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I Motivation

Despite some positive results, an important message from preceding results is that, in general, voting equilibria can fail to satisfy FIE, even when there is common knowledge of common values.

But people can talk:

with common knowledge of common values, immediate that all committee members credibly reveal their signals prior to any collective decision, thus insuring FIE.

What impact does pre-vote communication have on committee decision-making in general?

II(1) Deliberative Committees

A committee, $N = \{1, \ldots, n\}$, $n \geq 3$ (n odd), first deliberates and then votes.

Committee decisions over given agenda $X = \{A, B\}$ are made by a q-rule, $q \leq n$,

B chosen iff B receives at least q votes.

Individuals $i \in N$ are described by *bias types* $t_i \in T$ and *signals* $s_i \in S$

$$\mathbf{t} = (t_1, \ldots, t_n) \in \mathbf{T} = T^n; \; \mathbf{s} = (s_1, \ldots, s_n) \in \mathbf{S} = S^n$$

Call $\mathbf{s} \in \mathbf{S}$ a *state* and $\mathbf{S} = S^n$ the set of states

Let $p(\mathbf{t}, \mathbf{s})$ describe the common prior beliefs (with full support) over $\mathbf{T} \times \mathbf{S}$

Given $t_i \in T$ and $s_i \in S$, i's payoff from $x \in X$ is $u(x, t_i, (s_i, \mathbf{s}_{-i}))$.

Assume: $\forall t \in T$, $\exists \mathbf{S}_t \subsetneq \mathbf{S}$, $\mathbf{S}_t \neq \emptyset$, such that

$$\begin{aligned} \mathbf{s} &\in \mathbf{S}_t \Rightarrow u(B, t, \mathbf{s}) > u(A, t, \mathbf{s}) \\ \mathbf{s} &\in \mathbf{S} \backslash \mathbf{S}_t \Rightarrow u(A, t, \mathbf{s}) > u(B, t, \mathbf{s}). \end{aligned}$$

Suppose (largely for analytical convenience) that $\mathbf{T}$ and $\mathbf{S}$ are finite.

Example Recall the basic CJ model:

$X = \Omega = \{A, B\}$, $S = \{a, b\}$ and the probability of an "a"-signal is

$$P \equiv [\pi p + (1-\pi)(1-p)], \text{ where } \Pr[\omega = A] = \pi.$$

$T = (0, 1)$, all i; $\mathbf{t} = (t_1, \ldots, t_n)$ is common knowledge and

$$\begin{aligned} u_i(A, A) &= u_i(B, B) = 0; \\ u_i(A, B) &= -(1 - t_i);\; u_i(B, A) = -t_i \end{aligned}$$

Given $t_i \in T$, $u(B, t_i, \mathbf{s}) \equiv E[u_i(B, \omega)|\mathbf{s}]$.

Let $\mathbf{s}_k$ be any signal profile with k "b"-signals; then $\mathbf{S} = \{\mathbf{s}_k | k = 0, 1, \ldots, n\}$ and

$$p(\mathbf{t}, \mathbf{s}_k) \equiv p(\mathbf{s}_k) = \binom{n}{n-k} P^{n-k}(1-P)^k$$

Finally,

$$\Pr[\omega = B|\mathbf{s}_k] = \frac{(1-\pi)(1-p)^{n-k}p^k}{\Pr[\mathbf{s}_k|A \cup B]}$$

so, for all $t \in T$,

$$\begin{aligned} u(B, t, \mathbf{s}_k) &= -(1 - \Pr[\omega = B|\mathbf{s}_k])t; \\ u(A, t, \mathbf{s}_k) &= -\Pr[\omega = B|\mathbf{s}_k](1 - t). \end{aligned}$$

And therefore,

$$\begin{aligned} \mathbf{S}_t &= \{\mathbf{s}_k \in \mathbf{S}| \Pr[\omega = B|\mathbf{s}_k] > t\} \\ &= \{\mathbf{s}_k \in \mathbf{S}| k \geq k(t; \pi, p)\}. \ \square \end{aligned}$$

II(2) Communication and Decision

Before voting there is a *communication stage*:

Assume communication is simultaneous cheap talk among committee members

$\mu : T \times S \rightarrow M$ is a symmetric (pure) *message strategy*, where M is a set of messages

Wlog, assume $S \subset M$.

