Do Shareholders Vote Strategically?

Voting Behavior, Proposal Screening, and Majority Rules

Supplement

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1 Additional Results on the Theory of Strategic Voting

1.1 Heterogeneous Preferences

In the paper, we assume that shareholders are homogenous and, therefore, rule out conflicts of interest. In Section 6 of the paper, we make some verbal claims, which we substantiate here.

Assume that N_I shares are held by management friendly shareholders (I stands for "insider") and N_O shares are held by independent outsiders (index O), where $N_I + N_O = N$. Assume that insiders have an additional benefit t_I from getting the proposal accepted, whereas outsiders incur a loss, so they receive a negative benefit denoted by $t_O < 0$. We think about t as a transfer from the insiders to the outsiders and therefore stipulate $N_I t_I + N_O t_O = 0$, $t_O < 0 < t_I$. The payoffs are then for each class $c \in \{I, O\}$:

$$v_c = \begin{cases} 1 + t_c & \text{in the good state} \\ -1 + t_c & \text{in the bad state} \end{cases} .$$

Note that the decision rule for the social planner has not changed because the aggregate payoffs are still $+1$ and -1, as in the model in the paper. The signals are the same as before.

Consider the case where k shareholders vote responsively and $N - k$ shareholders ignore their information. The cutoffs are different, because each class votes to accept the proposal as follows:

$$\beta - (1 - \beta) + t_c \geq 1 \quad \Leftrightarrow \quad \beta \geq \frac{1 - t_c}{2} .$$

For the homogeneous case with $t = 0$ we obtain again $\beta \geq 1/2$ as a cutoff. From $t_O < 0 < t_I$ we obtain critical cutoffs β_c such that $\beta_I < 1/2 < \beta_O$. For the purpose of this discussion, we denote by g the number of responsive votes. Hence, the proposal is accepted if the number of responsive shareholders who observe a good signal plus the number of non-responsive shareholders who always vote in favor of the proposal together exceed the statutory majority requirement. Then the logic of Appendix A and the derivation of Equation (5) in the paper leads to cutoffs g_I and g_O for the minimum number of responsive votes in favor as for each class of shareholders as:

$$g_c = \frac{k}{2} - \frac{1}{\ln\left(\frac{1-\varepsilon}{\varepsilon}\right)} \ln\left(\frac{p\,(1+t_c)}{(1-p)\,(1-t_c)}\right) \ .$$

Note that $\ln\left(\frac{1-\varepsilon}{\varepsilon}\right) > 0$, so g_c decreases with t_c. This is intuitive: class c shareholders need fewer positive signals to convince them to accept the proposal if they receive a higher payoff in the good state and a lower payoff in the bad state. We therefore have $g_I < g^* < g_O$, where g^* is the cut-off chosen by the coordinator if she can observe only k signals (with $k = N$ and $t_c = 0$ we obtain again Equation (5) in the paper with $g^* = a^*$).

The critical question is now whether shareholders from both classes can vote responsively. This requires that:

$$\beta\,(g-1,k) \leq \frac{1-t_c}{2} \leq \beta\,(g,k)$$

for both classes of shareholders, or:

$$\beta\,(g,k) - \beta\,(g-1,k) \geq \frac{1}{2}\,(t_I - t_O) \ .$$

The right hand side is a measure of the conflict of interest between the two classes of shareholders with respect to the proposal. Hence, if the conflict of interest is sufficiently small, then the analysis in the paper is not affected at all as the conditions for shareholders to vote responsively can be met. From the point of view of the analysis in the paper, this type of heterogeneity is negligible and of no relevance.

However, if the conflict of interest between insiders and outsiders is sufficiently large, so that the above condition is violated, then at most one class of shareholders votes responsively.[1] Here two possible types of equilibria can exist that are excluded by the homogeneity assumption in the paper:[2]

1. No shareholder votes responsively. Non-responsive equilibria always exist for any parametriza-

[1] There is a technical detail here: the left hand side of the condition above depends also on k. In fact, it decreases in k, so a larger number of responsive voters reduces the left hand side. So, there is no unique cutoff that separates types of equilibria simply based on $t_I - t_O$.

[2] We cannot rule out multiple responsive equilibria here.

tion, but responsive equilibria cannot exist if $\beta(0,N) > \frac{1-t_I}{2}$ (no amount of evidence against the proposal can convince the insiders to vote against) and at the same time $\beta(N,N) < \frac{1-t_O}{2}$ (no amount of evidence in favor of the proposal can persuade the outsiders to vote in favor).

2. Only one class of shareholders votes responsively. Then there are two cases to be considered, depending on whether $N_I < a$ (then outsiders decide on the proposal) or $N_I \geq a$ (insiders decide on the proposal):

   (a) Only the outsiders vote responsively, because $\beta(g-1,k) \leq \frac{1-t_O}{2} \leq \beta(g,k)$ is satisfied, but for the insiders we have $\beta(g-1,k) > \frac{1-t_I}{2}$. Then all N_I insiders always vote in favor. This type of equilibrium can therefore only exist if $N_I < a$, so that the insiders cannot decide on the proposal independently of the outsiders.

   (b) Only the insiders vote responsively, because $\beta(g-1,k) \leq \frac{1-t_I}{2} \leq \beta(g,k)$, whereas $\beta(a,k) < \frac{1-t_O}{2}$. Then the N_O outsiders always vote against. This type of equilibrium can therefore exist only if $N_O \leq N-a$ ($a \leq N_I$), so that the outsiders cannot veto the proposal.

The first situation where no responsive equilibrium exists is the case where the information about the proposal is irrelevant and the proposal is entirely about redistribution between insiders and outsiders. The empirical prediction is then that voting outcomes and majority requirements are unrelated. We therefore test for this (Test 1 in the paper) and rule out this scenario based on our results.

