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A Capture Theory of Committees

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Abstract

Why do committees exist? The extant literature emphasizes that they pool dispersed information across members. In this paper, we argue that they also may serve to discourage outside influence or capture by raising its cost. As such, committees may contain members who are uninformed or else add no new information to the collective decision. We show that the optimal committee is larger when outsiders have larger stakes in its decision, contribute lower quality proposals, or when its members are more corruptible. We also show that keeping committee members anonymous and accountable for their votes help deter capture.

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"A committee should consist of three men, two of whom are absent."

– Sir Herbert Beerbohm Tree [1853-1917]

1 Introduction

Why is decision-making by committees so ubiquitous? Following Condorcet (1785), a vast literature emphasizes their ability to aggregate constituent members' diverse knowledge.[1] Since

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[1] For excellent surveys, see Gerling et al. (2005) and Li and Suen (2009).

the work of George Stigler (1971), however, it has been recognized that even if committees successfully aggregate decentralized information,[2] their decisions are reliable only to the extent that members are free from outside influence or "capture".[3] One reason why capture may occur is that individuals and groups having large stakes in the committee's decision are often well-organized to direct their resources toward "vote buying": promising committee members personal gains such as direct payments, gifts, future employment and campaign contributions in exchange for their favorable votes.[4]

In this paper, we follow Stigler's lead and ask a basic normative question: how should committees be designed to minimize capture? Our answer revolves around the idea that an optimal committee should have enough members, each endowed with a decisive vote, so that capture is prohibitively costly to outsiders. As such, the committee may contain members who are uninformed or bring no new information to improve the collective decision.

Our baseline model features a socially minded principal (e.g., municipality, admissions office, or journal editor) who appoints a panel of experts from an *ex ante* homogenous pool to evaluate the "project" of a self-interested agent (e.g., a firm, applicant, or author). Like the principal, the experts care about the project's social value, but they may be susceptible to outside influence, depending on how "corruptible" they are – personally and by institutional design governing transaction costs. To distinguish our theory from the Condorcet-type approach, we initially assume that every expert on the panel perfectly observes the project's social value, so information aggregation is a nonissue and, absent any concerns about capture, the principal would appoint only one expert in our setting; that is, she would not form a committee in the

[2]It is well-established in the literature that committees may fail to aggregate diverse information because of strategic (or pivotal) voting (e.g., Austen-Smith and Banks 1996; Feddersen and Pesendorfer 1998).

[3]Stigler presented an influential theory (and empirical evidence) of regulatory capture, which was later refined and expanded by Peltzman (1976) and Becker (1983) and applied to many other settings including the political economy of trade policy (Grossman and Helpman 1994). For edifying reviews of the regulatory capture literature, see Laffont and Tirole (1993, ch. 11) and Dal Bo (2006).

[4]Like other researchers, we recognize that vote buying is illegal in many societies and organizations, but the inducements offered to committee members need not be explicit. Indeed, many real cases exist in which committee decisions were doubted or even dismissed owing to the fear of capture. Elliott (2011) reports that, perceived of unduly favoring the industry, the US Atomic Energy Commission was replaced by the independent Nuclear Regulatory Commission (NRC) in 1975. In sports, the international soccer federation's (FIFA's) decision to award the 2018 and 2022 World Cups to Russia and Qatar, respectively, were linked to bribery and vote-rigging, resulting in the indictments of several top FIFA officials (Collett et al. 2015). Last, but not least, in the 2016 Rio Olympics, several referees and judges were removed from the boxing competitions after "suspicious results" (Belson 2016).

first place.[5] The agent, however, is likely to influence the lone expert; anticipating that possibility, the principal optimally adds more members to the committee and grants each a decisive vote (as with a unanimity rule) despite no informational gains, until the cost of capture becomes too high for the agent.[6] We find that the optimal committee is larger in environments that are more prone to capture: when the agent has a larger stake, offers a lower quality project, or when experts are more corruptible owing to, say, lower transaction costs of receiving bribes.

Building on these insights, we consider several variants of the baseline model. First, we show that when it is a viable option, the principal could be better off by not disclosing the committee's identity to the outside world, effectively (and costlessly) increasing its size by creating strategic uncertainty about its membership. Indeed, anonymous committees are prevalent in peer reviews and college student admission procedures. Perhaps what is more interesting, we also show that when the pool of experts is not large enough, it is best for the principal to adopt a partial disclosure policy: disclose the committee's size but not the identities of its members.[7] The intuition is that partial disclosure creates strategic uncertainty as in no disclosure, but also allows the principal credibly to raise the cost of capture as in full disclosure.[8] We therefore predict that the ability strategically to disclose the committee's identity alleviates the principal's design problem and results in smaller committees than those that would be appointed under full disclosure. We argue that the principal also can alleviate her design problem by requiring committee members to justify their (affirmative) votes by engaging in a costly action, such as preparing an onerous expert report. We demonstrate that such voting accountability, which is common in advisory committees, would help deter capture by compelling the agent to pay

[5] We later extend the analysis to imperfectly informed experts for whom information aggregation is an issue.

[6] In our baseline model, a larger committee size raises the cost of capture for the agent both because it increases the probability of a sufficiently incorruptible (or socially motivated) member and because it increases the number of bribes to be paid. What ensures a finite committee is a small cost of participation for each member (as in Persico 2004) or a finite pool of available experts. If, unlike our model, experts were purely self-motivated, no committee size would deter capture, as will be clear in the analysis.

[7] Consistent with this finding, a randomized scoring system is used in Olympic boxing competitions, whereby only a subset of judges' scores are tallied (Belson 2016). See also Amegashi (2006) for a similar rule in the Olympic figure skating. Similarly, the verdicts of panels of judges in civil law regimes are announced by the court as a whole; the votes of the individual judges are not disclosed.

[8] As will be seen in the analysis, without the ability to commit to size, the principal has an incentive to scale down the committee under no disclosure. Hence, if partial disclosure is not feasible or credible, the principal may opt for full disclosure of the committee.

larger bribes.

Next, we consider costly information acquisition by experts as well as the agent's potential use of threats. We show that when committee members need to gather costly information about the project's social value, only one becomes informed because of the well-known free-rider problem, but unlike in Condorcet-type settings (e.g., Persico 2004), the principal optimally includes *uninformed* members to raise the agent's cost of capture. Strikingly, the adding of uninformed members occurs despite the fact that those uninformed members are expected to approve the project with certainty, essentially delegating the decision to the informed member(s). As for the agent's use of threats to committee members in case of an unfavorable decision, we find that, all else equal, members view bribes ("carrots") and threats ("sticks") as perfect substitutes, but the agent prefers the latter. The reason is that unlike bribes, threats need not be fulfilled if the project is accepted, which is the agent's primary objective. Hence, when threats also are feasible, we predict the optimal committee to be larger or else the principal will allocate resources to shield committee members from outside influence, as often is given as a major reason for jury sequestration or isolation (Alcindor 2013). Last, but not least, we extend the analysis to committees whose members possess exogenously noisy information, as in a standard Condorcet jury. Our main finding here is that less informed committees are easier to influence. In particular, if each expert's information is sufficiently noisy, *no* committee composition can deter bribing. When information is sufficiently precise, however, such a committee always exists, as in our baseline model.

We should emphasize that in our investigation, we focus mainly on the optimal committee that deters capture. It is, however, obvious that if forming such a committee is not feasible, capture is possible, especially when members are sufficiently self-interested or when they are sufficiently uninformed about the project.

Aside from the papers mentioned above, our paper is related to committee voting when members have "mixed" motives: they receive utility not only from choosing the socially optimal alternative, but also from gaining personal reputation (Levy 2007); being on the winning side (Callander 2008); expressing his ideology (Morgan and Vardy 2012); or a disesteem cost for an *ex post* wrong decision (Midjord et al. 2017). Unlike those models, bribes are endogenous in ours, and can be discouraged in equilibrium by the committee's designer. Our paper also is related to previous work on vote buying. Among them, Dal Bo (2007) examines a complete-information model, in which the outsider costlessly can capture the committee by offering conditional bribes such that no vote is pivotal in equilibrium. Our paper complements his by exploring transparency and design issues under incomplete information. Employing complete-information frameworks, Congleton (1984), Groseclose and Snyder (1996) and Dekel et al. (2008) consider competitive vote buying. Unlike them, we focus on committee designs that deter bribing. Finally, in terms of the role of committee size, our paper echoes Besley and Prat's (2006) emphasis on media pluralism in preventing capture. Media outlets are, however, different from a committee in that they do not collectively decide on the content of news, nor can they be kept anonymous from politicians and citizens.

The rest of the paper is organized as follows. In the next two sections, we present the baseline model and characterize the optimal committee. In Sections 4, we consider strategic disclosure of the committee's identity. In Sections 5 and 6, we extend the analysis to costly vote justification actions and then to costly information acquisition. In Section 7, we allow for the possibility of threats by an outsider. In Section 8, we extend the analysis to imperfectly informed experts, followed by concluding remarks in Section 9. Proofs of all formal results are relegated to an online appendix.

2 The model

There are $N+2$ risk-neutral players: one principal, one agent, and $N \geq 2$ *ex ante* identical experts. The agent submits a project to the principal for approval, upon which he receives a fixed payoff $v > 0$. The principal, however, cares about the social value of the project, denoted by s, and believes that s is uniformly distributed on the interval $[-S, S]$.[9] To ascertain s, the principal appoints an ad hoc committee of n experts by incurring a sufficiently small, but positive

[9]The uniform distribution assumption greatly simplifies the analysis, but is not essential for the results.

social cost, $\varepsilon > 0$, per committee member.[10] To rule out information aggregation as a motive for appointing a committee, we initially assume that every member perfectly discovers s at no cost, although information about s is nonverifiable and can be misrepresented (see Section 8 for an extension to noisy information). The members decide whether or not to approve the project by voting simultaneously either Accept or Reject, and if the number of Accept votes reaches a threshold k preset by the principal, the project is approved. Without loss of generality, a rejected project yields a (normalized) gross payoff of 0 to all players, and ties are broken in favor of rejection. The agent does not learn the individual votes (i.e., votes are secret), but he may try to sway the outcome by offering members bribes conditional on the committee's decision.[11]

Let expert i be offered bribe $b_i \geq 0$ conditional on the project's acceptance,[12] and $s + \alpha_i b_i$ be his resulting payoff, where the parameter $\alpha_i \geq 0$ represents expert i's degree of "corruptibility," with $\alpha_i = 0$ and $\alpha_i = \infty$ referring to a purely socially minded expert, like the principal, and a purely self-interested expert, respectively. In general, the corruptibility of an expert may be dictated by both intrinsic factors, such as cultural background and moral stance, and extrinsic factors, such as the organizational code of conduct that determines transaction costs for bribing. We assume that α_i is privately known by expert i, and commonly believed to be an independent draw from a continuous cumulative distribution $G(\alpha)$ on some interval $[\underline{\alpha}, \overline{\alpha}]$, with $0 \leq \underline{\alpha} < \overline{\alpha} \leq \infty$ and mean $E[\alpha] = \mu < \infty$. That assumption is reasonable if the committee is ad hoc and the agent has little prior interaction with its members. In the baseline model, it also is assumed that the agent approaches the committee uninformed of s and shares the same uniform belief as the principal. Assuming an uninformed agent also is reasonable if, for instance, the principal keeps the criteria by which s is determined confidential until she forms the committee, or such criteria are too costly for the agent to discover. We relax many of the modeling assumptions later.

[10] The fact that the participation cost of a member is small reflects the idea that the committee serves the larger society.

[11] Whether individual votes are secret or public is of no consequence in our setting since, as we will see below, the principal optimally chooses a rule of the unanimity, i.e., $k = n$, thereby removing the possibility of vote-buying schemes based on casting a pivotal vote, as in Dal Bo (2007).