A *debate* is any realized profile of messages, $\mathbf{m} = (m_1, \ldots, m_n) \in M^n$.

$v : T \times S \times M^n \rightarrow \{0, 1\}$ is a symmetric (pure) *voting strategy*, where, for all $t \in T$, all $s \in S$ and all $\mathbf{m} \in M^n$, $v(t, s, \mathbf{m}) \equiv \Pr[i$ votes $B|\cdot]$.

Focus (mostly) on perfect Bayesian equilibria in weakly undominated strategies.

Suppose $(\boldsymbol{\mu}, \mathbf{v})$ is an equilibrium pair of strategy *n*-tuples; then

(1) $\mathbf{v}$ must satisfy the *vote-pivotal* constraints: for all i, $v(t_i, s_i, \mathbf{m})$ is a best response conditional on i's vote being pivotal;

(2) $\boldsymbol{\mu}$ must satisfy the *message-pivotal* constraints: for all i, $\mu(t_i, s_i)$ is a best response conditional on i's message being pivotal with respect to the final committee outcome, given $\mathbf{v}$.

Unfortunately, there is in general no nice relationship between vote-pivotal and message-pivotal constraints

For example, in a 3-person/3-signal version of the CJ model with majority rule, Austen-Smith & Feddersen (2005) find 8 distinct pure strategy equilibria that differ *only* with respect to voting strategies; that is -

for a given situation $(\mathbf{t}, \mathbf{s})$, the realized debate $\mathbf{m} = \boldsymbol{\mu}(\mathbf{t}, \mathbf{s})$ is invariant across equilibria;

but $\mathbf{v}$, and so the committee decision, varies across equilibria.

Happily, there exist (non-trivial) profiles $\boldsymbol{\mu}$ for which identifying equilibrium voting strategies is straightforward.

But first ...

III A Mechanism Design Approach

From a pragmatic perspective, jointly analysing the vote- and message-pivotal constraints is typically intractable in anything but the simplest environments.

From a conceptual perspective, the descriptive and normative limitations imposed by any particular communication protocol (such as a single round of simultaneous cheap talk) are undesirable.

A more abstract mechanism design approach seems sensible, therefore.

Let $\theta_i \in \Theta_i$ be i's generalized type and $\Theta = \Pi_{i \in N} \Theta_i$

e.g. in the deliberative model above, $\Theta_i = (T \times S)$ for all i

For all $\boldsymbol{\theta} = (\theta_1, \ldots, \theta_n) \in \Theta$, let $p(\boldsymbol{\theta}) > 0$ be the probability that $\boldsymbol{\theta}$ is the realized type-profile.

Types are private information

$u_i(x, \theta_i, \boldsymbol{\theta}_{-i}) \in \mathbb{R}$ is i's payoff from committee choice $x \in \{A, B\}$

Suppose first that there exists a mediator and, wlog (Revelation Principle), consider the following direct mechanism.

- Each individual $i \in N$ privately (and costlessly) reports a type $\theta_i \in \Theta_i$ to the mediator

- Given the reported profile $\boldsymbol{\theta} \in \Theta$, the mediator selects a vote profile $\mathbf{v}(\boldsymbol{\theta}) = (v_1(\boldsymbol{\theta}), \ldots, v_n(\boldsymbol{\theta}))$ according to a distribution $\gamma(\boldsymbol{\theta})$ and, for all $i \in N$, recommends i vote $v_i(\boldsymbol{\theta})$.

- Given the recommendation, each individual votes as she chooses

- Alternative B is chosen if and only if it receives at least q votes, $q \leq n$.

Given a particular q-rule, let Γ_q denote the set of *sequential equilibrium* outcomes under the mechanism.

Theorem (Gerardi & Yariv 2007)

$\Gamma_1, \Gamma_n \subseteq \Gamma_2 = \Gamma_3 = \ldots = \Gamma_{n-1}$.

Intuition Sequential equilibria do not preclude weakly dominated voting strategies;

the mediator can therefore always recommend all individuals vote identically, so there is individual incentive to deviate at the vote stage;

this effectively makes all *nonunanimous* q-rules equivalent at the communication stage.

Committee debate rarely (never?) involves an impartial mediator.