In the second situation we always have three groups of shareholders. Consider first case 2a, where only the outsiders vote responsively. Then there are (1) $k \leq N_O$ outside shareholders who vote responsively, (2) N_I inside shareholders who always vote in favor, and (3) $N_O - k$ outside shareholders who do not vote responsively. As in the homogeneous case analyzed in the model, the last group may vote in favor or against. The formula for k is now:

$$k = \max\{N_O - 2\,|g_O - (a - N_I)|\,, 0\}\ .$$

N_I insiders always vote in favor, so the outsiders vote in an environment where their effective majority requirement is $a - N_I$, which therefore replaces a in Equation (6) of the paper. Their cutoff is $g_O > a^*$, which therefore replaces a^* in Equation (6) of the paper. Analogously, in case 2b we have:

$$k = \max\left\{N_I - 2\left|g_I - a\right|, 0\right\} \ .$$

For the insiders, the effective majority requirement is a, as the outsiders always vote against.

The comparative static analysis has to to distinguish four cases now. In addition to the notation introduced on p. 10 of the paper we need $\theta_c = g_c/N$, $\nu_c = N_c/N$. Then:

$$E\left(y/N\right) = \begin{cases} \pi\kappa & = \pi\nu_I - 2\theta_I\pi + 2\alpha\pi & \text{if} \quad \alpha < \theta_I \leq \nu_I \\ \pi\kappa + 1 - \kappa & = \pi\nu_I + \nu_O - 2\left(1-\pi\right)\theta_I + 2\left(1-\pi\right)\alpha & \text{if} \quad \theta_I \leq \alpha \leq \nu_I \\ \pi\kappa + \nu_I & = \pi\nu_O + \nu_I\left(1-2\pi\right) - 2\theta_O\pi + 2\alpha\pi & \text{if} \quad \nu_I < \alpha < \theta_O + \nu_I \\ \pi\kappa + 1 - \kappa + \nu_I & = \nu_I + 1 - 2\theta_O\left(1-\pi\right) + 2\left(1-\pi\right)\alpha & \text{if} \quad \theta_O + \nu_I \leq \alpha \end{cases}$$

Then Equation (12) of the paper becomes:

$$\begin{array}{lll} \gamma_0 = \pi\nu_I - 2\theta_I\pi & \gamma_1 = 2\pi & \text{if} \quad \alpha < \theta_I \leq \nu_I \\ \gamma_0 = \pi\nu_I + \nu_O - 2\left(1-\pi\right)\theta_I & \gamma_1 = 2\left(1-\pi\right) & \text{if} \quad \theta_I \leq \alpha \leq \nu_I \\ \gamma_0 = \pi\nu_O + \nu_I\left(1-2\pi\right) - 2\theta_O\pi & \gamma_1 = 2\pi & \text{if} \quad \nu_I < \alpha < \theta_O + \nu_I \\ \gamma_0 = \nu_I + 1 - 2\theta_O\left(1-\pi\right) & \gamma_1 = 2\left(1-\pi\right) & \text{if} \quad \theta_O + \nu_I \leq \alpha \end{array} .$$

We still identify a monotonic positive relationship between the expected voting outcome and the majority rule. However, we cannot identify the kink points in the function anymore as we can for the homogeneous case. The $E\left(y/N\right)-$function (which is displayed in Figure 1 in the paper) now has three kink points instead of one, and the kink points depend on the proportions of management friendly shareholders ν_I and independent shareholders ν_O.

1.2 Asymmetric Payoffs

We assume that payoffs are symmetric in the paper. This section discusses the case where the payoffs are asymmetric and analyzes how asymmetry affects the tests in the paper.

1.2.1 Optimal Majority Requirement (Equation (5) of the Paper)

Assume that the payoff is $v = S > 0$ in the good ("success") state and $v = -D < 0$ in the bad ("disaster") state, so both S and D are positive constants. Denote by g the number of good signals, by k the number of shareholders who apply the simple voting rule, by ε the probability of observing a bad signal in the success state ($\Pr(\sigma_i = 0 \,|v = S) = \epsilon$), by η the probability of observing a good signal in the bad state ($\Pr(\sigma_i = 1 \,|v = D) = \eta$). Then:

$$\Pr(g, k, v = S) = \begin{pmatrix} k \\ g \end{pmatrix} p\,(1-\varepsilon)^g\,\varepsilon^{k-g}, \quad \Pr(g, k, v = D) = \begin{pmatrix} k \\ k-g \end{pmatrix} (1-p)\,\eta^g\,(1-\eta)^{k-g}$$

and therefore:

$$\beta(g,k) = \Pr(v = S\,|g,k) = \frac{\Pr(g,k,v=S)}{\Pr(g,k,v=S) + \Pr(g,k,v=D)} = \frac{p}{p + (1-p)\left(\frac{\eta}{1-\epsilon}\right)^g\left(\frac{1-\eta}{\epsilon}\right)^{k-g}}.$$

The criterion for simple voting is:

$$\beta(g,k)\,S - (1-\beta(g,k))\,S \geq 0 \;\Leftrightarrow \beta(g,k) \geq \beta_0 \equiv \frac{D}{D+S}.$$

Define:

$$y = \frac{1-\epsilon}{\eta}, \; z = \frac{1-\eta}{\epsilon}, \; \delta = \frac{\ln z}{\ln z + \ln y}.$$

and use these definitions to rewrite $\beta(g,k)$. The condition for a^* then follows from requiring $k = N$ and taking logs on $\beta(a^*, N) = \beta_0$. This gives:

$$\frac{a^*}{N} = \delta - \frac{1}{N(\ln y + \ln z)} \ln \frac{pS}{(1-p)\,D} \;. \tag{1}$$

With symmetry, $S = D$, $\varepsilon = \eta$, $y = z$ and therefore $\delta = 1/2$. Then we obtain $\alpha^* = a^*/N$ for two cases:

- $p = 1/2$, because then the second expression equals zero. This is not generic.
- $N \to \infty$ or $\varepsilon \longrightarrow 0$, hence this is asymptotically true.

