Shareholder Voice and Executive Compensation

John W. Barry[†]

Duke University
Fuqua School of Business

December 4, 2023

Click here for the latest version

Abstract

Managerial influence on the Board of Directors induces an agency problem in the design of executive compensation. I evaluate the role of shareholder voice in disciplining compensation practices by estimating a model of CEO compensation with non-binding shareholder approval votes (Say-on-Pay). The Board sets CEO pay and is biased towards a high wage; shareholders can fail the Say-on-Pay (SOP) and punish the Board for overpayment. Failed votes are perceived as costly by both the Board and shareholders: a cost of 2.06% (0.76%) of value for the Board (shareholders) is sufficient to match the data. SOP thus resembles a costly punishment mechanism and the disciplining effect on compensation increases firm value by 4.6% on average. Empirical evidence suggests the Board cost is a career and reputation concern for directors, and shareholders internalize a cost to dissenting from the Board on a prominent policy. I construct a counterfactual SOP mechanism which emulates giving a focal shareholder an advisory seat on the Board; this lowers the SOP failure rate, decreases wages and further increases firm value.

Keywords: shareholder voice, corporate governance, executive compensation, shareholder voting, say-on-pay, structural estimation

[†]I thank John Graham, Alon Brav, Simon Gervais, Arthur Taburet, Vish Viswanathan, and the entire Finance department at Fuqua for comments. James Pinnington played a key role in the earlier stages of this project. The staff at the Duke Computer Cluster, particularly Tom Milledge, were exceedingly helpful in implementing the estimation. This paper is a work in progress and results are subject to change. All errors are my own.
Email: john.w.barry@duke.edu
Web: https://johnwbarry.info/

1. Introduction

Shareholders elect the Board of Directors, but the Board need not represent their interests (Shleifer and Vishny, 1997). A primary manifestation of this agency problem is executive compensation: the Board should set compensation to align the interests of management and shareholders, yet directors generally have an incentive to favor the CEO (Bebchuk and Fried, 2003).

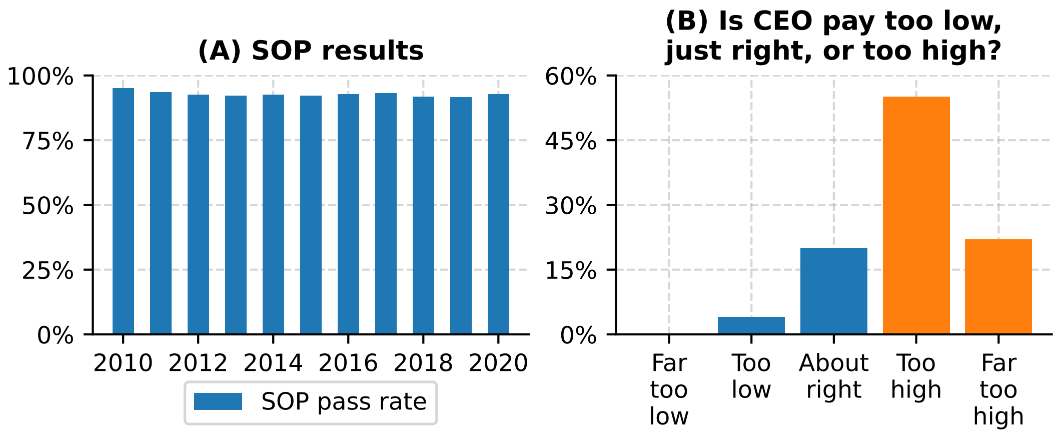
When shareholders disagree with compensation policy and exerting control is not viable, shareholders can convey dissent through *voice* (Hirschman, 1970; Cuñat et al., 2016). Say-on-Pay (SOP), a non-binding shareholder approval vote on CEO compensation policy, is the primary channel through which shareholders can voice dissent. While non-binding, SOP is in essence a vote of confidence on the Board's compensation decisions and the performance of the CEO. As executive compensation is the primary tool used to limit the agency problem afflicting managerial decision-making, SOP is a potentially important governance mechanism.

Yet the impact of SOP votes is unclear. Compensation policies receive over 90% support on average and only about 7% of SOP votes in the US fail.[1] As Figure 1 shows, the generally positive outcomes of SOP are hard to square with survey evidence in which shareholders express dissatisfaction with CEO pay (Edmans et al., 2021). Likewise, such apparently high SOP support is hard to reconcile with the well-developed literatures studying CEOs' influence on the pay-setting process (e.g., Bertrand and Mullainathan, 2001; Coles et al., 2014) and CEOs' abilities to demand a large share of rents (e.g., Custódio et al., 2013; Cziraki and Jenter, 2022).