Let $\mathcal{C}$ denote the following communication protocol:

All $i \in N$ simultaneously make cheap talk public statements, $\mu_i(\theta_i) \in M_i$

For $i = 3, \ldots, n$, $M_i \equiv \Theta_i$ and, for $j = 1, 2$, $M_j \equiv \Theta_j \times [0, 1]$.

Theorem (Gerardi & Yariv 2007)

Suppose the mediator is replaced by the communication protocol $\mathcal{C}$. *Then,* $\Gamma_1, \Gamma_n \subseteq \Gamma_2 = \Gamma_3 = \ldots = \Gamma_{n-1}$.

Intuition Essentially the same - but here, individuals $j = 1, 2$ each report a number chosen according to a uniform distribution on $[0, 1]$ that jointly coordinates all individuals voting unanimously for an alternative defined by the reported type profile.

Given two mild restrictions on the informational environment ("smallness" and "significance"), Gerardi & Yariv (2007) extend the previous results to ex ante undominated strategies.

$\mu_i : \Theta_i \rightarrow M_i$ is i's message strategy under a given communication protocol (here, M_i is left unspecified).

$v_i : \Theta_i \times \Pi_{i \in N} M_i \rightarrow \{A, B\}$ is i's voting strategy conditional on type and the realized message profile.

Definition

An individual i's strategy $\sigma_i = (\mu_i, v_i)$ is *ex ante weakly undominated* if there is no distinct σ'_i such that

$$E_{\theta_i} E_{[\boldsymbol{\theta}_{-i}|\theta_i]} \left[u_i(\cdot, \theta_i, \boldsymbol{\theta}_{-i}) | \sigma_i, \boldsymbol{\sigma}_{-i} \right] \geq E_{\theta_i} E_{[\boldsymbol{\theta}_{-i}|\theta_i]} \left[u_i(\cdot, \theta_i, \boldsymbol{\theta}_{-i}) | \sigma'_i, \boldsymbol{\sigma}_{-i} \right]$$

for all $\boldsymbol{\sigma}_{-i}$ with at least one inequality strict.

Three remarks:

(1) Being ex ante weakly undominated does not imply debate-contingent voting is weakly undominated.

Thus, unanimous voting conditional on any realized message profile can be exploited to establish the result.

(2) Removing the mediator when strategies are ex ante undominated requires (at present) $n \geq 5$ and a far more complex communication protocol than $\mathcal{C}$.

(3) The structure and character of deliberation seems to matter and the particular voting rule adopted for any final decision is subject to controversy: it is hard to reconcile these observations with the Gerardi & Yariv theorems.

To address (3), voting has to matter and voting matters with weakly undominated or trembling hand perfect voting strategies, *given* any debate.

IV Deliberation and Voting Rules

Assume the deliberative committee model described in Sections II(1) and II(2):

the communication protocol is simultaneous cheap talk public signaling

the equilibrium concept is perfect Bayesian with weakly undominated voting strategies.

Consider the existence of equilibria in which all signals are credibly revealed in debate.

If there are such separating equilibria, then (given a two-alternative agenda), all individuals have a unique weakly undominated voting strategy: vote sincerely conditional on the shared information.

two properties ...

Consensus For all $\mathbf{t} = (t_1, ..., t_n) \in \mathbf{T}$, $\mathbf{S}(\mathbf{t}) \equiv \cap_{i \in N} \mathbf{S}_{t_i} \neq \emptyset$.

Let $\succ$ be an ordering on S for which the following condition obtains

Monotonicity For any $s, s' \in S$ such that $s \succ s'$ and $\mathbf{s}_- \in \mathbf{S}^{n-1}$, let $\mathbf{s} = (\mathbf{s}_-, s) \in \mathbf{S}$ and $\mathbf{s}' = (\mathbf{s}_-, s') \in \mathbf{S}$. Then for all $t \in T$, $u(B, t, \mathbf{s}) > u(B, t, \mathbf{s}')$ and $u(A, t, \mathbf{s}) < u(A, t, \mathbf{s}')$.

three definitions ...

Definition

A committee is *minimally diverse* if and only if there exist $t, t' \in T$ such that $\mathbf{S}_t \neq \mathbf{S}_{t'}$.