1.2.2 Number of Sincere Voters

The number k of sincere voters requires:

$$\beta(a, k+1) \leq \beta_0 \leq \beta(a, k). \tag{2}$$

We define k implicitly from $\beta(a, k(a)) = \beta_0$ to yield:

$$k = N - \begin{cases} \frac{a^* - a}{\delta} & if \quad a \leq a^* \\ \frac{a - a^*}{1-\delta} & if \quad a > a^* \end{cases} \quad . \tag{3}$$

Consequently, the expected proportion of yes-votes is ($\kappa = k/N$, $\alpha = a/N$):

$$E(y/N) = \begin{cases} \pi\kappa & = \pi\left(1 - \frac{\alpha^*}{\delta}\right) + \frac{\pi}{\delta}\alpha & , \text{if } \alpha \leq \alpha^* \quad , \\ \pi\kappa + 1 - \kappa & = \pi - \frac{(1-\pi)\alpha^*}{1-\delta} + \frac{1-\pi}{1-\delta}\alpha & , \text{if } \alpha > \alpha^* \quad . \end{cases}$$

1.2.3 Derivation of the Tests

Test 1. In our regression model we obtain

$$\begin{array}{lll} \gamma_0 = \pi\left(1 - \frac{\alpha^*}{\delta}\right) & , \gamma_1 = \frac{\pi}{\delta} & , \text{if } \alpha \leq \alpha^* \quad , \\ \gamma_0 = \pi - \frac{(1-\pi)\alpha^*}{1-\delta} & , \gamma_1 = \frac{1-\pi}{1-\delta} & , \text{if } \alpha > \alpha^* \quad . \end{array} \tag{4}$$

Test 1 is then to test for $\gamma_1 = 0$. Hence, only the definition of γ_1 has changed relative to the special case studied in the paper, but the logic remains the same. With symmetry, $\delta = 1/2$ and we obtain again Equation (12) in the paper.

Test 2. Assume again that $p_H > p_L$ and consequently $\pi_H > \pi_L$. Assume, as in the paper, that η and ε are the same for high and low priors, so y, z, and δ are the same for both priors. Then $\alpha_H^* < \alpha_L^*$ from (1). Strategic voting implies that the slope parameters γ_{1H} and γ_{1L} from the regression are different (see (4)):

$$\begin{aligned} \gamma_{1H} > \gamma_{1L} \quad &, \text{if } \alpha \leq \alpha_H^* \quad , \\ \gamma_{1H} < \gamma_{1L} \quad &, \text{if } \alpha > \alpha_L^* \quad . \end{aligned} \tag{5}$$

Test 2 is therefore unchanged compared to the symmetric case.

Test 3. From Equation (8) in the paper the pass rate equals:

$$Pass = p\,(1 - e_I) + (1 - p)\, e_{II} \ ,$$

If $\alpha \leq \alpha^*$ we have:

$$e_I = \sum_{g=0}^{g=a-1} \Pr\left(g\,|v = S\right) = \sum_{g=0}^{g=a-1} \begin{pmatrix} k \\ g \end{pmatrix} (1-\varepsilon)^g\, \varepsilon^{k-g} \ , \tag{6}$$

$$e_{II} = \sum_{g=a}^{g=k} \Pr\left(g\,|v = D\right) = \sum_{g=a}^{g=k} \begin{pmatrix} k \\ g \end{pmatrix} \eta^g\, (1-\eta)^{k-g} \ . \tag{7}$$

If $\alpha > \alpha^*$ then k shareholders vote 'yes,' independently of their information, so we obtain the same expressions except that the summation in (6) goes up to $a - k - 1$ and the summation in (7) starts at $a - k$. Hence, symmetry affects only the definitions of e_I and e_{II}, which are not required for the test. As in the symmetric case, $\lim_{N\to\infty} e_I = \lim_{N\to\infty} e_{II} = 0$ and $\lim_{N\to\infty} Pass = p$.

Test M. There are two versions of Test M, depending on whether $\alpha \leq \alpha^*$ or $\alpha > \alpha^*$. For $\alpha \leq \alpha^*$ we test $\gamma_0 = 0$. From (4), this is equivalent to testing $\alpha^* = \delta$. For $\alpha > \alpha^*$, we test if $\gamma_0 + \gamma_1 = 1$. From (4):

$$\gamma_0 + \gamma_1 = \pi + \frac{(1-\pi)\,(1-\alpha^*)}{1-\delta} = 1 \Leftrightarrow \alpha^* = \delta \ .$$

Hence, for both cases the test is equivalent to testing $\alpha^* = \delta$. This test therefore depends on symmetry, because only with symmetry do we obtain that $\delta = 1/2$. From (1), $\alpha^* = \delta$ obtains when the second expression vanishes, which happens if $N(\ln y + \ln z)$ becomes large. This will be the case whenever either N becomes large, or when ε and η become small simultaneously. For the symmetric case, just having ε small is sufficient.

