The Inferiority of Deliberation under Unanimity Rule

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Abstract

A *deliberative committee* is a group of at least two individuals who publicly communicate with each other prior to voting on a set of alternatives. We examine a model in which members of such a committee have private information and common although not necessarily identical values. We demonstrate in a very general setting that the requirement of a unanimous vote to choose one of two alternatives makes it impossible for even a minimally diverse committee to fully reveal all private information prior to voting. Moreover, whenever full revelation is possible under the unanimity rule it is possible under any other rule. Finally, we show that other rules may support full revelation when unanimity rule does not.

Key words: Deliberation, Fully revealing debate, Unanimity rule

1 Introduction

A widely held intuition in the literature on jury and committee deliberation is that requiring a unanimous vote provides stronger incentives for those involved to share their opinions and decision-relevant information than other voting rules. Particularly direct statements of this intuition include

> "It should be remembered that veto power or unanimity represents a constraint that induces deliberation: when parties can block outcomes, actors have incentives to find reasons that are convincing to all, not just to the majority" (Eriksen, 2001:15/16)

and

> "The necessity of a consensus of all jurors which flows from the requirement of unanimity, promotes deliberation and provides some insurance that the opinions of each of the jurors will be heard and discussed" (South Australian High Court, 1993; quoted in Walker and Lane, 1994:2)

Similar perspectives on the connection between unanimity and deliberation also color much of the more normative literature on deliberative democracy (see, for example, Shapiro, 2002; Dryzek and List, 2002; and the essays in Bohman and Rehg, 1997 and in Elster, 2000). This intuition is, however, flawed.

Consider a committee that must choose between the *status quo* and an *alternative*. Assume that each member of the committee may have private information that is more or less favorable to the alternative. In a *deliberative* setting members of the committee make public statements to the rest of the committee prior to voting. Under the unanimity rule the alternative is chosen only if every member of the committee votes for it. Now consider the problem facing a committee member trying to decide if he should truthfully reveal private information favorable to the status quo. If all other committee members truthfully reveal their private information then at the voting stage the member can always ensure the status quo is selected whenever a state has occurred in which he prefers it. Thus the only time it matters what a member says prior to voting is if (1) the information revealed by the other members is such that when combined with his own private information he prefers the alternative, (2) there are other members who prefer the status quo given the same information and (3) by claiming to have observed information more favorable to the alternative he can induce all other members to vote for the alternative. Under the assumption that truthfully reporting information more favorable to the alternative cannot induce members to be less likely to vote for the alternative it follows that committee members have an incentive not to reveal information that is less favorable to the alternative

Below we show that a *fully revealing deliberation equilibrium* in which every member of the committee always truthfully reveals their private information prior to voting is possible under unanimity rule only when there can be no conflict about which collective choice is the right one. But given such preference homogeneity, deliberation can be fully revealing under any voting rule at all. Moreover, other rules can support full information revelation even when the unanimity rule cannot.

The existing formal literature concerned with deliberation and multi-person committee voting under incomplete information is as yet small.[1] Austen-Smith (1990a,b) considers the role of debate in a spatial model of endogenous agenda-setting under majority rule; Calvert and Johnson (1998) look at the coordinating role of debate in a complete information model of committee decision-making; and Aragones, Gilboa, Postlewaite and Schmeidler (2001) pro-

[1] There is a complementary formal literature concerned with n-person debate aimed at influencing an uninformed monopolistic decision-maker. Examples include Glazer and Rubinstein (2001), Ottaviani and Sorensen (2001), Lipman and Seppi (1995), Diermeier and Feddersen (2001) and Austen-Smith (1993a, 1993b). Key differences between the papers cited in the text and those falling within this complementary class are that, in the latter, the set of individuals deliberating does not coincide with the set of individuals responsible for making a decision and there is no explicit concern with strategic voting.