Definition

A *message* strategy profile $\boldsymbol{\mu}$ is *fully revealing* if, for all pairs of distinct signals $s, s' \in S$, $[\cup_{t \in T} \mu(t, s)] \cap [\cup_{t \in T} \mu(t, s')] = \emptyset$.

Definition

A perfect Bayesian equilibrium $(\boldsymbol{\mu}, \mathbf{v})$ is a *fully revealing debate equilibrium* (FRDE) if $\boldsymbol{\mu}$ is fully revealing and $\mathbf{v}$ is a profile of weakly undominated voting strategies.

and two theorems

Theorem (Coughlan 2000)

Suppose the bias profile $\mathbf{t}$ *is common knowledge and assume consensus and monotonicity. Then for all q-rules,* $n/2 < q \leq n$*, there exists a FRDE if and only if the committee is not minimally diverse.*

Note: Coughlan (2000) assumes $T = (0, 1)$ and $S = M = \{a, b\}$. Hence, minimal diversity can be consistent with heterogeneous bias-types.

Theorem (Austen-Smith & Feddersen 2006)

Assume consensus and monotonicity. Then there exists a FRDE under unanimity rule if and only if the committee is not minimally diverse. Moreover, the necessity claim for unanimity rule does not generalize to q-rules with $n/2 < q < n$*.*

Comparing Coughlan's result with that of A-S&F yields two recommendations (other things being equal) for designers who wish to encourage full information revelation in debate:

(1) *Don't* use unanimity rule;

(2) *Don't* require committee members to declare their private biases before deliberating.

Intuition Under non-unanimous q-rules and conditional on being message pivotal, individuals are uncertain about whether or not they are in a de facto winning coalition -

if a member of the winning coalition, then full revelation in debate is a best response

if a member of the losing coalition, then concealing private information is a best response

The best response depends on the relative likelihoods of these events

Conditioning on being message-pivotal reveals decision-relevant information about others' signals *and* others' bias-types, despite biases and signals being uncorrelated.

Some remarks

Meirowitz (2007) exploits correlation among bias-types, rather than among signals, to induce truth-telling under majority rule in a two-type model without consensus (see also Meirowitz 2006).

The difficulty of supporting full revelation in debate under unanimity rule has also been observed by Doraszelski, Gerardi & Squintani (2004) for $n = 2$ and Austen-Smith & Feddersen (2005) in an $n = 3$ model in which one of three available signals is wholly uninformative.

The intuition underlying Austen-Smith & Feddersen (2006) result also yields that (loosely speaking) the subsets of parameters for which FRDE's exist for any given q-rule shrinks monotonically as q increases from simple majority rule to unanimity rule.

Example $N = \{1, 2, 3\}$, $X = \Omega = \{A, B\}$

The prior belief that A is the correct decision ($\omega = A$) is $1/2$.

Assume: $T = \{h, l\}$, $M = S = \{a, b\}$ and, $\forall i \in N$,

$$\Pr[t_i = h] = r \in (0, 1),\ \Pr[s_i = z | \omega = Z] = p \in (\tfrac{1}{2}, 1).$$

Individual bias types and signals are private information.

Preferences:

$$u(A, h, \mathbf{s}) = -1 - u(B, h, \mathbf{s}) = \begin{cases} 0 & \textit{if} \quad \mathbf{s} \neq (b, b, b) \\ -1 & \textit{if} \quad \mathbf{s} = (b, b, b) \end{cases}$$

and

$$u(A, l, \mathbf{s}) = -1 - u(B, l, \mathbf{s}) = \begin{cases} 0 & \textit{if} \quad \mathbf{s} = (a, a, a) \\ -1 & \textit{if} \quad \mathbf{s} \neq (a, a, a) \end{cases} .$$

So

$$\begin{aligned} \mathbf{S}_h &= \{(b, b, b)\}, \\ \mathbf{S}_l &= \mathbf{S} \backslash \{(a, a, a)\} \end{aligned}$$

and both Consensus and Monotonicity obtain.

Suppose all committee members report their signals truthfully in debate: $m_i = s_i$, all i.

Then there is a unique undominated voting equilibrium under both *majority* and *unanimity* rules:

h types vote for B iff $\mathbf{m} = (b, b, b)$

l types vote for A iff $\mathbf{m} = (a, a, a)$

Suppose $t_j = l$ and $s_j = a$: given both $i \neq j$ reveal their signals truthfully in debate, what should j say?