1.3 Mixed Strategy Equilibria

In the paper we use the following definitions: The signal $\sigma_i \in \{0,1\}$, indicates the state of the world correctly with a probability strictly less than 1:

$$\Pr(\sigma = 1|v = 1) = \Pr(\sigma = 0|v = -1) = 1 - \varepsilon, \quad 0 < \varepsilon < \frac{1}{2}. \tag{8}$$

The probability of receiving a good signal is:

$$\pi = p(1-\varepsilon) + (1-p)\varepsilon. \tag{9}$$

The optimal cutoff rule is:

$$\frac{a^*}{N} = \frac{1}{2} - \frac{1}{2N\ln\left(\frac{1-\varepsilon}{\varepsilon}\right)} \ln\left(\frac{p}{1-p}\right) \quad , \tag{10}$$

Denote by ω_σ the probability to vote in favor of the proposal of a shareholder who has observed the signal $\sigma \in \{0,1\}$. Any symmetric mixed strategy equilibrium can be fully described by a tuple (ω_0, ω_1). Based on the analysis of Feddersen and Pesendorfer (1998) and using (10) we prove the following proposition:

Proposition 1 ***(Mixed Strategy Equilibria)***. *There exists a responsive mixed strategy equilibrium whenever $2a^* - N < a < 2a^* + 1$ where the mixing probabilities ω_σ are given as follows:*
(i) If $2a^* - N < a < a^*$, then $\omega_0 = 0$ and

$$0 < \omega_1 = \frac{h-1}{h(1-\varepsilon) - \varepsilon} < 1\ , \quad \text{where} \quad h = \left(\frac{1-\varepsilon}{\varepsilon}\right)^{\frac{N+a-2a^*}{N-a}} \quad . \tag{11}$$

(ii) If $a^* + 1 < a < 2a^* + 1$, then $\omega_1 = 1$ and

$$0 < \omega_0 = \frac{f(1-\varepsilon) - \varepsilon}{1 - \varepsilon(1+f)} < 1 \ , \quad \text{where} \quad f = \left(\frac{1-\varepsilon}{\varepsilon}\right)^{\frac{a-1-2a^*}{a-1}} \quad . \tag{12}$$

(iii) If $a^* \leq a \leq a^* + 1$, then $\omega_0 = 0$ and $\omega_1 = 1$, and the equilibrium is in pure strategies.

The proposition shows that shareholders either vote according to their information after observing a bad signal and mix after observing a good signal (case (i)), or the opposite (case (ii)). If the statutory rule is optimal (case (iii)), then the equilibrium is in pure strategies. Only in this special case do shareholders vote in favor whenever they observe a positive signal and against otherwise.

1.3.1 Proof of Proposition 1

Denote the probability of vote "yes" as a function of the state v by:

$$\pi(v = 1) = \pi_1 = (1-\varepsilon)\,\omega_1 + \varepsilon\omega_0 \quad ,$$
$$\pi(v = -1) = \pi_0 = \varepsilon\omega_1 + (1-\varepsilon)\,\omega_0 \quad .$$

Then, denote the beliefs of any shareholder conditional on knowing that $a-1$ of the other $N-1$ shareholders have voted in favor of the proposal by $\beta(a-1, N-1)$. Beliefs $\beta(a-1, N-1)$ summarize all information the $i-th$ shareholder obtains from being pivotal, but not the signal received by the $i-th$ shareholder herself.

$$\begin{aligned}\beta(a-1, N-1) &= \frac{p\pi_1^{a-1}(1-\pi_1)^{N-a}}{p\pi_1^{a-1}(1-\pi_1)^{N-a} + (1-p)\,\pi_0^{a-1}(1-\pi_0)^{N-a}} \\ &= \frac{p}{p + (1-p)\,X(a-1, N-1)}\end{aligned}$$

where

$$X(a-1, N-1) = \left(\frac{\pi_0}{\pi_1}\right)^{a-1}\left(\frac{1-\pi_0}{1-\pi_1}\right)^{N-a} \quad .$$

Now denote beliefs of any shareholder conditional on being pivotal and on her signal σ by β_σ. Any shareholder who randomizes after observing a certain signal σ has to be indifferent between voting “yes” and voting “no,” so that $\beta_\sigma = \frac{1}{2}$ after that signal. We have:

$$\begin{aligned}\beta_1 &= \frac{\beta(a-1,N-1)(1-\varepsilon)}{\beta(a-1,N-1)(1-\varepsilon)+(1-\beta(a-1,N-1))\varepsilon} \\ &= \frac{p}{p+(1-p)X(a-1,N-1)\frac{\varepsilon}{1-\varepsilon}} \quad . \end{aligned} \tag{13}$$

Similarly:

$$\begin{aligned}\beta_0 &= \frac{\beta(a-1,N-1)\varepsilon}{\beta(a-1,N-1)\varepsilon+(1-\beta(a-1,N-1))(1-\varepsilon)} \\ &= \frac{p}{p+(1-p)X(a-1,N-1)\frac{1-\varepsilon}{\varepsilon}} \quad . \end{aligned} \tag{14}$$

We can see immediately by direct calculation that:

$$\beta_1 - \beta_0 = \frac{p(1-p)X\left(\frac{1-2\varepsilon}{\varepsilon(1-\varepsilon)}\right)}{\left(p+(1-p)X\frac{1-\varepsilon}{\varepsilon}\right)\left(p+(1-p)X\frac{\varepsilon}{1-\varepsilon}\right)} > 0$$

since we assume that $\varepsilon < 1/2$. Hence, we have either that $\beta_1 = 1/2$ or that $\beta_0 = 1/2$, but never both. For a pure strategy equilibrium we need $\beta_0 \le 1/2 \le \beta_1$ with at least one inequality being strict. We can therefore distinguish three cases.

Case 1: $\beta_1 = 1/2$. If $\beta_1 = 1/2$, then $\beta_0 < 1/2$ and the shareholder strictly prefers rejection of the proposal after observing a bad signal, so $\omega_0 = 0$. Solving the condition $\beta_1 = 1/2$ gives:

$$\frac{p(1-\varepsilon)}{(1-p)\varepsilon} = X(a-1,N-1) = \left(\frac{\varepsilon}{1-\varepsilon}\right)^{a-1}\left(\frac{1-\varepsilon\omega_1}{1-\omega_1(1-\varepsilon)}\right)^{N-a} \quad .$$

Rearranging:

$$\frac{1-\varepsilon\omega_1}{1-\omega_1(1-\varepsilon)} = \left(\frac{p}{1-p}\left(\frac{1-\varepsilon}{\varepsilon}\right)^a\right)^{\frac{1}{N-a}} = h \quad . \tag{15}$$

We substitute for $\frac{p}{1-p}$ from (**??**), which gives the expression for h in (11). Solving (15) for ω_1 as a function of h gives (11). The equilibrium is responsive whenever $\omega_1 > 0$, which requires $h > 1$. The equilibrium is in mixed strategies if $\omega_1 < 1$, which is equivalent to $h < \frac{1-\varepsilon}{\varepsilon}$. From (11) this result obtains whenever the exponent of $\frac{1-\varepsilon}{\varepsilon}$ is positive, or $a > 2a^* - N$. The equilibrium is in mixed strategies if $\omega_1 < 1 \Longleftrightarrow h < \frac{1-\varepsilon}{\varepsilon}$. This requires the exponent of h to be less than 1, which is equivalent to $a < a^*$. Hence, for $a \geq a^*$ we always have $\omega_1 = 1$.