[12] As is standard in the literature on political influence, we assume that the agent fulfills his promise of bribes even in a one-shot interaction: perhaps because he cares strongly about his "word-of-honor" or building reputation across a sequence of ad hoc committees; see, e.g., Laffont and Tirole (1993, ch.11) for a discussion.

To summarize, our committee design game runs as follows.

- The agent submits a project of unknown social value, s, to the principal.
- To evaluate the project, the principal chooses a committee (n, k).
- Member i learns s perfectly at no cost.
- The agent offers bribe $b_i \geq 0$ confidentially to member i.
- Privately informed of (s, α_i, b_i), member i votes Accept or Reject.
- The project is accepted if the number of Accept votes is at least k, in which case the agent pays the bribes as promised.

We solve for the perfect Bayesian equilibrium of this game. For tractability and ease of exposition, however, we restrict attention to symmetric bribes by the agent: if $b_i > 0$ and $b_j > 0$, then $b_i = b_j$, which seems reasonable given that experts are *ex ante* symmetric. As alluded to above, our focus in this paper is on the equilibrium with no bribing or committee capture. To that end, the ε participation cost per expert simply means that the principal would not hesitate to appoint one more expert to the committee if that action were to reduce equilibrium bribing; otherwise, all else equal, the principal strictly prefers a smaller committee to economize on participation costs.

3 Optimal committee

To motivate our investigation, we begin with a simple observation.

Lemma 1 *(**Benchmark**) If bribing were infeasible, i.e., $b_i = 0$ for all i, the optimal committee would have only one member.*

That is, without the fear of capture, the principal would not form a committee at all in our model. The reason is obvious: in the absence of bribing, the preferences of the principal and experts are aligned perfectly, and appointing one more expert, which costs the principal $\varepsilon > 0$, would add no new information about s.

The agent is, however, likely to bribe the lone expert to influence his vote. To see this, note that being offered bribe b, the expert accepts the project whenever $s + \alpha b > 0$, deviating from the socially optimal policy $s > 0$. For the agent who is uninformed about s and α, the probability of a positive decision is:

$$\Pr\{s + \alpha b > 0\} = E_\alpha \left[\Pr\{s + \alpha b > 0|\alpha\}\right] = E_\alpha \left[\min\{\frac{S + \alpha b}{2S}, 1\}\right],$$

which is increasing in b. Since our investigation is centered on the *no-bribing* equilibrium, we ignore the upper limit of 1 on the probability and write the agent's relaxed problem:[13]

$$\max_{b \geq 0} \pi_A = \left(\frac{S + \mu b}{2S}\right)(v - b). \tag{1}$$

Simple algebra shows that $b^* = 0$ if and only if $\mu \leq \frac{S}{v}$, which is likely to be satisfied if the expert is expected to be sufficiently incorruptible and/or the agent attaches a relatively low value to the project's approval. To rule out the trivial case of no incentive to bribe even a one-member committee, we impose Assumption 1 throughout.

Assumption 1. $\mu > \frac{S}{v}$.

Clearly, any attempt to capture the committee would hurt the principal because it would cause the expert to approve some socially undesirable projects, with $s \in [-\alpha b^*, 0]$. To deter capture, one strategy the principal can adopt is to raise its cost to the agent by appointing multiple experts despite no informational gain. To that end, let the principal form a committee with n experts (out of N) and the threshold voting rule k. Note that if such a committee can deter capture, i.e., $b^* = 0$, so can a smaller and less costly committee with only k members. Hence, in designing the committee, it is *optimal* for the principal to restrict attention to approval decisions taken by unanimous consent, making every vote decisive and costly for the agent,[14]

[13]Claim A1 in the online appendix establishes that the agent has no incentive to bribe in the original problem if and only if he has no incentive to bribe in the relaxed problem.

[14]Other institutional and informational reasons not modeled here of course exist for adopting a unanimity rule (see, e.g., Yildirim 2007; Bond and Eraslan 2010; Alonso and Camara 2016; and Breitmoser and Valasek 2017).

meaning that the agent optimally would bribe either every member (and do so symmetrically by assumption) or none of them.[15] Let $\phi_{-i} > 0$ be the probability that members other than i vote to accept the project.[16] Then, member i also would vote to accept the project if and only if he would be better off than voting to reject it, namely,

$$\phi_{-i} \times (s + \alpha_i b) + (1 - \phi_{-i}) \times 0 > 0,$$

or, equivalently,

$$s + \alpha_i b > 0. \tag{2}$$

From (2), it is evident that if $\alpha_j > \alpha_i$ and $s + \alpha_i b > 0$, then $s + \alpha_j b > 0$. Hence, under the unanimity rule, the committee is captured if and only if its *least* corruptible member is captured. Let $\alpha_{\min} = \min_{1 \leq i \leq n}\{\alpha_i\}$ and $\mu_n = E[\alpha_{\min}|n]$ be that "pivotal" member (who is unknown to the agent) and his expected degree of corruptibility, respectively. Then, modifying (1), the agent who faces an n-member committee solves

$$\max_{b \geq 0} \pi_A = \left(\frac{S + \mu_n b}{2S}\right)(v - nb),$$

which, letting $B = nb$, reduces to:

$$\max_{B \geq 0} \pi_A = \left(\frac{S + \frac{\mu_n}{n} B}{2S}\right)(v - B). \tag{3}$$

The ratio $\frac{\mu_n}{n}$ in (3) can be interpreted as the committee's expected degree of corruptibility, taking into account the fact that only $1/n$ of the total bribe goes to the pivotal member with mean corruptibility μ_n. It is readily verified that μ_n and, thus, $\frac{\mu_n}{n}$ is strictly decreasing in n, with $\frac{\mu_n}{n} \to 0$ as $n \to \infty$. In words, $\frac{\mu_n}{n}$ reflects the idea that larger committees are less corruptible both because they raise the total cost of capture to the agent (the *size* effect), and because the pivotal member (with $\alpha_{\min}$) is expected to be less corruptible (the *composition* effect).

[15] Since an unbribed committee member would accept only a socially desirable project under the unanimity rule, bribes that target a subset of members would be a pure waste for the agent.

[16] As is common in committee voting problems, a trivial equilibrium exists in which all members reject the project regardless of its social value – i.e., $\phi_{-i} = 0$ for all i. Aside from being uninteresting, such an equilibrium involves weakly dominated strategies for committee members and thus is not considered herein.

Comparing (3) with (1), it follows that $B^* = 0$ if and only if:

$$\frac{\mu_n}{n} \leq \frac{S}{v}. \tag{4}$$

That is, the principal can avoid capture by choosing a committee size that satisfies (4). Let n_0 be the smallest of such committees.[17] By Assumption 1, $n_0 \geq 2$ and for convenience, that size is assumed to be feasible:

Assumption 2. $n_0 \leq N$.

The following proposition formalizes our arguments up to now and derives three comparative statics with respect to the optimal committee. It also underlies our subsequent analysis.

Proposition 1 *The optimal committee is of size $n_0 \geq 2$ and decides by the unanimity rule, where n_0 is the smallest integer satisfying (4). Moreover, n_0 is larger if:*

(a) *the relative social value of the project, S/v, is smaller,*

(b) *experts are stochastically more corruptible (in the sense of a first-order stochastic dominance), or*

(c) *experts are less heterogenous in corruptibility (in the sense of a mean-preserving contraction).*

Proposition 1(a) reveals that the optimal committee is larger when the agent has a stronger incentive to capture members, either because he has a larger stake, v, in the decision, or because his project is less likely to be socially desirable but approved nevertheless. Part (b) adds to that insight by indicating that the optimal committee also is larger when its members, especially the pivotal member with $\alpha_{\min}$, grow stochastically more corruptible, perhaps because the transaction costs of bribing are lower and, in turn, smaller bribes are required to sway the outcome. Part (c) shows that the same conclusion also holds true when the pool of experts is less heterogenous in the sense of a mean-preserving contraction, since that too would imply that the pivotal member is more corruptible. An important corollary to part (c) is that, all else

[17] Recall that experts incur a negligible, but positive participation cost, leading the principal to pick the smallest committee that deters bribery.

equal, the optimal committee is largest if experts are known to be homogenous, i.e., $\alpha_i = \mu$ for all i, in which case $n_0 = \left\lceil \frac{\mu v}{S} \right\rceil$, with $\lceil \cdot \rceil$ being the usual ceiling operator.

We illustrate Proposition 1 by an exponential example and then discuss its scope in three remarks before we consider strategic disclosure of the committee's identity.

Example 1 *Let $G(\alpha) = 1 - e^{-\frac{\alpha}{\mu}}$. Then, $\mu_n = \frac{\mu}{n}$ and, thus, $n_0 = \left\lceil \sqrt{\frac{\mu v}{S}} \right\rceil$.*

Remark 1 *(**Symmetric bribing**) In the model, the agent is assumed to bribe members equally. Proposition B1 in the online appendix shows that such a restriction is without loss of generality if $\frac{d}{d\alpha}\left(\frac{G'(\alpha)}{1-G(\alpha)}\right) \geq 0$ – a familiar hazard-rate condition that is satisfied by many well-known distributions, including the exponential and uniform (Bagnoli and Bergstrom 2005). Intuitively, under this condition, diminishing returns to bribing each voter are encountered, and the probability of acceptance is maximized by treating them equally.*

Remark 2 *(**Commitment not to overrule decision**) Another modeling assumption is that the principal delegates the decision to the committee by pre-committing to a voting rule, k, which raises the following question: does the principal have an ex post incentive to overrule the committee's decision? The answer is 'No'. Note that since s is perfectly observed by all members, the principal would overrule the committee's acceptance decision only if $k < n$ and at least one member voted Reject, which would imply $s \leq 0$ (by the same token, a rejection by the committee never would be overruled). But, anticipating that, the agent would bribe all n members regardless of k, rendering the principal's design problem strategically equivalent to the one considered in Proposition 1.*

Remark 3 ***(Members' soliciting bribes)*** *If, unlike in the model, members simultaneously make take-it-or-leave-it bribe offers to the special interest, capture would be harder to deter. To see that, consider an n_0-member committee and suppose that $\alpha_i = \alpha$ and s is realized before the offers are made. Then, in a symmetric equilibrium, $b_i^* = \frac{v}{n_0}$ so long as $s + \alpha\frac{v}{n_0} \geq 0$. Though the reality probably lies in between, in this paper, we follow the extant literature (e.g., Groseclose and Snyder 1996; Dal Bo 2007; Dekel et al. 2008), and assume that the special interest makes the offers.*

4 Strategic disclosure of committees

Until now, the committee is assumed to be disclosed to the agent, perhaps owing to institutional design or the high administrative cost of keeping members anonymous. In many real settings though, the principal seems to have a choice between disclosing (*d*) and not disclosing (*nd*) the committee's identity: whereas academic journals and admission offices alike rarely reveal the set of reviewers they have consulted to the outside world, search and nominating committees often are announced.[18] One obvious advantage of nondisclosure is that it creates strategic uncertainty for the agent as to which experts to approach and bribe, effectively raising the cost of capture. It therefore seems plain to conjecture that the committee should never be disclosed to the interested party. That conjecture, however, turns out to be "partially" correct, depending crucially on the size of the expert pool, N.

To develop some intuition, recall from Proposition 1 that the principal can deter capture by publicly appointing a committee of size n_0. Notice that the same committee also is feasible under nondisclosure, but unlikely to be chosen in equilibrium because having induced no bribing, the principal has a strong incentive to downsize the committee to only one member and save on the small participation cost, ε. Notice also that such an incentive to downsize would in turn motivate the agent to bribe unless the pool of experts is too large.