(1) *Unanimity rule*, $q = 3$.

There is a *unique* message-pivotal event for j

At least one individual $i \neq j$ is h-biased;

Both individuals $i \neq j$ have "b"-signals;

Conditional on $\mathbf{m}_{-j}$ and s_j, j prefers B to A.

Hence, j's best response is to dissemble, reporting $m_3' = b$.

Under unanimity rule, therefore, there can be no FRDE if $\Pr[\mathbf{t} \neq (t, t, t)] > 0$.

(2) *Majority rule*, $q = 2$

There are *two* message-pivotal events for j

[*Piv-1*] Both individuals $i \neq j$ are h-biased with "b"-signals:

$$\begin{aligned} \Pr(\textit{Piv-1}|s_j &= a) = \frac{r^2}{2} p^2 (1-p) + \frac{r^2}{2} p (1-p)^2 \\ &= \frac{r^2}{2} p \left(1-p\right). \end{aligned}$$

Piv-1 $\Rightarrow j$ strictly prefers to dissemble, reporting $m_3' = b$.

[*Piv-2*] Both individuals $i \neq j$ are l-biased with "a"-signals:

$$\Pr(\textit{Piv-2}|s_j = a) = \frac{(1-r)^2}{2} \left[(1-p)^3 + p^3\right].$$

Piv-2 $\Rightarrow j$ strictly prefers to tell the truth,reporting $m_3 = a$.

Truth-telling in debate is incentive compatible for j, therefore, iff

$$\Pr(\textit{Piv-2} | s_j = a) \geq \Pr(\textit{Piv-1} | s_j = a)$$

or

$$\left(\frac{1-r}{r}\right)^2 \geq \frac{p(1-p)}{(1-p)^3 + p^3}.$$

Rehearsing similar calculations for $t_j = h$ and $s_j = b$, we find there exists a FRDE under majority rule iff

$$\min\left[\left(\frac{1-r}{r}\right)^2, \left(\frac{r}{1-r}\right)^2\right] \geq \frac{p(1-p)}{(1-p)^3 + p^3}.$$

Conditioning on being message-pivotal, however, the minority type has no incentive to reveal her signal truthfully in debate whenever it is common knowledge that $\mathbf{t} \neq (t, t, t)$. $\square$

Intuition

(1) Because signals are informative ($p > 1/2$), j's assessment (under majority rule) conditional on her signal (a), is that it is relatively more likely that both of the others have seen this signal than that both have seen the other signal (b).

(2) j is message-pivotal only if either

all signals are the same (a) and all bias types are the same (l),

or

both of the others have the b signal and are both h types.

Therefore, if j is message-pivotal and it is relatively more likely that others share j's signal, then it must also be relatively more likely that the others share j's bias type.

V Sequential Deliberation

The following suggests that achieving FIE through debate can be more difficult when individuals speak in turn.

Theorem (Van Weelden 2008)

Assume consensus and monotonicity. Suppose deliberation is sequential with common knowledge about the order in which committee members speak. Then for all q–rules, $n/2 < q < n$, there exists a FRDE if and only if the committee is not minimally diverse.

Intuition FRDE's are supported by individuals being uncertain which particular message-pivot event obtains:

in some events, the speaker is a member of a full information decisive coalition, so best-responds by truth-telling;

in others, the speaker is not in a full information decisive coalition, so best-responds by dissembling.

Moreover, the sets of signal profiles consistent with the two types of pivot event have an empty intersection.

If all others reveal their signals truthfully in sequential debate and j is message-pivotal, therefore, j knows for sure which type of message-pivot event obtains.

VI Further Issues

(1) Endogenous agenda formation (Austen-Smith 1990)

(2) Deliberating to coordinate (Calvert & Johnson 1998; Austen-Smith & Feddersen 2008)

(3) "Active" and "Latent" arguments (Hafer & Landa 2005, 2006, 2007)

(4) Analogies (Aragones, Gilboa, Postlewaite & Schmeidler 2001)

(5) Tacit knowledge and delegation (Austen-Smith & Feddersen, nd)

(6) What are the optimal voting rules with and without deliberation? Are they the same?