pose a non-Bayesian framework for argument. The most closely connected papers to the current contribution are Doraszelski, Gerardi and Squintani (2001), Austen-Smith and Feddersen (2002) and Coughlan (2001). Assuming a cheap-talk stage prior to voting, Doraszelski, Gerardi and Squintani (2001: Proposition 3) prove an impossibility result for fully revealing equilibria in a two-person model with deliberation over a fixed binary agenda with unanimity rule; Austen-Smith and Feddersen (2002: Proposition 4) establish a similar claim for a particular three-person committee; and Coughlan (2001: Proposition 5) finds sufficient conditions for a fully revealing deliberation among jurors under unanimity rule. The results in Doraszelski, Gerardi and Squintani (2001) and Austen-Smith and Feddersen (2002), as well as the result in Coughlan (2001) are immediate corollaries of Theorem 1 below. This is the case since, by construction, the committee is composed of members with heterogenous preferences both in Doraszelski, Gerardi and Squintani and in Austen-Smith and Feddersen, and the sufficient conditions for Coughlan's claim insure the committee satisfies preference homogeneity.

Finally, Gerardi and Yariv (2002) adopt a quite different approach, either to the papers cited above or to this paper. In particular, unlike the focus on full information revelation in what follows, Gerardi and Yariv do not consider any qualitative properties of deliberation *per se*. Framing the issue as one of mechanism design under incomplete information, they instead study the abstract relationships between sets of sequential equilibrium outcomes achievable through unmediated cheap-talk communication in voting games. A key feature of their argument is the fact that all individuals *always* voting unanimously is consistent with sequential equilibrium under any non-unanimous rule. But in the case that deliberation prior to a vote results in complete information among committee members at the time of the vote, prescribing that individuals surely vote the same way in any decision amounts to prescribing that individuals use weakly dominated voting strategies.

2 Model and result

Consider a committee $N = \{1, 2, ..., n\}$, $n \geq 2$, that has to choose an alternative $z \in \{x, y\}$; let x be the *status quo* policy. Each individual $i \in N$ has private information $(b_i, s_i) \in B \times S$, where b_i is a preference parameter, or *bias*, and s_i is a *signal* regarding the alternatives. Assume the sets B and S are finite and common across individuals $i \in N$. Write $B^n \equiv \mathbf{B}$ and $S^n \equiv \mathbf{S}$; a *situation* is any pair $(\mathbf{b}, \mathbf{s}) \in \mathbf{B} \times \mathbf{S}$, where $\mathbf{b} = (b_1, ..., b_n)$, $\mathbf{s} = (s_1, ..., s_n)$. And with a convenient abuse of language, any profile $\mathbf{s} \in \mathbf{S}$ is a *state*.. Let $p(\mathbf{b}, \mathbf{s})$ be the probability that situation $(\mathbf{b}, \mathbf{s}) \in \mathbf{B} \times \mathbf{S}$ obtains..

For any committee member $i \in N$, i's preferences over $\{x, y\}$ depend exclusively on i's own bias $b_i \in B$ and on the state $\mathbf{s} \in \mathbf{S}$: for any bias $b \in B$ there is a nonempty subset of states $\mathbf{S}_b \subset \mathbf{S}$ such that $\mathbf{s} \in \mathbf{S}_b$ implies $u(y, b, \mathbf{s}) > u(x, b, \mathbf{s})$ and $\mathbf{s} \notin \mathbf{S}_b$ implies $u(y, b, \mathbf{s}) < u(x, b, \mathbf{s})$. To avoid trivialities we assume that every situation occurs with positive probability and, because the concern here is with unanimity rule, that there always exist states at which all members prefer alternative y.

Axiom 1 (Full Support) *For all* $(\mathbf{b}, \mathbf{s}) \in \mathbf{B} \times \mathbf{S}$, $p(\mathbf{b}, \mathbf{s}) > 0$.

Axiom 2 (Consensus) *For all* $\mathbf{b} = (b_1, ..., b_n) \in \mathbf{B}$, $\mathbf{S}(\mathbf{b}) \equiv \cap_{i \in N} \mathbf{S}_{b_i} \neq \emptyset$.

Given that the committee is to choose from a fixed binary agenda, it is fairly natural to interpret signals $s \in S$ as constituting more or less evidence for choosing one or other of the two altenatives. Consequently, assume that the set of signals S is ordered by a binary relation, $\succ$, such that the following monotonicity condition obtains.