An important consideration is that SOP votes are endogenous outcomes, occurring after compensation has been set and firm performance realized. What determines the impact of SOP is how much the Board internalizes the cost of failure into their *ex ante* compensation decision. As Figure 1 suggests, it may be just as important to understand shareholders' apparent hesitancy to fail SOP votes and dissent from the Board on compensation policy.

[1]SOP was formalized in the US as part of Dodd-Frank in 2010. SOP proposals are put forth by management at the annual shareholder meeting, and shareholders are asked to vote on the CEO's compensation from the just-passed fiscal year. Throughout the paper, I use "failure" to refer to SOP proposals that do not garner the required support from shareholders. In the US, SOP votes are non-binding, so there is no threshold which forces the Board to change pay policy. However, the understood threshold for SOP failure is 70% support (that is, 30% voting against, see ISS, 2022, Section 5 "Compensation"). 50% is also an important threshold (Hauder, 2019). SOP votes are binding in other countries, such as the United Kingdom. The analysis in this paper of non-binding SOP may not be applicable to those cases, even though the economic forces are likely similar.

Figure 1. Say-On-Pay results and shareholder satisfaction with CEO pay
This figure displays motivation for the paper. Panel A displays SOP vote results in the US by year from 2010 to 2020; it shows that the percentage of SOP votes that pass (garner over 70% support, see Appendix B) is about 93%. Panel B displays survey data from Edmans et al. (2021), based on a question that asks UK institutional investors about the levels of the CEOs' pay; over 75% of survey respondents believe that their CEO is overpaid.



This paper's goal is to build a structural model to quantify the influence of SOP on compensation policy and explore the mechanisms by which this influence occurs. In the model, the Board sets CEO pay and is biased towards paying a large wage (i.e., the CEO influences compensation). Shareholders decide to pass or fail the SOP: failure punishes the Board for overpayment, yet may be costly to shareholders.[2] Estimating the model will assess how much boards internalize the cost of SOP failure into its pay decision and whether shareholders consider SOP failure a costly outcome, thus quantifying the influence of SOP on compensation policy.

However, factors beyond these potential costs also influence wage and SOP vote decisions. The size of the Board's overpayment bias is not obvious. Some CEOs are more skilled than others and thus receive higher pay for their effort. The Board and shareholders cannot observe CEO skill directly, and may have different beliefs about the CEO's ability. They learn over time by observing company performance, with each receiving a private signal (like in Taylor, 2010). Quantifying the role of these forces is necessary to fully understand the impact of SOP.

I estimate model parameters via indirect inference and the model matches key features of the data. The model replicates the observed SOP failure rate: 7% in both the simulated and real data. Importantly, it matches the sensitivity of SOP failure likelihood to both the wage and company performance, the primary determinants of SOP vote outcomes (Fisch et al., 2018).

[2]SOP votes are *ex post* approval votes on the previous year's CEO compensation, not advisory votes on *proposed* compensation, hence the timing structure of the model (Appendix B and Novick, 2019).

The estimation produces several results. To start, boards are biased towards overpaying CEOs (relative to the profit-maximizing wage), which I refer to as *board capture.* I estimate that the average S&P1500 CEO captures 40.7% of expected surplus, in line with Taylor (2013), who finds that CEOs capture half of the surplus from positive updates about their ability. How does a bias in the pay-setting process of this magnitude square with the seemingly low SOP failure rate? My structural model provides an answer, considering the costs internalized by directors and shareholders from failed SOP votes.

First, for SOP to impact compensation policy, it must be that the Board internalizes the threat of vote failure into their decision. To explain observed behavior, I estimate that Boards internalize a cost from SOP failure that is equivalent to 2.06% of firm value.[3] While the unconditional failure rate of 7% means the cost is about 0.14% of value in expectation, the threat of costly SOP failure disciplines CEO pay, even when failure is *ex ante* unlikely. I estimate that SOP as a disciplining mechanism brings CEO wages down by 4.4% on average, in line with Correa and Lel (2016), who find that the adoption of SOP brought wages down by about 7%. Hence, *shareholder voice affects executive compensation policy.*

Second, failed SOP votes are perceived as costly by shareholders. I estimate that shareholders internalize a cost to SOP failure equivalent to 0.76% of value (about 0.05% in expectation).[4] This aligns with survey evidence from Edmans et al. (2021): shareholders state that failing the SOP may be undesirable, for example because they are hesitant to dissent from the Board on a prominent policy. Though SOP failure is internalized as conditionally costly, my estimates suggest that the disciplining effect of SOP improves firm value by 4.6% on average, consistent with Cuñat et al. (2016), who find that the adoption of SOP increased market value by 5%.