To see that result, suppose that under nondisclosure the agent anticipates a one-member committee and randomly bribes m out of N experts available for appointment. Then the probability that the agent targets the "right" expert is m/N. With probability $1 - m/N$, the sole member receives no bribe and renders an unbiased decision on the project. We assume that upon the project's acceptance, the agent pays *all* m members as promised regardless of their being on the (undisclosed) committee since no expert has an incentive to claim otherwise.[19] Incorporating those facts into (1), the agent solves

$$\max_{b \geq 0, m \geq 0} \pi_A^{nd} = \left[\frac{m}{N} \left(\frac{S + \mu b}{2S} \right) + \left(1 - \frac{m}{N} \right) \frac{1}{2} \right] (v - mb),$$

[18] For instance, the International Olympics Committee (of 98 members), the Tony Awards nominating committee (of 51 members) as well as university presidential search committees (of 15-21 members) commonly are publicized.

[19] By the same token, if experts actively could solicit bribes from the agent, all N would do so.

which, setting $B = mb$, simplifies to:

$$\max_{B \geq 0} \pi_A^{nd} = \left[\frac{S + (\mu/N)\, B}{2S} \right] (v - B). \tag{5}$$

It is immediate that $B^{nd} = 0$ if and only if $\frac{\mu}{N} \leq \frac{S}{v}$, or, equivalently, $N \geq \frac{\mu v}{S}$. Hence, under nondisclosure, the principal's picking of the smallest, one-member committee and the agent's offering no bribe is the unique equilibrium if and only if the pool of experts is sufficiently large. In that case, since capture is avoided under both disclosure and nondisclosure regimes, but the latter saves on participation costs by requiring a smaller committee (than $n_0 \geq 2$), the principal strictly prefers nondisclosure. Armed with that insight, though by a more involved analysis, the following proposition fully characterizes the principal's disclosure decision.

Proposition 2 *Define $\overline{N} = \lceil \frac{\mu v}{S} \rceil$, and suppose that the principal decides whether or not to disclose the committee to the agent. Then,*

- **(i)** *if $N \geq \underline{N}$ for some $\underline{N}$ ($\leq \overline{N}$) (defined in the proof), the principal strictly prefers nondisclosure. Moreover, for $N \geq \overline{N}$, the optimal committee has $n^{nd} = 1$ while for $N \in [\underline{N}, \overline{N})$, the principal mixes between the committee sizes $n^{nd} = \overline{n}_0$ and $\overline{n}_0 - 1$, where $\overline{n}_0 \leq n_0$ is the smallest integer satisfying:*

$$\frac{\mu_n}{N} \leq \frac{S}{v}, \tag{6}$$

- **(ii)** *if $n_0 \leq N < \underline{N}$, the principal strictly prefers disclosure, with $n^d = n_0$.*

Consistent with the insight above, Proposition 2(i) says that the principal would continue to adopt a nondisclosure policy whenever the pool of experts to which she has access to is sufficiently large, $N \geq \underline{N}$. Interestingly, though, the principal would not always form the smallest, one-member committee under nondisclosure, because when the pool is not large enough, $N \in [\underline{N}, \overline{N})$, she fears that the agent might still have a strong residual incentive to bribe enough potential experts in the hope of biasing the single voter who is selected. In fact, we show that under nondisclosure, the agent would bribe all N experts.[20] To counter that incentive, the prin-

[20]Specifically, Claim A2 in the online appendix shows that under nondisclosure, unless the committee size is conjectured to be one, it strictly would be optimal for the agent to bribe all N experts. Otherwise, as seen in (5), a trivial indifference exists as to the number of bribes, m, offered when the committee comprises one member.

cipal appoints multiple experts to the committee to diminish its corruptibility, i.e., $\alpha_{\min}$ – the composition effect identified above. Note that under nondisclosure, the principal does not benefit from the size effect of a larger committee as it is unobservable to the agent. Hence, under nondisclosure, the optimal committee trades off having fewer members to save on their participation costs against having more members to reduce corruptibility. And for $N \in [\underline{N}, \overline{N})$, that trade off leads to mixing over committee sizes. That is, in an equilibrium with nondisclosure, the agent may be left strategically uncertain about not only who but also how many experts are on the committee, although Proposition 2(i) indicates that his uncertainty about the committee size is likely to be limited: $\overline{n}_0$ or $\overline{n}_0 - 1$. Similar to n_0, committee size $\overline{n}_0$ solves a no-bribing condition (6) by recognizing that unless discouraged from doing so, the agent is expected to bribe all N experts under nondisclosure, which means that only $1/N$ of the total bribe goes to the pivotal member with mean corruptibility μ_n. The principal cannot, however, credibly commit to $\overline{n}_0$ in equilibrium since, having engendered no bribing, she has a strict incentive to reduce the committee's size, explaining her mixing. Mixing exactly between committee sizes $\overline{n}_0$ and $\overline{n}_0 - 1$ is explained by the statistical fact that the mean of the sample minimum, μ_n, is strictly decreasing in n at a decreasing rate. That is, the corruptibility of a smaller committee grows disproportionately, leading the principal to add more members, given a sufficiently small participation cost.

Proposition 2(ii) indicates that when the number of experts is moderate, the principal adopts a disclosure policy in order to take advantage of the committee size effect, too. Put differently, the reason why the principal discloses the committee to the agent, the interested party, is credibly to raise the cost of capture by committing to not downsizing the committee behind "closed doors".

In order to understand the scope of Proposition 2, it is, however, worth noting that in some applications, the principal may also have a third option: partial disclosure (*pd*), whereby she reveals to the agent the committee's size but not its members – at least not before a decision is rendered. Indeed, the trade off behind Proposition 2 suggests that the principal can do better by partially disclosing, because it would allow her to exploit both the size effect as in disclosure and the agent's strategic uncertainty as in nondisclosure.[21] Proposition 3 confirms that this suggestion.

Proposition 3 *Suppose that the principal also may partially disclose the committee: disclose its size but not its members. Then, the principal weakly prefers partial disclosure to both full and no disclosure policies, with a strict preference whenever $N_0 \leq N < \overline{N}$ for some $N_0 \geq n_0$. Under partial disclosure, the optimal committee has size $n^{pd} = \overline{n}_0$ and deters capture.*

Not surprisingly, partial disclosure is strictly optimal for the principal only when she has a strict preference between the full and no disclosure policies examined in Proposition 2, so that either the size effect or the agent's strategic uncertainty is not taken advantage of. Proposition 3 also indicates that the principal successfully can deter capture by simply announcing committee size $\overline{n}_0$, which is no greater than n_0. That result contrasts with Proposition 2(i), where nondisclosure produces some positive bribing in equilibrium when the principal mixes over committee sizes $\overline{n}_0$ and $\overline{n}_0 - 1$. In practice, whether the principal can, however, adopt partial disclosure depends on whether she credibly can commit to the size of a fully anonymous committee, given her incentive to downsize. Otherwise, her only credible options may be the all-or-nothing disclosure policies examined in Proposition 2. The next example illustrates the two results in this section.

Example 2 *Continuing with Example 1, let $\mu = 25$ and $\frac{v}{S} = 1$, implying $n_0 = 5$ and $\overline{n}_0 = \lceil \frac{25}{N} \rceil$.*

Full or no disclosure: *For $5 \leq N < 9$, the principal discloses a committee of 5 whereas for $N \geq 9$, she maintains the committee's anonymity. In the latter case, the principal mixes between committee sizes 2 and 3 if $9 \leq N \leq 12$, and between committee sizes 1 and 2 if $13 \leq N \leq 24$. Finally, for $N \geq 25$, the principal appoints only one expert.*

Full, partial, or no disclosure: *Partial disclosure is strictly optimal for $7 \leq N < 25$. In particular, for $N = 7, 8$, partial disclosure strictly dominates full disclosure by requiring a smaller committee of 4 members, whereas for $9 \leq N \leq 24$ it strictly dominates no disclosure by requiring committees of 3 and 2, respectively – eliminating mixing in committee size in return for no bribing in equilibrium.*

[21] The composition effect identified under full disclosure is internal to the committee and operates regardless of other circumstances.

Propositions 2 and 3 seem consistent with the anecdotal evidence. As alluded to above, academic journals rarely reveal the set of reviewers to authors, and the set typically is much smaller than the pool of potential reviewers. In law, trial juries of six to 12 persons also are selected from a large jury pool, but the public has a constitutional right to know their identities except when the chances of bribery, intimidation and undesirable media attention are high. Those possibilities also explain why jurors sometimes are sequestered or isolated from the public view until they reach a verdict. In contrast, many search and nominating committees deliberately are made public and appear much larger in size (see Footnote 18). Last, but not least, in an attempt to free judges from outside pressure, the Olympic figure skating and boxing competitions use a scoring rule that resembles partial disclosure: a computer randomly and anonymously selects a subset of the judges' marks to determine the winner (see Footnote 7).

5 Vote justification

In many applications, committee members are required to justify their votes, which may be costly. For example, journal reviewers routinely are asked to supply a written report along with their summary recommendations. Similarly, search committees often explain how their members have reached consensus on a job candidate. While such vote justification may help elicit and aggregate salient information, here we show that it also may help deter capture.

In practice, vote justification may depend on one's vote as well as on the collective decision. For instance, a journal reviewer typically prepares an expert report *ex ante* before knowing others' publication recommendations, whereas a search committee member may have to defend his favorable vote *ex post* only upon a favorable committee vote on the candidate. Consider first *ex post* vote justifications and suppose that if a socially undesirable project, $s < 0$, is accepted by the committee, each member incurs a justification cost of:

$$J(s) = -cs,$$

where $c \geq 0$ is a fixed marginal cost. In particular, the lower the quality of the project, the harder, though not impossible, it is for a committee member to defend an Accept vote. Without loss of generality, we assume no justification cost for a socially desirable project, $s > 0$, or for a Reject vote. In general, marginal cost c may depend on the member's innate ability for (or moral stance on) misrepresenting the project's quality, but it may also depend on the principal's strict rules for preparing an expert report.[22]

Note that given the need to account for the vote *ex post*, member i who receives bribe b accepts the project if and only if: $s > 0$; or $s \leq 0$ and $s + \alpha_i b - J(s) > 0$, implying that from the agent's perspective, the pivotal voter continues to be the least corruptible committee member as in the baseline analysis and an n-member committee accepts the project with probability:

$$\frac{S + \frac{\mu_n}{1+c} b}{2S}.$$

Setting $B = nb$, the agent therefore solves

$$\max_{B \geq 0} \pi_A = \left(\frac{S + \frac{1}{1+c} \left(\frac{\mu_n}{n}\right) B}{2S} \right) (v - B),$$

which mirrors (3) and reveals that the optimal bribe with *ex post* vote justification is $B^J = 0$ whenever

$$\left(\frac{1}{1+c} \right) \frac{\mu_n}{n} \leq \frac{S}{v}. \tag{7}$$

Let $n^J(c)$ be the smallest integer that satisfies (7). The following result then is immediate.

Proposition 4 *The optimal committee that deters capture under ex post vote justification has size $n^J(c)$, which is decreasing in c. In particular, $n^J(c) = 1$ for $c > \frac{v}{S}\mu - 1$. Furthermore, the same committee also deters capture under ex ante vote justification.*

Proposition 4 obtains because costly vote justification compels the agent to pay larger bribes to members, raising his cost of capture. In particular, the larger the cost of defending a low quality project, the smaller is the committee size that prevents capture. In fact, for a sufficiently high

[22] If the committee prepares a joint report after the vote, then $c = \frac{C}{n}$ may be considered to be the (decreasing) marginal cost per member. Our conclusion in Proposition 4 would, however, not change.

marginal cost of vote justification, the principal optimally may appoint a one-member committee and thereby ensure an unbiased decision.[23] Proposition 4 further shows that it is easier for the principal to discourage bribing if members must justify their Accept votes regardless of the committee's decision. The reason is that a member may now not receive a bribe from the agent despite his affirmative vote, effectively increasing his cost of justification.