Axiom 3 (Monotonicity) *For any* $s, s' \in S$ *such that* $s \succ s'$ *and* $\mathbf{s}_- \in S^{n-1}$, *let* $\mathbf{s} = (\mathbf{s}_-, s) \in \mathbf{S}$ *and* $\mathbf{s}' = (\mathbf{s}_-, s') \in \mathbf{S}$. *Then* $u(y, b, \mathbf{s}) > u(y, b, \mathbf{s}')$ *and* $u(x, b, \mathbf{s}) < u(x, b, \mathbf{s}')$ *for any* $b \in B$.

In words, suppose there is a pair of states that differ only in that some member has observed $s \in S$ in the first state and $s' \in S$; then $s \succ s'$ implies that s is stronger information than s'

in favor of y and against x. And notice that this axiom also builds in a degree of symmetry: any individual's relative evaluation of the two alternatives is monotone in signals whatever the individual's bias b and irrespective of exactly which committee member receives what signal.

The committee chooses an outcome by voting under unanimity rule. That is, x is the outcome unless every member of the committee votes for y. Prior to voting we assume there is a deliberation phase in which every member of the committee can simultaneously send a message m to every other member of the committee. For any $i \in N$, bias $b \in B$ and signal $s \in S$, let M be the set of available messages where M is an arbitrary, uncountably infinite set. A *message strategy* for $i \in N$ is a function, $\mu_i : B \times S \to M$. A message profile $\mathbf{m} = (m_1, m_2, ..., m_n) \in M^n \equiv \mathbf{M}$ is a *debate.*

Definition 1 *A message strategy profile* $\boldsymbol{\mu}$ *is* fully revealing *if, for all* $i \in N$*, for all* $b \in B$ *and all pairs of distinct signals* $s, s' \in S$*,* $\mu_i(b, s) \neq \mu_i(b, s')$*.*

As defined here, fully revealing message strategies may or may not reveal information about individual biases. Because individuals' preferences depend only on the state and on their own bias, if a debate fully reveals the state then additional information about others' biases is decision-irrelevant. Thus the key feature of a fully revealing message strategy is that it provides full information about the speaker's signal.

Consistent with the motivation for the paper, our focus is on deliberation that yields all individuals' information being shared prior to the voting stage; that is, on fully revealing debates. In this context, there is no loss of generality in associating messages directly with the information they are presumed to report, so assume $B \times S \subset M$. Then $\boldsymbol{\mu}$ is fully revealing if, for all $i \in N$ and all $(b, s) \in B \times S$, $\mu_i(b, s) = s$.

Definition 2 *A committee is* minimally diverse *if and only if there exist* $b, b' \in B$ *such that* $\mathbf{S}_b \neq \mathbf{S}_{b'}$*.*

In words, a committee is minimally diverse if its membership exhibits preference heterogeneity at least to the extent that there is some pair of individual bias parameters that disagree about the states in which alternative y should be selected. Under the full support assumption, it is possible for all individuals to exhibit the same bias and, therefore, the only committees that are not minimally diverse are committees in which there is *never* any disagreement about when alternative y is the best choice ($\mathbf{S}_b = \mathbf{S}_{b'}$ for all $b, b' \in B$).

For all $\mathbf{b} \in \mathbf{B}$, let $\mathbf{T}^0(\mathbf{b}) \equiv \mathbf{S}(\mathbf{b})$ and, for any $k = 1, 2, \ldots$, recursively define the sets

$$\mathbf{T}^k(\mathbf{b}) = \{\mathbf{s} \notin \cup_{l=1}^{l=k} \mathbf{T}^{k-l}(\mathbf{b}) | \exists s, s' \in S : s' \succ s,\ (\mathbf{s}_-, s) = \mathbf{s},\ (\mathbf{s}_-, s') = \mathbf{s}' \text{ and } \mathbf{s}' \in \mathbf{T}^{k-1}(\mathbf{b})\}.$$