Case 2: $\beta_0 = 1/2$. If $\beta_0 = 1/2$, then $\omega_1 = 1$ and the condition can be written as:

$$\frac{p}{1-p}\frac{\varepsilon}{1-\varepsilon} = X(a-1, N-1) = \left(\frac{\varepsilon + (1-\varepsilon)\,\omega_0}{1-\varepsilon\,(1-\omega_0)}\right)^{a-1}\left(\frac{1-\varepsilon}{\varepsilon}\right)^{N-a} .$$

Rearranging:

$$\frac{\varepsilon + (1-\varepsilon)\,\omega_0}{1-\varepsilon\,(1-\omega_0)} = \left(\frac{p}{1-p}\left(\frac{\varepsilon}{1-\varepsilon}\right)^{N-a+1}\right)^{\frac{1}{a-1}} = f \quad . \tag{16}$$

Using (**??**) to substitute for $\frac{1-p}{p}$ gives the expression for f in 12. Solving (16) for ω_0 as a function of f gives (12). We have a mixing equilibrium if $\omega_0 > 0$, which requires $f > \frac{\varepsilon}{1-\varepsilon}$. Then, the exponent of $\frac{1-\varepsilon}{\varepsilon}$ in f has to exceed -1, which is equivalent to $a > a^* + 1$. Hence, for any $a \leq a^* + 1$ we have $\omega_0 = 0$. For the equilibrium to be responsive we need $\omega_0 < 1$, or $f < 1$, hence the exponent of $\frac{1-\varepsilon}{\varepsilon}$ in f has to be negative, or $a < 2a^* + 1$.

Case 3: Pure Strategy Equilibria. From the discussion of Case 1 above we know that $\omega_1 = 1$ whenever $a \geq a^*$. Also, from the discussion of Case 2 we know that $\omega_0 = 0$ whenever $a \leq a^* + 1$. Hence, for $a^* \leq a \leq a^* + 1$ the equilibrium is in pure strategies.

1.3.2 Testing Methodology

In mixed strategy equilibria, all shareholders with a good signal *and* some of the shareholders with a bad signal vote in favor. From Proposition 1, the expected proportion of votes in favor in mixed strategy equilibria equals:

$$E(y/N) = \begin{cases} \pi\omega_1 & , \text{if } \alpha < \alpha^* \quad , \\ \pi + (1-\pi)\,\omega_0, & , \text{if } \alpha \geq \alpha^* \quad . \end{cases} \tag{17}$$

The difference between mixed and pure strategy equilibria is marked only for small values of ε. The difference vanishes as $\varepsilon \to 1/2$.

Posit that $y/N = E(y/N) + \xi$, where ξ is defined as above. We apply non-linear least squares to estimate:

$$y/N = \begin{cases} \gamma_0 \left(\frac{(1-\gamma_1)^{\frac{\alpha+\gamma_2}{1-\alpha}} - \gamma_1^{\frac{\alpha+\gamma_2}{1-\alpha}}}{(1-\gamma_1)^{\frac{1+\gamma_2}{1-\alpha}} - \gamma_1^{\frac{1+\gamma_2}{1-\alpha}}} \right) + \xi & \text{if } \alpha < \alpha^*, \\ \gamma_0 + (1-\gamma_0) \left(\frac{(1-\gamma_1)\gamma_1^{\frac{\gamma_2}{\alpha}-1} - \gamma_1 (1-\gamma_1)^{\frac{\gamma_2}{\alpha}-1}}{(1-\gamma_1)^{\frac{\gamma_2}{\alpha}} - \gamma_1^{\frac{\gamma_2}{\alpha}}} \right) + \xi & \text{if } \alpha \geq \alpha^*, \end{cases} \tag{18}$$

where $\gamma_0 = \pi$, $\gamma_1 = \varepsilon$, and

$$\gamma_2 = \begin{cases} 1 - 2\alpha^* & \text{if } \alpha < \alpha^*, \\ 2\alpha^* & \text{if } \alpha \geq \alpha^*. \end{cases}$$

We can test whether the model parameters are plausible: $\pi, \alpha^* \in [0,1]$ and, from (9):[3]

$$\begin{aligned} &\varepsilon \in [0, \pi] \quad &, \text{ if } \pi < 1/2 \quad , \\ &\varepsilon \in [0, 1-\pi] \quad &, \text{ if } \pi \geq 1/2 \quad . \end{aligned} \tag{19}$$

These tests imply the analogues of Test 1 and 2. Test 3 is the same for pure and mixed strategy equilibria. We are also interested in testing whether the simple majority rule is optimal (Test M). The implied parameter restriction is:

$$\gamma_2 = \begin{cases} 0 & \text{if } \alpha < \alpha^* = 1/2 \quad , \\ 1 & \text{if } \alpha \geq \alpha^* = 1/2 \quad . \end{cases} \tag{20}$$

1.3.3 Derivation of Testing Methodology for Mixed Strategy Equilibria

Case 1: $\alpha < \alpha^*$. Use $\alpha = a/N$ and $\alpha^* = a^*/N$ in (11) to obtain:

$$h = \left(\frac{1-\varepsilon}{\varepsilon}\right)^{\frac{2(a-a^*)}{N-a}+1} = \left(\frac{1-\varepsilon}{\varepsilon}\right)^{\frac{2(\alpha-\alpha^*)}{1-\alpha}+1} .$$

[3] Solve (9) for p and observe that $\varepsilon < 1/2$ from (8). Then, the conditions (19) follow from $p \in (0,1)$.