6 Endogenous information

Heretofore, we have maintained an exogenous information structure for both committee members and the agent – i.e., members are assumed to be informed and the agent is assumed to be uninformed of the project's social value. In this section, we relax each assumption to understand players' incentives to acquire costly information and how those incentives affect the principal's committee design.

6.1 Committee members

Suppose that unlike the baseline analysis, committee members initially are uninformed about the project's social value, s. Each of them can, however, become informed by paying a fixed cost $\eta_E > 0$ before receiving a bribe.[24] To avoid a trivial multiplicity of equilibria, we assume that members make information decisions sequentially in a random order. Without observing their decisions or the order, the agent offers bribes and members then vote simultaneously on the project as before.

Note that with no outside influence, a lone expert would become informed as long as $\eta_E < \frac{S}{4}$.[25] Note also that owing to a severe free-rider problem, a larger committee would continue to have only one informed member, namely the last one to decide on information ac-

[23]Given that prediction, one may wonder why the principal would not set a very high c – perhaps by requiring very detailed and onerous expert reports. While not part of our model, we believe that such high costs may affect experts' willingness to serve on committees.

[24]Whether a member decides to become informed before or after receiving a bribe has no qualitative effects since we focus on the no-bribing equilibrium.

[25]Given that $s \sim U[-S, S]$, the value of information is

$$\Pr\{s > 0\}E[s|s > 0] + \Pr\{s < 0\}(0) - E[s] = \frac{S}{4}.$$

quisition, leading the principal to choose a one-member committee. In particular, consistent with Condorcet-type settings (e.g., Persico 2004), the optimal committee would involve no uninformed members to save on their participation costs. With outside influence, however, that is not the case, as our next result shows.

Proposition 5 *Suppose that $\eta_E < \frac{S}{4}$. Then, under an endogenous information setup, the optimal committee that deters capture has size $n^E = \lceil \frac{\mu v}{S} \rceil$. In equilibrium, only one member acquires information, and the remaining – uninformed – members all cast Accept votes.*

Given no bribery in equilibrium, the free-rider problem mentioned above implies that only one member acquires information. And under the unanimity voting rule, the remaining – uninformed – members all cast Accept votes and leave the approval of the project to the decisive vote of the informed member, meaning that the agent ideally would bribe only the informed member, but because he cannot identify that member, the principal raises his cost of bribing by appointing a larger committee, which contains mostly uninformed experts. Put differently, the principal intentionally appoints uninformed experts to ensure an unbiased informed decision by one of them, which is consistent with the role of nondisclosure considered above. It also is worth noting that unlike the baseline analysis with exogenously informed members, the optimal committee size under endogenous information depends on the mean corruptibility, μ, of one – informed – member as opposed to that of the least corruptible member, μ_n. Hence, Proposition 5 predicts a larger committee to deter bribing when information acquisition is costly to members.[26] To illustrate, recall from Example 1 that $n_0 = \left\lceil \sqrt{\frac{\mu v}{S}} \right\rceil$, which is smaller than n^E.

6.2 Agent

In the baseline analysis, like the principal, the agent is uninformed about the project's social value, s. As mentioned before, that assumption makes sense if, for instance, the principal keeps the evaluation criteria by which s is determined secret until she appoints the committee,

[26]In fact, no committee size would deter bribing if $\eta_E > \frac{S}{4}$. The reason is that with sufficiently high information costs, all members would remain uninformed and vote to accept the project in exchange for a negligible bribe. Anticipating such full capture, the principal would not appoint a committee.

or such criteria are too costly for the agent to discover. Otherwise, it is conceivable that the agent would invest in ascertaining s to better tailor his influence on the committee. To examine that possibility, suppose that before approaching committee members, the agent can perfectly learn s by paying a fixed cost $\eta_A \geq 0$, and his decision to do so is unobservable to the principal.

Clearly, if $s > 0$, an informed agent would not bribe any committee member since the project would be accepted regardless. If, on the other hand, $s \leq 0$, an informed agent would offer bribe b so that the pivotal member accepts the project, i.e., $s + \alpha_{\min} b > 0$ or, equivalently, $\alpha_{\min} > -s/b$, yielding to the agent the following indirect utility:

$$\pi_A^{I,-}(s,n) = \max_b \left[1 - G(-s/b)\right]^n (v - nb). \tag{8}$$

Hence, since $s \sim U[-S,S]$, the expected utility for an informed agent is given by

$$\pi_A^I(n) = \frac{1}{2}v + \frac{1}{2S}\int_{-S}^{0} \pi^{I,-}(s,n)ds. \tag{9}$$

For an uninformed agent, the decision to bribe is the same as in the baseline model. In particular, the principal can form a committee of n_0 members and ensure no capture by an uninformed agent, resulting in an expected payoff of:

$$\pi_A^U = \frac{1}{2}v. \tag{10}$$

Subtracting (10) from (9), the agent's value of information therefore is

$$\Delta(n) = \frac{1}{2S}\int_{-S}^{0} \pi_A^{I,-}(s,n)ds.$$

Clearly $\Delta(n) \geq 0$, but the agent will become informed if and only if the cost is justified, namely $\Delta(n) \geq \eta_A$. Applying the envelope theorem to (8), it readily can be checked that $\Delta(n)$ is decreasing in n, leading us to Proposition 6.

Proposition 6 *The optimal committee size is decreasing in the agent's information cost, η_A, and is given by:*

$$n^A = \begin{cases} N & \text{if} \quad \eta_A < \Delta(N) \\ \lceil \Delta^{-1}(\eta_A) \rceil & \text{if} \quad \Delta(N) \leq \eta_A \leq \Delta(n_0) \\ n_0 & \text{if} \quad \Delta(n_0) < \eta_A. \end{cases}$$

Proposition 6 says that it is easier for the principal to deter committee capture when the agent is less likely to share members' information about the project. In particular, the principal prefers an uninformed agent. As alluded to above, an informed agent bribes committee members just enough to secure their Accept votes and needs to do so only when his project is socially undesirable. Hence, bribing is less costly to an informed agent and requires a larger committee to discourage. Altogether we conclude that the principal prefers a smaller cost of information acquisition for experts and a larger cost of information for the agent.

7 Bribes versus threats

Besides promising them bribes conditional on a favorable decision, the agent also may make threats to committee members conditional on an unfavorable decision. Examples of threats include retaliation in kind, personal or property injury, bad publicity and violence. Intuition suggests that threats should provide members with incentives to vote similar to bribes and thus not qualitatively change the baseline analysis. We confirm that intuition below, but also prove that, all else equal, threats are harder for the principal to deter than bribes.

To formalize, suppose that in addition to bribe $b_i \geq 0$, the agent also threatens to impose a cost $t_i \geq 0$ on member i in the baseline model. Specifically, if the project is rejected by the committee, the member now receives a negative payoff: $-\beta_i t_i$, where $\beta_i \geq 0$ is his privately known "sensitivity" to threats. Threat t_i is commensurate to a bribe and assumed to cost the agent t_i up to a commonly known capacity (or credibility) constraint, $\overline{T}$:

$$\sum_{i=1}^{n} t_i \leq \overline{T}.$$

To focus purely on the agent's strategic choice between the two types of incentives, let $\beta_i = \alpha_i$ so that member i views bribes and threats to be perfect substitutes. Mathematically, given that others accept the project with probability $\phi_{-i} > 0$, member i would vote for the project if

$$\phi_{-i} \times (s + \alpha_i b_i) + (1 - \phi_{-i})(-\alpha_i t_i) > -\alpha_i t_i,$$

or, equivalently,

$$s + \alpha_i \times (b_i + t_i) > 0.$$

Assuming symmetric treatment of members by the agent as in the baseline model and letting $B = nb$ and $T = nt$, it follows that the project is accepted with probability: $\frac{S+\left(\frac{\mu_n}{n}\right)(B+T)}{2S}$. Hence, accounting for the fact that threats are fulfilled only when the project is rejected, the agent solves the following program, extending (3):

$$\max_{B\geq 0, T\leq \overline{T}} \pi_A^t = \left(\frac{S + \left(\frac{\mu_n}{n}\right)(B+T)}{2S}\right)(v - B) - \left(1 - \frac{S + \left(\frac{\mu_n}{n}\right)(B+T)}{2S}\right) T$$

or, simplifying,

$$\max_{B\geq 0, T\leq \overline{T}} \pi_A^t = \left(\frac{S + \left(\frac{\mu_n}{n}\right)(B+T)}{2S}\right)(v + T - B) - T. \tag{11}$$

Inspecting (11), it is evident that the agent's expected payoff π_A^t is concave in B but convex in T. Roughly speaking, although, being perfect substitutes for members, a marginal increase in B or T has the same positive effect on the project's acceptance, the agent need not pay T *ex post*, implying that, all else equal, the agent is more likely to use threats than bribes, requiring a larger committee to deter the former, as formalized in Proposition 7.

Proposition 7 *The optimal committee that deters capture with threats, i.e.,* $B^t = T^t = 0$, *has size* $n^t \geq n_0$, *where* n^t *is the smallest integer that satisfies:* $\frac{\mu_n}{n} \leq \frac{S}{v+\overline{T}}$. *Moreover,* n^t *is increasing in the agent's threat capacity,* $\overline{T}$.

To understand Proposition 7, note that since his expected payoff is convex in threats, the agent adopts an all-or-nothing strategy in using them – i.e., $T^t = 0$ or $\overline{T}$. In addition, since threats need not be fulfilled after a favorable committee decision, the agent has a larger stake in the project's approval, $v + \overline{T}$. Hence, the optimal committee that deters capture with threats is larger than that without them, and its size is increasing in the agent's threat capacity, $\overline{T}$. To that end, Proposition 7 suggests that when the pool of experts is too small to dilute threats on the committee, the principal may want to invest in raising the agent's cost of threatening, which effectively lowers $\overline{T}$, by shielding the committee members from outsiders, as in the case of jury sequestration.

8 Noisy information

To isolate the role of committees as a deterrent to capture, we have assumed in the baseline model that every member learns the social value of the project perfectly so that information aggregation is a nonissue. Here, we relax that assumption by introducing an exogenous source of noise. Let expert i receive signal s_i, which is uninformative with probability $\lambda \in [0, 1]$, but is accurate with probability $1 - \lambda$. In the former condition, s_i is a random draw from $U[-S, S]$ as before. For consistency, we continue to require unanimous agreement for project approval and, for tractability, we assume that experts are homogenous in their corruptibility, i.e., $\alpha_i = \alpha$ in this section, meaning that if experts were perfectly informed, $\lambda = 0$, a committee of size $n_0 = \lceil \frac{\alpha v}{S} \rceil$ would deter bribing. Next, we show that no such committee exists when experts are sufficiently uninformed.