These results highlight the simple economics through which Say-on-Pay votes impact compensation policy and value: SOP resembles a costly punishment mechanism (Silveira, 2017). The threat of punishment disciplines the Board, even in states when SOP failure is unlikely. Giving shareholders access to a punishment technology is value-enhancing, even if punishment is costly and rarely occurs.

[3]It is important to clarify that these costs are utility costs. SOP failures do not affect value directly, the Board and shareholders must behave *as if* they do for the model to match observed outcomes.

[4]That is, the cost is equivalent to 0.76% (0.05% in expectation) of each shareholder's equity stake in the firm.

To infer the magnitude of unobservable model parameters, the structural estimation uses observed, endogenous patterns in company performance, CEO pay and SOP vote outcomes. Its success hinges in part on whether there are sensible empirical patterns to reinforce the structural results. As described next, I document several fundamental empirical facts about the Board and shareholder costs to SOP failure which underpin the model.

The first set of new descriptive facts shows that SOP failure leads to negative effects for directors, in support of the magnitude of the Board's cost. I find that failing SOP votes is a career and reputation concern for directors. SOP failure is associated with a 2 percentage point (pp) increase in the likelihood that a compensation committee director leaves or is removed from the Board (a 20% larger likelihood of turnover relative to the non-fail group). For directors that remain on the board following SOP failure, I also find they are more likely to be removed or step down from the compensation committee: SOP failure is associated with a 1.5 pp increase in the likelihood they are removed from the compensation committee the next year (a 26% larger likelihood than the non-SOP-fail group).

Interestingly, I find that failed SOP votes lead to *external* reputational damage for directors. A failed SOP at a director's current firm is associated with a decrease in outside Board positions at other firms (a 2 pp increase in the likelihood that a director loses at least one outside board position). This evidence is in line with Fos and Tsoutsoura (2014) and Aggarwal et al. (2019, 2023); however to the best of the knowledge, my paper is the first to document such internal and external reputation costs to directors tied to SOP failure.

While directors generally wish to be re-appointed to the Board (the average director salary is around $400 thousand), I argue that a large portion of the Board's perceived SOP failure cost acts through a prestige channel (Fos and Tsoutsoura, 2014; Bebchuk and Fried, 2003). SOP failure is a public negative performance evaluation from shareholders on a prominent issue. Directors have an incentive to favor the CEO; however, the threat of SOP failure pushes their incentives towards shareholders.

My estimation also shows that SOP failures are perceived as costly by shareholders. From survey evidence in Edmans et al. (2021), shareholders state they avoid SOP failure to maintain relations with the Board; my results above show that SOP failure leads to director turnover.

The negative performance evaluation aspect of SOP failure may commit shareholders to raising the rate of Board turnover, which *ex ante* may be undesirable.

Similar motivations exist for the CEO. The model suggests that the SOP is about more than pay, it is a public signal revealing shareholder beliefs about the CEO's match with the firm; the model indirectly predicts that CEO turnover likelihood should be higher when SOPs fail. I find that the turnover rate is around 30% higher in SOP failure relative to pass (about 9% *vs.* 12%). Given costs associated with CEO turnover (Taylor, 2010), and increased uncertainty for the company and stock price (Clayton et al., 2005), this suggests a motivation for why SOPs rarely fail: shareholders prefer to avoid the negative outcomes associated with CEO turnover.

As further evidence consistent with this cost, I show there is bunching in SOP vote outcomes: defining SOP *dis*approval as one minus the proportion of shareholder that approve the SOP, I uncover excess density directly below the failure thresholds of 30% and 50%.[5] Bunching helps to identify the parameters which measure Board and shareholder costs from SOP failure. In the data, bunching is consistent with shareholders internalizing a cost from SOP failure. Blockholders (often pivotal in SOP votes) may have an incentive to force a close pass relative to a close fail, precisely because they internalize a cost to SOP failure.