Rewrite the exponent as:

$$\frac{2(\alpha-\alpha^*)}{1-\alpha}+1=\frac{\alpha}{1-\alpha}+\underbrace{\frac{2\alpha^*-1}{1-\alpha}}_{=C}.$$

Write expected fraction of votes from (17) as:

$$\begin{aligned}E(y/N)=\pi\omega_1&=\pi\left[\frac{\left(\frac{1-\varepsilon}{\varepsilon}\right)^{\frac{\alpha}{1-\alpha}+C}-1}{(1-\varepsilon)\left(\frac{1-\varepsilon}{\varepsilon}\right)^{\frac{\alpha}{1-\alpha}+C}-\varepsilon}\right]\\&=\pi\left[\frac{(1-\varepsilon)^{\frac{\alpha}{1-\alpha}+C}-\varepsilon^{\frac{\alpha}{1-\alpha}+C}}{(1-\varepsilon)^{\frac{\alpha}{1-\alpha}+C+1}-\varepsilon^{\frac{\alpha}{1-\alpha}+C+1}}\right].\end{aligned}$$

The last expression gives the first line of (18) from $\frac{\alpha}{1-\alpha}+1=\frac{1}{1-\alpha}$.

Case 2: $\alpha\geq\alpha^*$. We use (17), where ω_0 is given by (12). Then, with $\alpha=a/N$ and $\alpha^*=a^*/N$, we rewrite the exponent as:

$$-\frac{2a^*}{a-1}+1=-\frac{2\alpha^*}{\alpha-1/N}+1\approx-\frac{2\alpha^*}{\alpha}+1=-E,$$

so that $E+1=\frac{2\alpha^*}{\alpha}$. Then:

$$\begin{aligned}\omega_0=\frac{f(1-\varepsilon)-\varepsilon}{1-\varepsilon(1+f)}&=\frac{\left(\frac{1-\varepsilon}{\varepsilon}\right)^{-E}(1-\varepsilon)-\varepsilon}{1-\varepsilon-\varepsilon\left(\frac{1-\varepsilon}{\varepsilon}\right)^{-E}}\\&=\frac{(1-\varepsilon)^{1-E}\varepsilon^{E}-\varepsilon}{1-\varepsilon-(1-\varepsilon)^{-E}\varepsilon^{E+1}}=\frac{(1-\varepsilon)\varepsilon^{E}-\varepsilon(1-\varepsilon)^{E}}{(1-\varepsilon)^{E+1}-\varepsilon^{E+1}}\\&=\frac{(1-\varepsilon)\varepsilon^{\frac{2\alpha^*}{\alpha}-1}-\varepsilon(1-\varepsilon)^{\frac{2\alpha^*}{\alpha}-1}}{(1-\varepsilon)^{\frac{2\alpha^*}{\alpha}}-\varepsilon^{\frac{2\alpha^*}{\alpha}}}.\end{aligned}$$

The last expression gives the second line of (18).

2 Additional Empirical Results

2.1 Pass Rate and Statutory Rule

To further assess economic significance, we compare estimated and predicted elasticities from the models of strategic voting and simple voting, respectively. The relevant results are gathered in Table 1, where we report the predicted pass rate for $p = 0.985$ (the average pass rate for the entire sample), $N = 25$, and ε-values ranging from 0.1 to 0.4. Strategic voting (Panel A) implies that the elasticity is close to zero. By contrast, simple voting (Panel B) predicts a sharp decline in the pass rate except when shareholders have signals that are practically free of error ($\epsilon = 0.1$). Even for a relatively precise signal ($\epsilon = 0.2$), the pass rate decreases by more than four percentage points when we move from $\alpha = 0.5$ to $\alpha = 2/3$, about one order of magnitude more than the estimated elasticities in Table VIII of the paper.

Table 1: **Predicted Pass Rate and Statutory Rule**

	$\varepsilon = 0.1$	$\varepsilon = 0.2$	$\varepsilon = 0.3$	$\varepsilon = 0.4$
A. Strategic voting				
$\alpha = 1/2$	0.9850	0.9852	0.9848	0.9993
$\alpha = 2/3$	0.9850	0.9863	0.9852	1.0000
$\alpha = 4/5$	0.9851	0.9910	0.9913	1.0000
B. Simple voting				
$\alpha = 1/2$	0.9850	0.9846	0.9681	0.8358
$\alpha = 2/3$	0.9845	0.9389	0.6668	0.2695
$\alpha = 4/5$	0.9521	0.6074	0.1906	0.0289

The table shows the predicted pass rate for pure strategy equilibria and simple voting, respectively. We assume that $p = 0.985$ and $N = 25$.

2.2 Agenda-Control Hypothesis

If a positive ISS vote recommendation reflects a higher value of p and therefore a higher value of π, then the agenda-control hypothesis predicts that ISS is more likely to support a supermajority proposal. We test this prediction by estimating a probit model, where the dependent variable equals one if ISS recommends to vote in favor, and zero if ISS recommends to vote against. We use the same independent variables plus a set of dummy variables for each of the main proposal categories in Table IV of the paper. The estimated coefficients and standard errors are reported in Table 2. The relation between the ISS dummy variable and the statutory rule is positive, but not statistically different from zero. While this statistical test does not rule out the agenda-control hypothesis, it does not speak in its favor either.