Note that with noisy information, member i still follows a cut off voting strategy: accept the project if $s_i > s_i^*$, and reject it otherwise. As is common in the literature on strategic voting, we focus on symmetric equilibrium, i.e., $s_i^* = s^*$. Upon receiving bribe b and privately observing s_i, member i accepts the project if:

$$(1 - \lambda)s_i + \lambda \left((1 - \lambda^{n-1}) E[s|s_i, s^*, I] + \lambda^{n-1} E[s|s_i, s^*, U] \right) + \alpha b > 0,$$

where the left-hand side is the member's expected payoff from accepting the project in the event of being pivotal. Specifically, with probability $1 - \lambda$, member i's signal is correct. With probability λ, however, it is pure noise, in which case member i relies on at least one informed Accept vote, occurring with probability $1 - \lambda^{n-1}$, amongst the rest of the committee. Here, $E[s|s_i, s^*, I]$ and $E[s|s_i, s^*, U]$ represent the expected quality of the project conditional on equilibrium strategies as well as on having either at least one informed member or none, respectively.[27] Given the uniform distribution assumption, $E[s|s_i, s^*, I] = \frac{s^*+S}{2}$ and $E[s|s_i, s^*, U] = 0$. Hence, in equilibrium the following indifference equation must hold,

$$(1 - \lambda)s^* + \lambda(1 - \lambda^{n-1})\frac{s^* + S}{2} + \alpha b = 0,$$

[27] Recall that all informed members observe the same signal, so $E[s|s_i, s^*, I]$ is not conditioned on the number of informed members.

which yields the equilibrium cutoff: $s^* = -\frac{(\lambda-\lambda^n)S+2\alpha b}{2-\lambda-\lambda^n}$ and, in turn, the equilibrium probability of an Accept vote:

$$\phi^* = \min\left\{\frac{(1-\lambda^n)S+\alpha b}{(2-\lambda-\lambda^n)S}, 1\right\}. \tag{12}$$

Given ϕ^*, the project is approved with probability:

$$p_A(\phi^*;\lambda,n) = \phi^*\left(1-\lambda+\lambda\phi^*\right)^n + (1-\phi^*)\left(\lambda\phi^*\right)^n. \tag{13}$$

The first term in (13) reflects the project's acceptance conditional on its social value exceeding s^*, which occurs with probability ϕ^*. Conditional on the complementary event, $s < s^*$, the second term reflects acceptance, which requires all members to be uninformed. As expected, $p_A(\phi^*;0,n) = \phi^*$ and $p_A(\phi^*;1,n) = (\phi^*)^n$. Conjecturing (13), the agent solves the following program:

$$\max_{b\geq 0} \pi_A = p_A(\phi^*;\lambda,n)(v-nb)$$

Clearly, the agent has no incentive to bribe if $\partial\pi_A/\partial b|_{b=0} \leq 0$; otherwise, no committee can discourage bribing.

Proposition 8 *There exist $0 < \underline{\lambda} \leq \overline{\lambda} < 1$ such that a finite committee deters bribing for $\lambda \leq \underline{\lambda}$, but no such committee exists for $\lambda \geq \overline{\lambda}$.*

Proposition 8 follows from a continuity argument: we know from the baseline model that a committee of finite size n_0 deters bribing when experts are perfectly informed, $\lambda = 0$, whereas no such committee can be found when experts are perfectly uninformed, $\lambda = 1$, since they are willing to accept the project in exchange for a negligible bribe, i.e., $\phi^* = 1$ for $b > 0$. As such, Proposition 8 reinforces Proposition 5: less informed experts are more susceptible to outside influence, and committees that rely on such experts need to be larger to prevent capture.

9 Conclusion

Committees are a fixture of collective decision-making in modern society. Following Condorcet (1785), much of the existing literature stresses their ability to draw upon the diverse opinions of their constituent members. In this paper, following the Chicago school's capture theory of regulation, we have offered a complementary explanation: committees may also serve to minimize outside influence by parties having stakes in committee decisions. We have argued that a committee that contains enough members, each granted a decisive vote (as with a unanimity rule), can make capture unprofitable for the stakeholders in its decision. As such, we predict an optimal committee to be larger in environments that are more vulnerable to capture: when outsiders have larger stakes in the decision, submit lower quality projects for approval, or when committee members potentially are more corruptible and poorly informed on the issue before them. We have shown further that keeping the committee's identity anonymous from the interested parties as well as requiring its members to justify their votes can help deter capture. Nevertheless, it also follows from our results that a committee may be captured if it cannot be optimally designed, such as when its members are sufficiently uninformed or when they are sufficiently self-motivated. In fact, a future extension of the analyses presented herein might examine how to design a self-motivated committee that maximizes bribes from special interests.

In closing, we note that one could test our predictions by comparing an actual committee's size to that needed for accurate (unbiased) information aggregation. For instance, the optimal committee in a purely informational setting should be relatively small if the signals about a project's social value received by members are highly correlated (perhaps because their information sources and expertise are similar), or if signals are significantly costly to acquire so that the free-riding problem is severe. One could also test our predictions by looking into committee sizes for cross-sections of project qualities and stakes in the decision.

Appendix A: proofs of formal results

Proof of Lemma 1. Immediately follows from the argument in the text. ■

Before proving Proposition 1, we introduce the agent's "relaxed" problem for a given committee of size n and voting rule k, denoted by the pair (n, k). Let the agent bribe m members, each in the amount $b \geq 0$. Clearly, the optimal m must be either $m = 0$ or $k \leq m \leq n$. Suppose that $k \leq m \leq n$. Then, from the agent's viewpoint, the pivotal voter is the member whose α is the kth highest among the bribed since if this voter accepts the project, so will $k - 1$ others with greater α's, ensuring the project's approval. Statistically, the pivotal voter has α that is the $(m - k + 1)$th order statistic in a sample of size m (for $k = m$, the order statistic reduces to the sample minimum). Let $\alpha_{k,m}$ and $\mu_{k,m} = E[\alpha_{k,m}]$ denote the pivotal voter and his mean corruptibility, with the convention that $\mu_{k,m} = 0$ for $k > m$ and, for notational ease, let $\mu_{m,m} = \mu_m$ as in the text. The following fact is immediate from the properties of the order statistics.

Fact A1 *For $k < m$, $\mu_{k,m}$ is strictly decreasing in k. Moreover, μ_m is strictly decreasing in m.*

Proof. The first conclusion obtains directly by the definition of the order statistics and the assumption that $G(\alpha)$ is nondegenerate and continuous. To see the second, note that μ_m is the mean of the first-order statistic. Hence, by definition, $\mu_m = \int_{\underline{\alpha}}^{\overline{\alpha}} \alpha dG_{\min}(\alpha)$, where $G_{\min}(\alpha) = 1 - [1 - G(\alpha)]^m$. Integrating by parts, we have

$$\mu_m = \underline{\alpha} + \int_{\underline{\alpha}}^{\overline{\alpha}} [1 - G(\alpha)]^m d\alpha. \tag{A-1}$$

From (A-1), it follows that μ_m is strictly decreasing in m. ■

For a fixed committee (n, k), the agent's "original" problem can be written:

$$\begin{aligned} \max_{b \geq 0, m \geq 0} \widehat{\pi}_A &= \Pr\{s + \alpha_{k,m} b > 0\}(v - mb) \\ &= E\left[\min\left\{\frac{S + \alpha_{k,m} b}{2S}, 1\right\}\right](v - mb) \end{aligned} \tag{OP}$$

where the second line follows because $s \sim U[-S, S]$. By Jensen's Inequality, note that

$$E\left[\min\left\{\frac{S + \alpha_{k,m} b}{2S}, 1\right\}\right] \leq \min\left\{\frac{S + \mu_{k,m} b}{2S}, 1\right\} \leq \frac{S + \mu_{k,m} b}{2S}.$$

Given this, we can write the agent's relaxed problem:

$$\max_{b \geq 0, m \geq 0} \pi_A = \left(\frac{S + \mu_{k,m} b}{2S}\right)(v - mb). \tag{RP}$$

Letting $B = mb$ and $M(k,m) = \frac{\mu_{k,m}}{m}$, the relaxed problem can be re-stated more conveniently as:

$$\max_{B\geq 0, m\geq 0} \pi_A = \left(\frac{S + M(k,m)B}{2S}\right)(v - B).$$

Conditional on m, the optimal total bribe in (RP) is found to be:

$$B^R(k,m) = \begin{cases} \frac{1}{2}\left[v - \frac{S}{M(k,m)}\right] & \text{if} \quad M(k,m) > \frac{S}{v} \\ 0 & \text{if} \quad M(k,m) \leq \frac{S}{v}. \end{cases} \tag{A-2}$$

Claim A1 *Fix a committee (n,k). Then, the agent does not bribe in the relaxed problem if and only if he does not bribe in the original problem.*

Proof. The sufficiency part is obvious because the agent cannot be worse off under (RP) and, without bribing, he receives the same payoff of $\frac{v}{2}$ in both (OP) and (RP). To prove the necessity, suppose that the agent chooses not to bribe under (OP) but bribes some members under (RP): $\frac{\partial}{\partial b}\widehat{\pi}_A\Big|_{b=0} \leq 0$ for all m, and from (A-2), $M(k,m') > \frac{S}{v}$ for some $m' \geq k$. In particular, $\frac{\partial}{\partial b}\widehat{\pi}_A\Big|_{b=0} \leq 0$ for $m = m'$. Note from (OP) that

$$\widehat{\pi}_A = \left[\int_{\underline{\alpha}}^{\min\{S/b,\overline{\alpha}\}} \frac{S+\alpha b}{2S} dG_{k,m}(\alpha) + 1 - G_{k,m}(\min\{S/b,\overline{\alpha}\})\right](v - m'b),$$

where $G_{k,m}$ represents the cumulative distribution of $\alpha_{k,m}$. Simple algebra shows that

$$\frac{\partial}{\partial b}\widehat{\pi}_A = \left(\int_{\underline{\alpha}}^{\min\{S/b,\overline{\alpha}\}} \frac{\alpha}{2S} dG_{k,m}(\alpha)\right)(v - m'b) - m'\left[\int_{\underline{\alpha}}^{\min\{S/b,\overline{\alpha}\}} \frac{S+\alpha b}{2S} dG_{k,m}(\alpha) + 1 - G_{k,m}(\min\{S/b,\overline{\alpha}\})\right],$$

and, in turn,

$$\begin{aligned} \frac{\partial}{\partial b}\widehat{\pi}_A\Big|_{b=0} &= \frac{\mu_{k,m'}}{2S}v - m'\frac{S}{2S} \\ &= \frac{vm'}{2S}\left[M(k,m') - \frac{S}{v}\right] \\ &> 0, \end{aligned}$$

yielding a contradiction. Hence, the agent would also choose not to bribe under (RP). ■

Proof of Proposition 1. We first show that (n_0, n_0) is the unique optimal committee that deters bribing. Suppose, to the contrary, that there is another committee $(n', k') \neq (n_0, n_0)$ that also deters bribing in equilibrium and $n' \leq n_0$. Then, $k' < n_0$. Moreover, by (A-2), $M(k', m) \leq \frac{S}{v}$ for all $m \leq n'$. In particular, $M(k', k') \leq \frac{S}{v}$. But since n_0 is the smallest integer that satisfies (4) and $M(k,k) = \frac{\mu_k}{k}$ is strictly decreasing in k by Fact A1, it must be that $k' \geq n_0$ – a contradiction. Hence, (n_0, n_0) is the unique optimal committee.

Part (a) directly follows from the definition of n_0. To prove part (b), recall from above that $G_{\min}(\alpha) = 1 - [1 - G(\alpha)]^n$ is the cumulative distribution of $\alpha_{\min}$. Clearly, if $G^1(\alpha) \leq G^2(\alpha)$ $\forall\alpha$ (i.e., G^1 first-order stochastically dominates G^2), then $G^1_{\min}(\alpha) \leq G^2_{\min}(\alpha)$ $\forall\alpha$, which implies $\mu^1_n \geq \mu^2_n$ and in turn $\frac{\mu^1_n}{n} \geq \frac{\mu^2_n}{n}$. Using (4) and the fact that $\frac{\mu_n}{n}$ is strictly decreasing in n, the desired conclusion is reached.