Thus $\mathbf{T}^1(\mathbf{b})$ is the set of states not in $\mathbf{T}^0(\mathbf{b})$ such that, given the realized bias profile $\mathbf{b}$, changing any one person's information from s to s' results in a state in $\mathbf{T}^0(\mathbf{b}) \equiv \mathbf{S}(\mathbf{b})$; $\mathbf{T}^2(\mathbf{b})$ is the set of states not in $\mathbf{T}^1(\mathbf{b})$ such that changing any one person's information from s to s' results in a state in $\mathbf{T}^1(\mathbf{b})$; and so on. Informally, the set $\mathbf{T}^k(\mathbf{b})$ is the set of states such that there is a path of k single coordinate changes of information that lead to a state at which y is preferred unanimously. Since S and N are finite it follows that

$$\cup_{k=0,1,\ldots,n} \mathbf{T}^k(\mathbf{b}) = \mathbf{S}.$$

Lemma 1 *Assume full support, consensus and monotonicity. In a minimally diverse committee there exists a bias profile* $\mathbf{b} = (\mathbf{b}_-, b, b') \in \mathbf{B}$ *and a state* $\mathbf{s} \in \mathbf{T}^1(\mathbf{b})$ *such that* $\mathbf{s} \notin \mathbf{S}_b$ *but* $\mathbf{s} \in \mathbf{S}_{b'}$.

Proof Let $\mathbf{b} = (\mathbf{b}_-, b, b') \in \mathbf{B}$ (where, by an abuse of notation, it is understood that $\mathbf{b}_- \in B^{n-2}$); by consensus, $\mathbf{S}(\mathbf{b}) \neq \emptyset$. First assume there is a state $\mathbf{s} \in \mathbf{S}_b \cap \mathbf{T}^{k+1}(\mathbf{b})$. By full support and definition of $\mathbf{T}^k(\mathbf{b})$, there exists a signal $s' \succ s$ such that $(\mathbf{s}_-, s') = \mathbf{s}' \in \mathbf{T}^k(\mathbf{b})$; moreover, by monotonicity, $\mathbf{s}' \in \mathbf{S}_b$. Hence, $\mathbf{s} \in \mathbf{S}_b \cap \mathbf{T}^{k+1}(\mathbf{b})$ implies there exists a state $\mathbf{s}' \in \mathbf{S}_b \cap \mathbf{T}^k(\mathbf{b})$. Now suppose b is such that, for any $\mathbf{s} \in \mathbf{T}^k(\mathbf{b})$, $\mathbf{s} \notin \mathbf{S}_b$. Then by the previous argument, there can be no $\mathbf{s} \in \mathbf{T}^{k+1}(\mathbf{b})$ such that $\mathbf{s} \in \mathbf{S}_b$. Hence, $\mathbf{S}_b \cap \mathbf{T}^1(\mathbf{b}) = \emptyset$ implies $\mathbf{S}_b \cap \mathbf{T}^k(\mathbf{b}) = \emptyset$ for all $k > 1$ in which case, because $\cup_{k=0,1,\ldots,n} \mathbf{T}^k(\mathbf{b}) = \mathbf{S}$, it must be that $\mathbf{S}_b = \mathbf{S}(\mathbf{b})$. It follows that if, contrary to the lemma, for all $\mathbf{b} \in \mathbf{B}$ there exists no $\mathbf{s} \in \mathbf{T}^1(\mathbf{b})$ and components b, b' of $\mathbf{b}$ such that $\mathbf{s} \notin \mathbf{S}_b$ but $\mathbf{s} \in \mathbf{S}_{b'}$, then $\mathbf{S}_b = \mathbf{S}(\mathbf{b})$ for all components of $\mathbf{b}$, violating minimal diversity. □

A *voting strategy* for member $i \in N$ is a function $\nu_i : B \times S \times \mathbf{M} \to \{x, y\}$ that maps every debate into a voting decision. A *fully revealing deliberation equilibrium* is a Perfect Bayesian Equilibrium $(\boldsymbol{\mu}, \boldsymbol{\upsilon}) = ((\mu_1, \ldots, \mu_n), (\nu_1, \ldots, \nu_n))$ such that $\boldsymbol{\mu}$ is fully revealing and $\boldsymbol{\upsilon}$ is a profile of weakly undominated voting strategies.