Table 2: **Determinants of ISS Vote Recommendations**

Constant	Majority	Type III	Routine	Insider	Size	Compen	Recapit	Restruct	Restore	Remove
0.915 (3.1)*	0.772 (1.4)	0.115 (1.7)	0.354 (7.8)*	-1.257 (-8.7)*	0.044 (4.1)*	-0.724 (-7.4)*	-0.569 (-5.8)*	0.810 (5.7)*	0.853 (3.2)*	-2.423 (-13.1)*

The table shows the results of estimating a probit model, where the dependent variable equals one if the ISS vote recommendation is for and zero if it is against. The explanatory variables are the statutory rule, a dummy variable for Type III proposals, a dummy variable for routine proposals, insider voting power, size measured as the log of market capitalization deflated by 1,000 times the S&P500 index, and dummy variables for each of the proposal categories in Table IV of the paper. t-statistics are reported below the coefficients. An asterisk denotes significance at the 5%-level or better. There are 5,377 observations at one and 1,796 observations at zero.

2.3 Proxy Solicitation Costs

Our data provide a natural experiment to test the higher-effort hypothesis. There are 198 shareholder meetings with simultaneous simple-majority and supermajority proposals. Direct contact with the large shareholders should raise the support for all proposals put forward at the same meeting. Then, the proportion in favor should not differ between the simple-majority proposals and the supermajority proposals in the matched sample. We select one simple-majority proposal and one supermajority proposal from each of the 198 meetings with at least one proposal of each type. When there are multiple proposals, we randomly choose one proposal at simple majority and one at supermajority. In 138 of the 198 matched proposals or 70% of the time, the supermajority proposal obtains more votes in its favor than the simple-majority proposal. Table 3 reports supportive regression results with control variables. We can see that the proportion in favor increases significantly with the statutory rule also in the matched sample. We conclude that explanations based on proxy solicitation costs are unlikely to account for our results.

Table 3: **Simultaneous Simple-Majority and Supermajority Proposals**

Constant	Majority	Routine	Type III	Insider	Size	R^2	#Super	#Obs
0.796 (0.041)	0.200 (0.066)	0.026 (0.010)	0.022 (0.014)	0.029 (0.042)	0.007 (0.003)	0.094	198	396

The table shows the results of ordinary least squares regressions of the proportion in favor on the statutory rule, a dummy variable for routine proposals, a dummy variable for Type III proposals, insider voting power, and size measured as the log of market capitalization deflated by 1,000 times the S&P500 index. The sample mean has been subtracted from each of the control variables. Robust standard errors are reported below the estimated parameters. The sample is restricted to 198 meetings with at least one simple-majority and one supermajority proposal put forward at the same time. Only one proposal at each level of the majority rule is chosen from each shareholder meeting.

2.4 Pre-Play Communication

Table 4 reports the voting results and the average of the ISS vote recommendation dummy for major proposal categories. We can see that the average proportion in favor y/N and the average of the ISS vote recommendation dummy are approximately equal for proposals to restructuring proposals (C), charter amendments (D), and corporate governance proposal to restore shareholder rights (D1). We can also see that the two averages are somewhat different for compensation (A) and recapitalization (B) proposals but strikingly different for corporate governance proposals to remove shareholder rights (D2). The differences between the averages for the latter categories suggest that many shareholders form their own opinion and, therefore, that voting aggregates private information.

Table 4: **Voting Results and ISS Vote Recommendation**

	Compen- sation A	Recapita- lization B	Restruct- turing C	Charter amendments D	Restore rights D1	Remove rights D2
Proportion voted for	0.851	0.905	0.972	0.958	0.957	0.713
ISS recommendation for	0.706	0.802	0.975	0.928	0.979	0.101
#Observations	4,789	1,120	571	417	143	119

The table shows the proportion voted for and the average of the ISS vote recommendation dummy variable for 7,159 management proposals with known ISS vote recommendation. The proposal categories are defined in Table IV of the paper.

2.5 Time Trend

Table 5 shows that there is no strong time trend in the main regression variables (except size which has been deflated by the stock market index). In the left section, we can see that there are fewer proposals at supermajority, fewer routine proposals, and fewer Type III proposals in the years 2001-2002-2003 around the corporate scandals. We can see in the right section that the proportion in favor and the pass rate also decrease somewhat these years. Table 6 shows our main regression results with fixed-year effects (year dummies not reported). The effects on the coefficients are small. The biggest effect occurs in the subset where ISS recommends against. The slope coefficient of the majority rule drops from 0.282 to 0.162 and the statistical significance level from p-value 0.007 to p-value 0.102. This coefficient and the related Test 2 is sensitive because there are only 60 observations at supermajority in the subset with negative ISS recommendations.

Table 5: **Regression Variables by Year**

	Proportion of all proposals			Average			
	Majority	Routine	Type III	y/N	PASS	Insider	Size
1994	0.005	0.049	0.024	0.895	0.981	0.086	7.80
1995	0.003	0.047	0.023	0.889	0.998	0.082	7.81
1996	0.004	0.048	0.024	0.885	0.987	0.090	7.71
1997	0.004	0.044	0.023	0.895	0.990	0.094	7.44
1998	0.006	0.054	0.036	0.884	0.986	0.106	7.38
1999	0.006	0.051	0.035	0.876	0.985	0.098	7.18
2000	0.003	0.049	0.032	0.866	0.987	0.112	7.32
2001	0.003	0.039	0.018	0.857	0.979	0.114	7.21
2002	0.002	0.036	0.014	0.851	0.974	0.104	7.12
2003	0.002	0.030	0.011	0.847	0.978	0.092	7.64
All	0.038	0.447	0.239	0.875	0.985	0.099	7.45

2.6 Estimation of Mixed Strategy Equilibria

Table 7 summarizes our non-linear least squares estimations for the mixed strategy equilibria. The estimation must be carried out without the control variables. The table reports the results of