Finally, to prove part (c), let H and G be two continuous cumulative distributions on the support $[\underline{\alpha}, \overline{\alpha}]$. And suppose that H is a (simple) mean-preserving spread of G (or G is a (simple) mean-preserving contraction of H) in the sense of Diamond and Stiglitz (1974): **C1**: $\int_{\underline{\alpha}}^{\overline{\alpha}} H(\alpha)d\alpha = \int_{\underline{\alpha}}^{\overline{\alpha}} G(\alpha)d\alpha$ and **C2**: for a unique $\widehat{\alpha} \in (\underline{\alpha}, \overline{\alpha})$, $H(\alpha) > (<) G(\alpha)$ when $\alpha < (>) \widehat{\alpha}$. Given (4), it suffices to prove that the means of the sample minimums are ordered: $\Delta \equiv \mu_n(G) - \mu_n(H) > 0$ for $n > 1$. By definition,

$$\Delta = \int_{\underline{\alpha}}^{\overline{\alpha}} \alpha n \left[1 - G(\alpha)\right]^{n-1} dG(\alpha) - \int_{\underline{\alpha}}^{\overline{\alpha}} \alpha n \left[1 - H(\alpha)\right]^{n-1} dH(\alpha),$$

which, using integration by parts and canceling terms, reduces to

$$\Delta = \int_{\underline{\alpha}}^{\overline{\alpha}} \left[(1 - G(\alpha))^n - (1 - H(\alpha))^n\right] d\alpha.$$

Recalling the algebraic factorization: $a^n - b^n = (a - b)Q(a, b)$, where $Q(a, b) = \sum_{i=1}^{n} a^{n-i} b^{i-1}$, we have that

$$\begin{aligned}
\Delta &= \int_{\underline{\alpha}}^{\overline{\alpha}} \left[H(\alpha) - G(\alpha)\right] Q(1 - G(\alpha), 1 - H(\alpha)) d\alpha \\
&= \int_{\underline{\alpha}}^{\widehat{\alpha}} \left[H(\alpha) - G(\alpha)\right] Q(1 - G(\alpha), 1 - H(\alpha)) d\alpha + \int_{\widehat{\alpha}}^{\overline{\alpha}} \left[H(\alpha) - G(\alpha)\right] Q(1 - G(\alpha), 1 - H(\alpha)) d\alpha
\end{aligned}$$

where $\widehat{\alpha}$ is as defined in C2 above. Since $Q(a, b)$ is strictly increasing in both arguments, we further have that

$$\begin{aligned}
\Delta &> \int_{\underline{\alpha}}^{\widehat{\alpha}} \left[H(\alpha) - G(\alpha)\right] Q(1 - G(\widehat{\alpha}), 1 - H(\widehat{\alpha})) d\alpha + \int_{\widehat{\alpha}}^{\overline{\alpha}} \left[H(\alpha) - G(\alpha)\right] Q(1 - G(\widehat{\alpha}), 1 - H(\widehat{\alpha})) d\alpha \\
&= Q(1 - G(\widehat{\alpha}), 1 - H(\widehat{\alpha})) \int_{\underline{\alpha}}^{\overline{\alpha}} \left[H(\alpha) - G(\alpha)\right] d\alpha.
\end{aligned}$$

Since $\displaystyle\int_{\underline{\alpha}}^{\overline{\alpha}} \left[H(\alpha) - G(\alpha)\right] d\alpha = 0$ by C1, we conclude that $\Delta > 0$, as claimed. ∎

To prove Propositions 2 and 3, we first define the equilibrium under nondisclosure and then prove Claims A2-A6. To that end, let $p(m, n) = \frac{\binom{m}{n}}{\binom{N}{n}}$ be the probability that if m out of N experts are bribed randomly, an n-member committee would lie in among them. Also, slightly abusing the notation above, let

$$M(m,n) = \frac{\mu_n}{m}.$$

Clearly, $M(m,n)$ is strictly decreasing in both arguments by Fact A1.

Definition A1 Suppose that the committee's identity is not disclosed – neither its size nor its members. We say that the triple (n^{nd}, m^{nd}, b^{nd}) is a pure strategy Nash equilibrium if:

1. *(**Principal**) Given (m^{nd}, b^{nd}), n^{nd} solves*

$$\begin{aligned} \max_{n \geq 1} \pi_P &= \left[p(m^{nd}, n) \int_{-\mu_n b^{nd}}^{S} \frac{s}{2S} ds + \left[1 - p(m^{nd}, n) \right] \int_0^S \frac{s}{2S} ds \right] - n\varepsilon \qquad \text{(A-3)} \\ &= \frac{S}{4} - p(m^{nd}, n) \frac{(\mu_n b^{nd})^2}{4S} - n\varepsilon. \end{aligned}$$

2. *(**Agent**) Given $n^{nd} \geq 1$, (m^{nd}, b^{nd}) solves*

$$\begin{aligned} \max_{m,b} \pi_A &= \left[p(m, n^{nd}) \left(\frac{S + \mu_{n^{nd}} b}{2S} \right) + (1 - p(m, n^{nd})) \frac{1}{2} \right] (v - mb) \qquad \text{(A-4)} \\ &= \left(\frac{1}{2} + \frac{p(m, n^{nd}) M(m, n^{nd})}{2S} mb \right) (v - mb). \end{aligned}$$

Claim A2 *Given $n^{nd} \geq 1$, it is optimal for the agent to bribe all N experts – i.e., $m^{nd} = N$, with strict optimality for $n^{nd} > 1$. Moreover, $b^{nd} = \frac{1}{2N} \left(v - \frac{S}{M(N, n^{nd})} \right)$ for $M(N, n^{nd}) > \frac{S}{v}$.*

Proof. From the first-order condition of (A-4), it is immediate that given m,

$$b^{nd} = \frac{1}{2m} \left[v - \frac{S}{p(m, n^{nd}) M(m, n^{nd})} \right]$$

whenever $\frac{S}{v} < p(.)M(.)$. Next, by definition, for any $m \in [n^{nd}, N)$,

$$\underbrace{p(N, n^{nd})}_{=1} M(N, n^{nd}) = p(m, 1) M(m, n^{nd}).$$

Since $p(m, 1) \geq p(m, n)$, with strict inequality for $n > 1$, it follows that $p(N, n^{nd}) M(N, n^{nd}) \geq p(m, n^{nd}) M(m, n^{nd})$, with strict inequality for $n^{nd} > 1$. Moreover, by the envelope theorem, the agent's optimal payoff in (A-4) is increasing in $p(.)M(.)$, which implies that given n^{nd}, it is optimal for the agent to bribe all experts – i.e., $m^{nd} = N$, with strictly optimality whenever $n^{nd} > 1$. Hence, $p(m^{nd}, n^{nd}) M(m^{nd}, n^{nd}) = M(N, n^{nd})$ and b^{nd} reduces to the expression stated. ■

Claim A3 *If $N \geq \overline{N}$, then $n^{nd} = 1$ and $b^{nd} = 0$, where $\overline{N} = \lceil \frac{\mu v}{S} \rceil$.*

Proof. It directly follows from the arguments preceding Proposition 2 in the text. ■

Before stating Claim A4, recall from Proposition 2 that $\overline{n}_0$ is the smallest integer such that $\frac{\mu_n}{N} \leq \frac{S}{v}$.

Claim A4 *$\overline{n}_0 \leq n_0$, and $\overline{n}_0$ is decreasing in N, with $\overline{n}_0 > 1$ for $n_0 \leq N < \overline{N}$, and $\overline{n}_0 = 1$ for $N \geq \overline{N}$.*

Proof. Directly follows from the definition of n_0 in Proposition 1 and the fact that μ_n is strictly decreasing in n (Fact A1). ■

The following statistical fact is instrumental to prove Claim A5.

Fact A2 *Both $\mu_n - \mu_{n+1}$ and $\mu_n^2 - \mu_{n+1}^2$ are strictly decreasing in n.*

Proof. From (A-1), we find

$$\mu_n - \mu_{n+1} = \int_{\underline{\alpha}}^{\overline{\alpha}} [1 - G(\alpha)]^n G(\alpha) d\alpha. \tag{A-5}$$

Clearly, $\mu_n - \mu_{n+1}$ is strictly decreasing in n and so does $\mu_n^2 - \mu_{n+1}^2$ because $\mu_n^2 - \mu_{n+1}^2 = (\mu_n - \mu_{n+1})(\mu_n + \mu_{n+1})$. ■

Claim A5 *Suppose the principal does not disclose the committee's identity. Then, there exists $\overline{\varepsilon} > 0$ such that for $\varepsilon \in (0, \overline{\varepsilon})$ and $n_0 \leq N < \overline{N}$, there is a unique equilibrium, in which the principal mixes between committee sizes $\overline{n}_0 - 1$ and $\overline{n}_0$.*

Proof. Suppose that $n_0 \leq N < \overline{N}$. Then, $\overline{n}_0 > 1$ by Claim A4. Let the principal mix between the committee sizes $\overline{n}_0 - 1$ and $\overline{n}_0$, placing probabilities $\phi \in (0, 1)$ and $1 - \phi$, respectively. To characterize, we extend (A-4) to accommodate for mixing:

$$\max_{m,b} \pi_A = \left(\frac{1}{2} + \phi p(m, \overline{n}_0 - 1) \frac{\mu_{\overline{n}_0 - 1} b}{2S} + (1 - \phi) p(m, \overline{n}_0) \frac{\mu_{\overline{n}_0} b}{2S} \right) (v - mb).$$

Let $m^o(\phi)$ denote the optimal number of bribes. Then, applying the same arguments as in the proof of Claim A2, we find $m^o(\phi) = N$ and therefore

$$b^o(\phi) = \max\{ \frac{1}{2N} \left[v - \frac{S}{\phi M(N, \overline{n}_0 - 1) + (1 - \phi) M(N, \overline{n}_0)} \right], 0\}. \tag{A-6}$$

Note that for the principal to mix between the committee sizes $\overline{n}_0 - 1$ and $\overline{n}_0$, she must be indifferent: $\pi_P(\overline{n}_0 - 1) = \pi_P(\overline{n}_0)$, which, from (A-3), implies that $\left(\mu_{\overline{n}_0 - 1}^2 - \mu_{\overline{n}_0}^2 \right) \frac{(b^{nd})^2}{4S} = \varepsilon$ or, equivalently,

$$b^{nd} = \sqrt{\frac{4S\varepsilon}{\mu_{\overline{n}_0 - 1}^2 - \mu_{\overline{n}_0}^2}} > 0. \tag{A-7}$$

Since, by definition, $b^{nd} = b^o(\phi^{nd})$, we see from (A-6) that, for a sufficiently small $\varepsilon > 0$, there is a unique probability $\phi^{nd} \in (0,1)$ that supports the principal's mixing between $\overline{n}_0 - 1$ and $\overline{n}_0$. To show that such mixing by the agent is indeed an equilibrium, we next argue that the principal has no incentive to deviate given that $m^{nd} = N$ and the agent pays b^{nd} to each expert (recall that, under nondisclosure, the principal and the agent play a simultaneous game).

For notational convenience, let

$$L(n) = \frac{(\mu_n b^{nd})^2}{4S} = \frac{\mu_n^2}{\mu_{\overline{n}_0-1}^2 - \mu_{\overline{n}_0}^2}\varepsilon \tag{A-8}$$

be the principal's expected loss in (A-3) from the committee's biased decision given b^{nd} and the committee size n. Clearly, $L(n) \to 0$ and $n\varepsilon \to 0$ as $\varepsilon \to 0$. Hence, by (A-3), the principal is strictly better off by appointing at least one expert for a sufficiently small ε. Suppose, to the contrary, that the principal deviates to a committee size $n_1 < \overline{n}_0 - 1$. Then, from (A-3), it must be that

$$\frac{S}{4} - L(n_1) - n_1\varepsilon \geq \frac{S}{4} - L(\overline{n}_0 - 1) - (\overline{n}_0 - 1)\varepsilon, \tag{A-9}$$

or, using (A-8) and simplifying terms,

$$\overline{n}_0 - 1 - n_1 \geq \frac{\mu_{n_1}^2 - \mu_{\overline{n}_0-1}^2}{\mu_{\overline{n}_0-1}^2 - \mu_{\overline{n}_0}^2}. \tag{A-10}$$

Since, by Fact A2, the change $\mu_n^2 - \mu_{n+1}^2$ is strictly negative and strictly decreasing in n (i.e., μ_n^2 is strictly decreasing and strictly "convex"), the following slope conditions must also hold:

$$\frac{\mu_{\overline{n}_0-1}^2 - \mu_{n_1}^2}{\overline{n}_0 - 1 - n_1} < \frac{\mu_{\overline{n}_0}^2 - \mu_{\overline{n}_0-1}^2}{\overline{n}_0 - (\overline{n}_0 - 1)} \Leftrightarrow \overline{n}_0 - 1 - n_1 < \frac{\mu_{n_1}^2 - \mu_{\overline{n}_0-1}^2}{\mu_{\overline{n}_0-1}^2 - \mu_{\overline{n}_0}^2}, \tag{A-11}$$

contradicting (A-10). An analogous argument also rules out a deviation to $n_2 > \overline{n}_0$. Hence, the principal's mixing between $\overline{n}_0 - 1$ and $\overline{n}_0$ is an equilibrium.