Theorem 1 *Assume full support, consensus and monotonicity. There exists a fully revealing deliberation equilibrium if and only if the committee is not minimally diverse.*

Proof (Necessity) In any fully revealing deliberation equilibrium, the restriction to weakly undominated voting strategies implies $\nu_i(b, s, \mathbf{m}) = y$ if and only if $(\mathbf{s}_{-i}, s) \in \mathbf{S}_b$, where $\mathbf{s}_{-i} = \mathbf{m}_{-i}$ for every $i \in N$ and $b \in B$. It follows that a member's voting strategy does not depend on the message she sends in debate. Consider the deliberation stage and, by way of contradiction, suppose $\boldsymbol{\mu}$ is fully revealing yet the committee is minimally diverse. Then, given the behavior at the voting stage, fully revealing message strategies constitute an equilibrium if and only if, for every $i \in N$ and every $(b_i, s_i) \in B \times S$, it is the case that

$$EU(m_i = s_i, b_i, s_i) - EU_i(m_i = s', b_i, s_i) \geq 0 \text{ for any } s' \in M \backslash \{s_i\} \tag{1}$$

where $EU(m_i, b_i, s_i) =$

$$\sum_{\mathbf{b}_{-i} \in B^{n-1}} \sum_{\mathbf{s}_{-i} \in S^{n-1}} p(\mathbf{b}_{-i}, \mathbf{s}_{-i} | b_i, s_i) \left[\Pr(x | \mathbf{b}, \mathbf{s}, m_i) u(x, b_i, \mathbf{s}) + \Pr(y | \mathbf{b}, \mathbf{s}, m_i) u(y, b_i, \mathbf{s}) \right]$$

and $\Pr(z | \mathbf{b}, \mathbf{s}, m_i)$ is the probability that $z \in \{x, y\}$ is the committee decision given bias profile $\mathbf{b} = (\mathbf{b}_{-i}, b_i)$, state $\mathbf{s} = (\mathbf{s}_{-i}, s_i)$ and debate $(\mathbf{m}_{-i}, m_i) = (\mathbf{s}_{-i}, m_i)$. Fix $i \in N$ and let $(b_i, s_i) = (b, s)$; for any $s' \in M \backslash \{s\}$, define the function

$$\varphi_{(b,s)}(s, s'; \mathbf{b}_{-i}, \mathbf{s}_{-i}) \equiv \left[\Pr(x | \mathbf{b}, \mathbf{s}, s) - \Pr(x | \mathbf{b}, \mathbf{s}, s') \right] \left[u(x, b, \mathbf{s}) - u(y, b, \mathbf{s}) \right]$$

with $\mathbf{b} = (\mathbf{b}_{-i}, b)$ and $\mathbf{s} = (\mathbf{s}_{-i}, s)$. Then we can rewrite (1) equivalently as requiring that for all $(b, s) \in B \times S$ and all $s' \in M \backslash \{s\}$,

$$\sum_{\mathbf{b}_{-i} \in B^{n-1}} \sum_{\mathbf{s}_{-i} \in S^{n-1}} p(\mathbf{b}_{-i}, \mathbf{s}_{-i} | b, s) \varphi_{(b,s)}(s, s'; \mathbf{b}_{-i}, \mathbf{s}_{-i}) \geq 0. \tag{2}$$

By assumption, $\boldsymbol{\mu}_{-i}$ is fully revealing of all others' signals and, by the preceding argument on ν_i, for all messages $m_i \in M$ and all bias profiles $(\mathbf{b}_{-i}, b) \in \mathbf{B}$, $(\mathbf{s}_{-i}, s) \in \mathbf{S} \backslash \mathbf{S}_b$ implies $\Pr(x | (\mathbf{b}_{-i}, b), (\mathbf{s}_{-i}, s), m_i) = 1$. Similarly, for any state $(\mathbf{s}_{-i}, s) \in \mathbf{S} \backslash (\mathbf{S}(\mathbf{b}) \cup \mathbf{T}^1(\mathbf{b}))$ it must be that $\Pr(x | (\mathbf{b}_{-i}, b), (\mathbf{s}_{-i}, s), m_i) = 1$.. Given $(b_i, s_i) = (b, s)$, therefore, for all $s' \in M \backslash \{s\}$ and all $\mathbf{b}_{-i} \in B^{n-1}$,

$$(\mathbf{s}_{-i}, s) \in \mathbf{S} \backslash \left[\mathbf{S}(\mathbf{b}) \cup \mathbf{T}^1(\mathbf{b}) \cup \mathbf{S}_b \right] \Rightarrow \varphi_{(b,s)}(s, s'; \mathbf{b}_{-i}, \mathbf{s}_{-i}) = 0. \tag{3}$$