Table 6: **Proportion in Favor and Statutory Rule with Fixed-Time Effects**

	All proposals	ISS for	ISS against
A. Regressions			
Constant	0.782 (0.012)	0.908 (0.010)	0.730 (0.059)
Majority (α)	0.215 (0.023)	0.063 (0.016)	0.162 (0.099)
Routine	0.035 (0.002)	0.004 (0.002)	0.048 (0.007)
Type III	0.047 (0.002)	0.032 (0.002)	0.034 (0.007)
Insider	0.069 (0.008)	0.108 (0.008)	0.235 (0.021)
Size	0.008 (0.001)	0.007 (0.001)	0.002 (0.002)
R^2	0.079	0.122	0.138
#Supermajority	510	434	60
#Observations	13,405	5,377	1,796

estimating (18) and those of a corresponding regression subject to the restriction that $p = 0.99$. We report only the results for the parameter region $\alpha \geq \alpha^*$, because the identifying condition $\alpha < \alpha^*$ is violated in the other region. In the unrestricted regression, the parameter estimates for π and α^* are close to those of the pure strategy equilibria, while the estimate for ε falls outside the allowed range in (19), but the standard error is large. In the restricted regression, where we force ε to be inside the permissible range from 0 to $1 - \pi$, the point estimates are the maximum allowed. The parameter estimates suggest that the mixed strategy equilibria are similar to the pure strategy equilibria of this game.

The nature of the non-linear regressions can be seen in Figure 1. The dots represent the seven conditional sample means. Four sample means are supplemented with vertical lines, which represent plus/minus two standard errors away from the mean. We suppress the standard errors for the other three means with only a few observations. The upward-sloping line represents the pure strategy equilibria (dash-dotted), the curved line the mixed strategy equilibria (solid), and the horizontal line sincere voting (dashed). We assume that $\alpha^* = 1/2$, which forces the $E(y/N)-$functions to

Table 7: **Non-Linear Least Squares Estimation of Mixed Strategy Equilibria**

	All proposals	ISS For	ISS Against
A. Unrestricted			
π	0.853	0.916	0.764
	(0.007)	(0.005)	(0.024)
ε	0.500	0.500	0.500
	(0.255)	(0.123)	(0.395)
α^*	0.429	0.486	0.563
	(0.014)	(0.019)	(0.070)
B. Restricted			
π	0.856	0.917	0.749
	(n/a)	(n/a)	(n/a)
ε	0.137	0.074	0.246
	(0.005)	(0.003)	(0.016)
α^*	0.414	0.421	0.528
	(0.010)	(0.011)	(0.093)
χ^2-test	2.0	11.8	0.5
	(0.157)	(0.000)	(0.493)

The table provides non-linear regression estimates for the parameter region $\alpha \geq \alpha^*$. The Wald χ^2-statistic tests the restriction $p = 0.99$. Standard errors are below the parameter estimates and p-values below the χ^2-statistics.

pass through $(1, 1)$. The mass of observations at $\alpha = 1/2$ forces all three functions to pass through the conditional sample mean of the simple majority. We can see that the conditional mean of the other mass point in the data, $\alpha = 2/3$ with 82% of the supermajority proposals, lies *above* the pure strategy equilibria line. Therefore, the non-linear least squares-estimator chooses ε such that the $E(y/N)-$function becomes as concave as possible, which occurs when ε approaches $1/2$ and the function becomes linear. When we impose the constraint $\varepsilon \leq 1 - \pi$, then this constraint becomes binding.

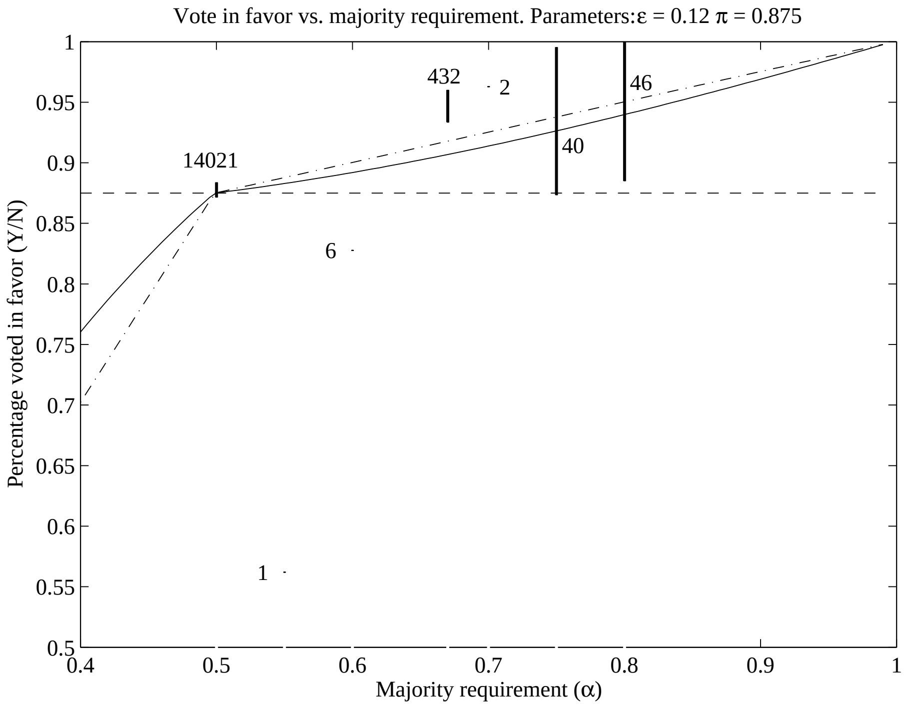

Figure 1: **Predicted and Observed Proportion in Favor**: Mixed strategy equilibria (solid), pure strategy equilibria (dash-dotted), sincere voting (dashed), and conditional sample means (marked with a diamond). The labels indicate the number of observations. The vertical lines represent the ± 2 standard error-bounds around the conditional sample means.