We now prove that this is the unique equilibrium. To do so, suppose that the principal mixes over some committee sizes $n_l < n_h$ such that $n_h - n_l > 1$. We argue that the principal would strictly benefit from choosing $n \in (n_l, n_h)$ in this case. Suppose not. Then, by a similar payoff comparison to (A-9), we find

$$\frac{S}{4} - L(n_l) - n_l\varepsilon \geq \frac{S}{4} - L(n) - n\varepsilon,$$

which reveals

$$\frac{\mu_{n_l}^2 - \mu_{n_h}^2}{n_h - n_l} \geq \frac{\mu_{n_l}^2 - \mu_n^2}{n - n_l}.$$

Again, that contradicts the slope conditions similar to (A-11). Hence, $n_h - n_l = 1$. Next, we argue that the principal does not mix over three consecutive committee sizes. To the contrary, suppose that she mixes over n_l, $n_l + 1$, and $n_l + 2$. Then, the principal must be indifferent across:

$$\frac{S}{4} - \frac{(\mu_{n_l} b^{nd})^2}{4S} - n_l \varepsilon = \frac{S}{4} - \frac{(\mu_{n_l+1} b^{nd})^2}{4S} - (n_l+1)\varepsilon = \frac{S}{4} - \frac{(\mu_{n_l+2} b^{nd})^2}{4S} - (n_l+2)\varepsilon,$$

which implies that

$$\frac{\mu_{n_l}^2 - \mu_{n_l+1}^2}{4S}(b^{nd})^2 = \varepsilon = \frac{\mu_{n_l+1}^2 - \mu_{n_l+2}^2}{4S}(b^{nd})^2,$$

and in turn,

$$\mu_{n_l}^2 - \mu_{n_l+1}^2 = \mu_{n_l+1}^2 - \mu_{n_l+2}^2.$$

But that contradicts Fact A2 (that $\mu_n^2 - \mu_{n+1}^2$is strictly decreasing in n). Hence, the principal mixes only between n_l and $n_l + 1$ for some n_l. Finally, to prove that $n_l = \overline{n}_0 - 1$, we consider the two complementary cases. If $n_l \geq \overline{n}_0$, then, by setting the committee size $\overline{n}_0$ with probability 1, the principal would be strictly better off because $\overline{n}_0$ would deter bribing and economize on the participation cost, ε. Hence, $n_l \leq \overline{n}_0 - 1$. If $n_l \leq \overline{n}_0 - 2$, then $b^o(\phi) > 0$ for all $\phi \in [0, 1]$ (since, in this case, both n_l and $n_l + 1$ are strictly lower than $\overline{n}_0$). But then, for a sufficiently small ε, the principal would be strictly better off by choosing a larger committee size of $\overline{n}_0$, that ensures no bribing. Hence, $n_l \geq \overline{n}_0 - 1$ and together, $n_l = \overline{n}_0 - 1$, establishing the unique mixing. ■

Claim A6 *The principal's expected payoff under nondisclosure $\pi_P^{nd}(N)$ is increasing in N for $N \in [n_0, \overline{N})$, where $\overline{N} = \lceil \frac{\mu v}{S} \rceil$.*

Proof. Pick any $N_1 \in [n_0, \overline{N})$ and define $N_2 = \frac{v\mu_{\overline{n}_0(N_1)-1}}{S}$. By construction, $\overline{n}_0(N_2) = \overline{n}_0(N_1) - 1$ and given that $\overline{n}_0(N)$ is decreasing in N, we have that (i) $N_2 > N_1$ and (ii) $\overline{n}_0(N) = \overline{n}_0(N_1)$ for any $N \in (N_1, N_2)$. Suppose $N_2 \notin [n_0, \overline{N})$. Then, from (ii), $\overline{n}_0(N) = \overline{n}_0(N_1)$ for any $N > N_1$ in $[n_0, \overline{N})$. That implies $\pi_P^{nd}(N_1) = \pi_P^{nd}(N)$. Next, suppose $N_2 \in [n_0, \overline{N})$. Given that $\overline{n}_0(N_2) = \overline{n}_0(N_1) - 1$, we observe from Claim A5 that $\overline{n}_0(N_1) - 1$ is in the principal's mixing support when $N \in \{N_1, N_2\}$. Then we obtain

$$\pi_P^{nd}(N_2) - \pi_P^{nd}(N_1) = \left[\frac{\mu^2_{\overline{n}_0(N_1)-1}}{\mu^2_{\overline{n}_0(N_1)-1} - \mu^2_{\overline{n}_0(N_1)}} - \frac{\mu^2_{\overline{n}_0(N_1)-1}}{\mu^2_{\overline{n}_0(N_1)-2} - \mu^2_{\overline{n}_0(N_1)-1}} \right] \varepsilon > 0$$

where the inequality follows from the strict "convexity" of μ_n^2 in n (Fact A2), guaranteeing that $\mu^2_{\overline{n}_0(N_1)-2} - \mu^2_{\overline{n}_0(N_1)-1} > \mu^2_{\overline{n}_0(N_1)-1} - \mu^2_{\overline{n}_0(N_1)}$. Hence, $\pi_P^{nd}(N_1) \leq \pi_P^{nd}(N)$ for any N in $(N_1, N_2]$, where the inequality is strict at N_2.

By the same line of argument as above, there is some N_3 in $(N_2, \overline{N})$ such that $\pi_P^{nd}(N_2) \leq \pi_P^{nd}(N)$ for any N in $(N_2, N_3]$. Consequently, $\pi_P^{nd}(N_1) \leq \pi_P^{nd}(N)$ for any N in $(N_1, N_3]$. Iteratively applied, we obtain a sequence $N_2, N_3, ..., N_k$, such that (I) $\overline{n}_0(N_i) > \overline{n}_0(N_{i+1})$, (II) $\pi_P^{nd}(N_i) < \pi_P^{nd}(N_{i+1})$, and (III) $\overline{n}_0(N) = 1$ for any $N \geq N_k$. Moreover, from (III), it is clear that $\overline{N} = \lceil N_k \rceil$. Thus, $\pi_P^{nd}(N_1) \leq \pi_P^{nd}(N)$ for every N in $(N_1, \overline{N})$. Finally, since N_1 was chosen arbitrarily from $\left[n_0, \overline{N}\right)$, the claim follows. ■

Proof of Proposition 2. As indicated in Proposition 1, under disclosure, bribing is deterred by a committee of size n_0, which is independent of N and implies that $\pi_P^d = \frac{S}{4} - n_0\varepsilon$. Define $\Delta(N) = \pi_P^d - \pi_P^{nd}(N)$, and let $\underline{N}$ such that if $\Delta(n_0) \leq 0$, $\underline{N} = n_0$, and if $\Delta(n_0) > 0$, $\underline{N}$ is the smallest N such that $\Delta(N) \leq 0$ and $\Delta(N-1) > 0$. We argue that $\underline{N} \in \left[n_0, \overline{N}\right]$.

Suppose $\left[n_0, \overline{N}\right) \neq \varnothing$. By Claim A6, $\Delta(N)$ is decreasing in N. Moreover, $\Delta(\overline{N}) = -\left(n_0 - 1\right)\varepsilon < 0$ because $\pi_P^{nd} = \frac{S}{4} - \varepsilon$ for $N \geq \overline{N}$ by Claim A4, and $n_0 \geq 2$. Thus, if $\left[n_0, \overline{N}\right) \neq \varnothing$, $\underline{N}$ is well-defined in $\left[n_0, \overline{N}\right]$. If, on the other hand, $\left[n_0, \overline{N}\right) = \varnothing$ – i.e $n_0 = \overline{N}$, then, it trivially follows that $\underline{N} = \overline{N}$. From the definitions of $\Delta(N)$ and $\underline{N}$, and given that $\Delta(N)$ is decreasing in N, part (ii) follows. Similarly, if $N \geq \underline{N}$, the principal strictly prefers nondisclosure since $\Delta(N) < 0$ in that region. Moreover, for $N \in [\underline{N}, \overline{N})$, the principal uniquely mixes between the committee sizes $n^{nd} = \overline{n}_0$ and $\overline{n}_0 - 1$, as established in Claim A5. Finally, for $N \geq \overline{N}$, the optimal committee has $n^{nd} = 1$ as established in the text, proving part (i). ■

Proof of Proposition 3. If $N \geq \overline{N}$, Proposition 2 reveals that $n^{nd} = 1$ and $b^{nd} = 0$, which, again, the principal can replicate under partial disclosure but cannot improve upon.

Now consider $n_0 \leq N < \overline{N}$. As in the proof of Proposition 2, define $\overline{\Delta}(N) = \pi_P^d - \pi_P^{pd}(N)$, where π_P^{pd} represents the principal's payoff under partial disclosure. Also define N_0 such that if $\overline{\Delta}(n_0) \leq 0$, $N_0 = n_0$, and if $\overline{\Delta}(n_0) > 0$, N_0 is the smallest N such that $\overline{\Delta}(N) < 0$ and $\overline{\Delta}(N-1) \geq 0$. We show that $N_0 \in \left[n_0, \overline{N}\right]$. Suppose that $\left[n_0, \overline{N}\right) \neq \varnothing$. Since n_0 and $\overline{n}_0(N)$ (recall that n_0 does not depend on N) are the smallest committee sizes that deter bribing under full and partial disclosure regimes, we have that

$$\overline{\Delta}(N) = \left[\overline{n}_0(N) - n_0\right]\varepsilon.$$

By Claim A4, $\overline{\Delta}(N)$ is decreasing in N, and $\overline{\Delta}(n_0) \leq 0$. Moreover, $n_0(\overline{N}) = 1$ and thus $\overline{\Delta}(\overline{N}) = (1 - n_0)\varepsilon < 0$. Together, these three observations imply that $N_0 \in \left[n_0, \overline{N}\right]$.