The preceding argument implies that an individual i with bias b can change the outcome by switching from message s to some $s' \neq s$ only in situations $(\mathbf{b}, \mathbf{s})$ such that $(\mathbf{s}_{-i}, s) \in \mathbf{S}(\mathbf{b}) \cup \left(\mathbf{T}^1(\mathbf{b}) \cap \mathbf{S}_b \right)$. For all $\mathbf{b} \in \mathbf{B}$, define

$$X_i(\mathbf{b}, s, s') = \{ (\mathbf{s}_{-i}, s) \in \mathbf{S}(\mathbf{b}) | (\mathbf{s}_{-i}, s') \notin \mathbf{S}(\mathbf{b}) \}$$

to be the set of states such that if an individual i who is supposed to report s instead reports s' then, conditional on $\mathbf{b}$, the outcome changes from y to x. Similarly, define

$$Y_i(\mathbf{b}, s, s') = \{ (\mathbf{s}_{-i}, s) \in \left(\mathbf{T}^1(\mathbf{b}) \cap \mathbf{S}_b \right) | (\mathbf{s}_{-i}, s') \in \mathbf{S}(\mathbf{b}) \}$$

to be the set of states in which i prefers y and, if i is supposed to report s but instead reports s' at $\mathbf{b}$, the outcome changes from x to y. Note that, by monotonicity, if $Y_i(\mathbf{b}, s, s') \neq \emptyset$ for some $\mathbf{b} \in \mathbf{B}$, then $X_i(\mathbf{b}, s, s') = \emptyset$ for all $\mathbf{b} \in \mathbf{B}$ and, if $X_i(\mathbf{b}, s, s') \neq \emptyset$ for some $\mathbf{b} \in \mathbf{B}$, then $Y_i(\mathbf{b}, s, s') = \emptyset$ for all $\mathbf{b} \in \mathbf{B}$. That is, $Y_i(\mathbf{b}, s, s') \neq \emptyset$ for some $\mathbf{b} \in \mathbf{B}$ implies that s' is stronger evidence for y than s, whereas $X_i(\mathbf{b}, s, s') \neq \emptyset$ for some $\mathbf{b} \in \mathbf{B}$ implies s' is weaker evidence for y than s. By monotonicity both statements cannot be true. For any $\mathbf{b} \in \mathbf{B}$ and $s, s' \in S$, let

$$Z_i^-(\mathbf{b}, s, s') \equiv \{ \mathbf{s}_{-i} \in S^{n-1} | (\mathbf{s}_{-i}, s) \in \left[Y_i(\mathbf{b}, s, s') \cup X_i(\mathbf{b}, s, s') \right] \}.$$

Collecting terms and using (3), we can rewrite the incentive compatibility constraint (2) as requiring, for all $i \in N$, $(b, s) \in B \times S$ and $s' \in M \backslash \{s\}$,

$$\sum_{\mathbf{b}_{-i} \in \mathbf{B}^{-}} \sum_{\mathbf{s}_{-i} \in Z_i^{-}(\mathbf{b}, s, s')} p(\mathbf{b}_{-i}, \mathbf{s}_{-i}, |b, s) \varphi_{(b,s)}(s, s'; \mathbf{b}_{-i}, \mathbf{s}_{-i}) \geq 0. \qquad (4)$$