If $\left[n_0, \overline{N}\right) = \varnothing$ – i.e., $n_0 = \overline{N}$, it trivially follows that $N_0 = \overline{N}$. From the definition of N_0, and given that $\overline{\Delta}(N)$ is decreasing in N, the principal strictly prefers partial disclosure to full disclosure whenever $N_0 \leq N < \overline{N}$. To see that the principal also strictly prefers partial disclosure to no disclosure in this region of N, we simply note that

$$\frac{S}{4} - \overline{n}_0(N)\varepsilon = \pi_P^{pd} > \pi_P^{nd}(N) = \frac{S}{4} - L(\overline{n}_0(N)) - \overline{n}_0(N)\varepsilon,$$

since $L(\overline{n}_0(N)) > 0$ as defined in (A-8). ■

Proof of Proposition 4. The first two observations directly follow from (7) and the fact that $\frac{\mu_n}{n}$ is strictly decreasing in n. To show the last observation, note that under *ex ante* vote justification, member i who receives bribe b accepts the project if and only if: (I) $s > 0$; or (II) $s \leq 0$ and $\phi_{-i} \times (s + \alpha_i b) - J(s) > 0$, where $\phi_{-i} > 0$ is the probability that other members accept the project. Re-arranging (II), we have $s + \alpha_i b - \frac{1}{\phi_{-i}} J(s) > 0$. Since $\frac{1}{\phi_{-i}} \geq 1$, the result follows. ■

Proof of Proposition 5. Suppose that $\eta_E < \frac{S}{4}$. Conjecturing no bribery in equilibrium, each committee member cares only about s, making information about s a pure public good among them. Since information decisions are sequential and observable within the committee, it is clear that only the last member in the sequence will pay η_E and become informed. Let i be the informed member, who is known to member $j \neq i$ but unknown to the agent. In particular, the agent believes that each member is equally likely to be informed. Let the agent bribe m out of n members randomly, each in the amount of $b \geq 0$. Note that an uninformed member j votes to accept the project since his expected payoff cannot be lower than $E[s|s > -\alpha_i b] \geq 0$ – the expected social value of the project when he does not receive b, but the informed member does. Then, with probability $\frac{m}{n}$, the agent targets the informed member, in which case his project is accepted with probability $\left(\frac{S+\mu b}{2S}\right)$ whereas, with probability $\left(1 - \frac{m}{n}\right)$, the agent misses the informed member, in which case his project is accepted with probability $\frac{1}{2}$. Together, the agent solves

$$\max_{b \geq 0, m \geq 0} \pi_A = \left[\frac{m}{n}\left(\frac{S + \mu b}{2S}\right) + \left(1 - \frac{m}{n}\right)\frac{1}{2}\right](v - mb).$$

Simplifying terms and letting $B = mb$,

$$\max_B \pi_A = \left(\frac{S + \frac{\mu}{n}B}{2S}\right)(v - B).$$

From here, $B^* = 0$ if and only if $n \geq \frac{\mu v}{S}$, implying an optimal committee of size: $n^E = \left\lceil \frac{\mu v}{S} \right\rceil$, as claimed. ■

Proof of Proposition 6. First it can be verified from (8) that an informed agent will choose a positive bribe for any given $s < 0$ (otherwise, he knows his project will be rejected with probability 1). If the principal expects an uninformed agent, she optimally will set the committee size to be n_0 and deter bribing by Proposition 1. To determine information acquisition by the agent, recall from the text that the value of information $\Delta(n)$ is strictly decreasing in n. Hence, since $n_0 \leq N$ by Assumption 2, $\Delta(N) \leq \Delta(n_0)$, with a strict inequality for $n_0 < N$. If $\Delta(n_0) < \eta_A$, the agent remains uninformed for all n and the optimal committee size is therefore n_0. At the other extreme, if $\eta_A < \Delta(N)$, then the agent becomes informed for all n, and to minimize bribing for all s, the principal forms the largest committee of size N. Finally, suppose $\Delta(N) \leq \eta_A \leq \Delta(n_0)$. Then, the optimal committee size is the smallest $n \in \{n_0, ..., N\}$ that discourages information acquisition – i.e., $\Delta(n) \leq \eta_A < \Delta(n-1)$ – and since such $n \geq n_0$, it also deters bribing. As noted in the proposition, that corresponds to $n = \lceil \Delta^{-1}(\eta_A) \rceil$. Since $\Delta^{-1}(\eta_A)$ is decreasing in η_A, so is the optimal committee size. ■

Proof of Proposition 7. Note from (11) that π_A^t is strictly concave in B. Hence, $B^t = 0$ if and only if

$$\frac{\partial}{\partial B}\pi_A^t\bigg|_{B=0} = \frac{\frac{\mu_n}{n}v - S}{2S} \leq 0 \Longleftrightarrow \frac{\mu_n}{n} \leq \frac{S}{v},$$

which, by Proposition 1, implies that the principal can deter bribing by choosing a committee size $n \geq n_0$. Without loss of generality, set $B = 0$, which reduces (11) to:

$$\pi_A = \left(\frac{S + \frac{\mu_n}{n}T}{2S}\right)(v + T) - T. \tag{A-12}$$

Clearly, π_A is strictly convex in T. Hence, the optimal threat is either $T^t = 0$ or $\overline{T}$. And $T^t = 0$ if and only if $\pi_A|_{T=\overline{T}} \leq \pi_A|_{T=0}$ or, more explicitly,

$$\left(\frac{S + \frac{\mu_n}{n}\overline{T}}{2S}\right)(v + \overline{T}) - \overline{T} \leq \frac{v}{2}. \tag{A-13}$$

Simple algebra reveals that (A-13) holds if and only if

$$\frac{\mu_n}{n} \leq \frac{S}{v + \overline{T}}. \tag{A-14}$$

Since $\frac{\mu_n}{n}$ is strictly decreasing in n, the optimal committee size n^t that deters capture is the smallest integer that satisfies (A-14) and it is decreasing in $\overline{T}$, as claimed. ■

Proof of Proposition 8. The agent has no local incentive to bribe if $\partial\pi_A/\partial b|_{b=0} \leq 0$ or, equivalently,

$$\frac{dp_A(\phi^*; \lambda, n)}{db}(v - nb) - np_A(\phi^*; \lambda, n)\bigg|_{b^*=0} \leq 0. \tag{A-15}$$

Using (12) and (13), and letting $\phi^*|_{b=0} = \phi_0$, (A-15) reduces to:

$$\begin{aligned}
\frac{\alpha v}{S} &\leq \frac{n(2-\lambda-\lambda^n)p_A(\phi_0;\lambda,n)}{\partial p_A(\phi_0;\lambda,n)/\partial\phi} \\
&= \frac{n(2-\lambda-\lambda^n)p_A(\phi_0;\lambda,n)}{n\lambda p_A(\phi_0;\lambda,n-1)+(1-\lambda+\lambda\phi_0)^n-(\lambda\phi_0)^n} \\
&\equiv RHS(\lambda,n).
\end{aligned}$$

Note that

$$\begin{aligned}
RHS(\lambda,n) &\leq \frac{n(2-\lambda-\lambda^n)p_A(\phi_0;\lambda,n)}{n\lambda p_A(\phi_0;\lambda,n)+(1-\lambda+\lambda\phi_0)^n-(\lambda\phi_0)^n} \\
&< \frac{n(2-\lambda-\lambda^n)p_A(\phi_0;\lambda,n)}{n\lambda p_A(\phi_0;\lambda,n)} \\
&= \frac{2}{\lambda}-1-\lambda^{n-1} \\
&\equiv \overline{RHS}(\lambda,n).
\end{aligned}$$

Clearly, (1) $\overline{RHS}(\lambda,n)$ is strictly decreasing in λ, with $\overline{RHS}(\lambda,n) \to 0$ as $\lambda \to 1$, and (2) $\overline{RHS}(\lambda,n)$ is strictly increasing in n, with $\overline{RHS}(\lambda,n) \to \frac{2}{\lambda}-1$ as $n \to \infty$. Recall $n_0 = \lceil \frac{\alpha v}{S} \rceil$ and let $\overline{\lambda} = \frac{2}{n_0+1}$ ($\overline{\lambda} < 1$ since $n_0 \geq 2$ by Assumption 1). Then, by (1) and (2), $\overline{RHS}(\lambda,n) < n_0$ for $\lambda \geq \overline{\lambda}$ for all n. Thus, $\partial\pi_A/\partial b|_{b=0} > 0$ for $\lambda \geq \overline{\lambda}$, implying that no committee size deters bribing.

Next, note that $p_A = \frac{1}{2}$ and $\phi_0 = \frac{1}{2}$ for $\lambda = 0$. Therefore, $RHS(0,n) = n$, which implies that $n = n_0$ satisfies (A-15) for $\lambda = 0$. Moreover, since $RHS(\lambda,n)$ is continuous in λ, there exists $\underline{\lambda} > 0$ such that (A-15) is satisfied for some $n < \infty$ and $\lambda < \underline{\lambda}$. One can show further that $\pi_A(.)$ is single-peaked in b in this region, so deterring bribing locally is sufficient. ■

Appendix B: on symmetric bribes

Throughout the analysis, the agent is assumed to bribe members equally. In this appendix, we show that such equal bribing is without loss of generality (as claimed in Remark 1 in the text) if a monotone hazard-rate condition on the (random) corruptibility parameter α is satisfied.

Proposition B1 *Consider a committee of size n and the unanimity rule as in the baseline model and suppose that* $\frac{d}{d\alpha}\left(\frac{G'(\alpha)}{1-G(\alpha)}\right) \geq 0$ *for all* $\alpha \in [\underline{\alpha}, \overline{\alpha}]$*. Then, fixing the total bribe* $\overline{B} > 0$*, it is optimal for the agent to bribe members equally – i.e.,* $b_i^* = \frac{\overline{B}}{n}$*.*

Proof. Fix the total bribe $\overline{B} > 0$ and let $\mathbf{b} = (b_1, ..., b_n)$ be the profile of individual bribes. Recall that given b_i, member i votes for the project if $s + \alpha_i b_i > 0$, where $\alpha_i \sim G(\alpha)$. Let $z_i = \alpha_i b_i$ and $z_{\min} = \min_{1 \le i \le n}\{z_i\}$. Then, under the unanimity rule, the pivotal voter has $z_{\min}$ whose cumulative distribution is found to be

$$\begin{aligned} H(z;\mathbf{b}) &= \Pr\{z_{\min} \le z\} \\ &= 1 - \Pr\{z_{\min} > z\} \\ &= 1 - \prod\nolimits_i \Pr(z_i > z) \\ &= 1 - \prod\nolimits_i \Pr(\alpha_i > \frac{z}{b_i}). \end{aligned}$$

Hence,

$$H(z;\mathbf{b}) = 1 - \prod\nolimits_i \left(1 - G\left(\frac{z}{b_i}\right)\right). \tag{B-1}$$

Note that fixing the total bribe, the agent chooses $\mathbf{b}$ that maximizes the probability of the project's acceptance:

$$\max_{\mathbf{b}} \int_0^{\infty} \left(\frac{S+z}{2S}\right) dH(z;\mathbf{b}) \text{ s.t. } \sum_i b_i = \overline{B}. \tag{B-2}$$

To solve (B-2), it suffices to minimize $H(z;\mathbf{b})$ or, equivalently, maximize $1 - H(z;\mathbf{b})$, for every $z \in (0, \infty)$, which, using (B-1), reduces the agent's problem to:

$$\max_{\mathbf{b}} \prod\nolimits_i \left(1 - G\left(\frac{z}{b_i}\right)\right) \text{ s.t.} \sum_i b_i = \overline{B}. \tag{B-3}$$

Without loss of generality, we replace the objective function with its log transformation: $\Lambda(\mathbf{b};z) \equiv \sum_i \ln\left(1 - G\left(\frac{z}{b_i}\right)\right)$. Note that if a solution, $\mathbf{b}^*$, to (B-3) exists, it must be that $b_i^* > 0$ for all i; otherwise, $\Lambda(;z) = -\infty$, which can be strictly improved upon. Since $\Lambda(\mathbf{b};z)$ is continuous in $\mathbf{b}$ when $b_i > 0$ for all i, $\mathbf{b}^*$ exists. Moreover, $\mathbf{b}^*$ is unique *if* $\Lambda(\mathbf{b};z)$ is strictly concave in $\mathbf{b}$. But the strict concavity easily follows from the facts that $\frac{\partial^2}{\partial b_i \partial b_j}\Lambda(\mathbf{b};z) = 0$ for all $i \neq j$, and

$$\frac{\partial^2}{\partial b_i^2}\Lambda(\mathbf{b};z) = -\frac{d}{d\alpha}\left(\frac{G'(\alpha)}{1-G(\alpha)}\right)\left(\frac{z}{b_i^2}\right)^2 + \frac{G'(\alpha)}{1-G(\alpha)}\left(-\frac{2z}{b_i^3}\right) < 0,$$

under the assumption that $\frac{d}{d\alpha}\left(\frac{G'(\alpha)}{1-G(\alpha)}\right) \ge 0$. Since a unique solution must be symmetric, we have that $b_i^* = \frac{\overline{B}}{n}$ for all i. ■

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