By Lemma 1 and full support, minimal diversity implies there is a $(\mathbf{b}_{-i}, b) \in \mathbf{B}$ and a pair of signals $s, s' \in S$ such that $Y_i((\mathbf{b}_{-i}, b), s, s') \neq \emptyset$ and $X_i((\mathbf{b}_{-i}, b), s, s') = \emptyset$. By definition, $(\mathbf{s}_{-i}, s) \in Y_i((\mathbf{b}_{-i}, b), s, s')$ implies $u(x, b, (\mathbf{s}_{-i}, s)) < u(y, b, (\mathbf{s}_{-i}, s))$ and $\Pr(x|(\mathbf{b}_{-i}, b), \mathbf{s}, s) - \Pr(x|(\mathbf{b}_{-i}, b), \mathbf{s}, s') = 1.$. Hence, for all $(\mathbf{b}_{-i}, b) \in \mathbf{B}$,

$$\mathbf{s}_{-i} \in Z_i^{-}(\mathbf{b}, s, s') \Rightarrow \varphi_{(b,s)}(s, s'; \mathbf{b}_{-i}, \mathbf{s}_{-i}) < 0.$$

But then the incentive compatibility conditions are surely violated, contradicting the existence of a fully revealing deliberation equilibrium in any minimally diverse committee. This proves necessity.

(Sufficiency) Assume the committee is not minimally diverse. Then for all $b \in B$ and all $\mathbf{b} = (\mathbf{b}_{-}, b) \in \mathbf{B}$, $\mathbf{S}_b = \mathbf{S}(\mathbf{b})$. In this case there is no $\mathbf{b} \in \mathbf{B}$ and pair of signals $s, s' \in S$ such that $Y_i(\mathbf{b}, s, s') \neq \emptyset$ for any $i \in N$. Since incentive compatibility is assured for any $i \in N$, $b \in B$ and pair of signals $s, s' \in S$ such that $X_i(\mathbf{b}, s, s') \neq \emptyset$ and $Y_i(\mathbf{b}, s, s') = \emptyset$, full revelation is an equilibrium strategy. This completes the proof. □

Thus the circumstances under which unanimity rule promotes fully revealing deliberation are confined to those in which it is common knowledge that the committee is homogenous with respect to preferences over alternatives. Moreover, it is easy to see that the theorem holds in the case that the true bias profile $\mathbf{b} \in \mathbf{B}$ is common knowledge.[2] We close this section by recording an easy implication of Theorem 1; although technically straightforward, the corollary is substantively consequential.

[2] This is essentially a matter of notation: fix a bias profile $\mathbf{b} = (b_1, \ldots, b_n)$, suppose $\mathbf{b}$ is common knowledge and let $B = \{b_1, \ldots, b_n\}$. Then the definitions and analysis go through on replacing references to "biases $b, b' \in B$" with references to "individuals $i, j \in N$ with biases $b_i, b_j \in B$", and so on.

Let $q \in \{1, 2, \ldots, n\}$. A *q rule* is a voting rule such that if at least $q \geq 1$ committee members vote for y against x, then y is the committee decision. Unanimity rule is a q rule with $q = n$. Then noting that the sufficiency argument for Theorem 1 does not depend in any substantive way on the unanimity rule, the argument can be applied directly to yield

Corollary 1 *Assume full support, consensus and monotonicity. If there exists a fully revealing deliberation equilibrium under unanimity rule then there exists a fully revealing deliberation equilibrium under all q rules.*

Because committees that are not minimally diverse unanimously agree on the preferred alternative in every situation, such committees can always support fully revealing debate whatever voting rule is used to finalize a decision. Finally, Austen-Smith and Feddersen (2002) describe a model of a minimally diverse three-person committee in which $|B| = 2$, $|S| = 3$ and, for a non-degenerate set of parameters, there exists a fully revealing deliberation equilibrium under majority rule. Thus there are circumstances in which the committee is minimally diverse and unanimity rule elicits strictly less information from deliberators than simple majority rule.

3 Conclusion

In contrast to a common wisdom, unanimous voting can, under very general conditions, create incentives for individuals to reveal less information in debate than they would be willing to reveal under a non-unanimous rule. Moreover, when circumstances are such that fully revealing deliberation is possible under unanimity, then it is likewise possible under all voting rules; the converse, however, is not true. Finally, while we examine a model with cheap talk the basic insight extends to a setting in which agents are sometimes constrained to tell the truth. As long as agents are capable of hiding some decision relevant information that supports the *status quo*, unanimity rule can provide the incentive to do so.

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