The model recognizes the same force, but highlights that bunching also contains information about the Board cost. The shareholders' voting decision trades off the cost from increasing the threat (probability) of SOP failure against the benefit of reducing the Board's overpayment bias. Importantly, the threat of failure is a function of the wage, so the Board has an incentive to *bunch* wage choices (across realizations of their private information) if the benefit of decreasing the threat of failure outweighs the cost of paying the CEO a lower wage. Bunching thus identifies both the Board and shareholder costs to SOP failure.[6] Dey et al. (2023) use a similar identification strategy Similar empirical evidence has been found in Babenko et al. (2019) in the broader context of management proposals. However, to my knowledge, I am the first to use bunching to identify vote failure cost parameters in a structural model.[7]

[5]In SOP, 30% and 50% of shareholders voting against the SOP are key thresholds (Appendix B and Hauder, 2019).

[6]In Appendix C.1, I show in a simple model that one can use bunching to uncover a cost associated with SOP failure. This analysis also shows that, though bunching is a useful feature of the data for identification, a richer structural model (such as that presented in Section 3 is necessary to separately the Board and shareholder costs.

[7]This methodology has been used in the public finance literature (Saez, 2010; Chetty et al., 2011), and more recently in corporate finance (Antill, 2021; Ewens et al., 2023; Alvero et al., 2023).

The empirical evidence of the Board and shareholder cost provides further insight about the economics at play. SOP votes are non-binding, so they do not impact the Board's compensation policy directly. To give power to voice, shareholders hold the Board accountable when the SOP vote fails; for example, by exerting control and replacing directors in the future. Failure is thus costly for the Board, but not a free ride for shareholders.

Finally, the structural model allows me to go beyond estimating parameters and uncovering their implications: I can construct a counterfactual way of implementing SOP. In my baseline model, the Board and shareholders' private information about the CEO determine wage and voting strategies, so SOP vote outcomes are determined in part by different beliefs about the CEO. A simple change to information-sharing in the model emulates a commonly proffered way to engender communication and align beliefs between the Board and shareholders: granting a focal shareholder an advisory seat on the Board (Kakhbod et al., 2023). As explained in Section 6, this change allows shareholders to influence *ex ante* proposed compensation policy, as opposed to approving *ex post*.

In the model, this amounts to the Board and shareholders *sharing* their private signals (beliefs) about the CEO *in advance* of their decisions, as opposed to the wage and vote being determined by these possibly divergent signals. In this counterfactual, the SOP failure rate falls, wages decrease on average (though can increase, see Section 6) and firm value increases on average. Importantly, this counterfactual does not involve changing structural parameters, these effects are achieved solely by changing the way information is revealed.

The rest of the paper is organized as follows. I first describe the paper's contribution and context within the literature. Section 2 describes the data and presents empirical facts about CEO pay and SOP, which both motivate and discipline the model. Section 3 presents the structural model and section 4 describes the estimation methodology. Section 5 presents the results of the structural estimation. Section 6 introduces and analyzes the counterfactual SOP mechanism. Appendix A contains additional results, and Appendix B provides an institutional summary of SOP. Additional empirical, model and estimation details are in Appendices C, D and E, respectively.

1.1. Literature Review

This paper contributes to the literature on shareholder voice as a way to influence corporate policies (e.g. Hirschman, 1970; Gillan and Starks, 2007). Levit and Malenko (2011) study non-binding votes as a form of communication, showing how a large (activist) investor can make votes more effective at influencing management. My paper provides empirical evidence of this hypothesis by estimating how much the Board internalizes the cost of failing a SOP, and my subsample analysis shows that this cost varies with the presence of large shareholders. Levit (2019) studies the effectiveness of communication (voice) in influencing the decision-maker (the Board), which is directly related to the voice mechanism in my paper — the Board and shareholder costs to SOP failure determine the effectiveness of SOP as a communication device in disciplining wages.

My empirical results speak to the literature on how non-binding or non-consequential shareholder voting can influence the Board of Directors. Fos and Tsoutsoura (2014) study how proxy contests impact the careers of directors and Aggarwal et al. (2019) study the impact of dissent votes in uncontested director elections on careers; my paper shows the career and reputation consequences of a specific form of non-binding shareholder votes — SOP.[8]

My paper also contributes to the literature on Say-on-Pay. Several papers study the effects of the adoption of SOP (e.g., Cai and Walkling, 2011; Ferri and Maber, 2013; Correa and Lel, 2016; Cuñat et al., 2016), showing that increasing voice through SOP improved firm value, impacted CEO pay, or both. However, given the high SOP support, several papers (such as Armstrong et al., 2013; Kaplan, 2013) conclude that, once implemented, SOP has not influenced compensation and question its effectiveness in practice. My paper shows that SOP is an effective governance mechanism in practice: the low failure rate belies that SOP does have large impacts on compensation and value.[9]

There is a large literature studying if and how corporate governance or social responsibility affects firm value (e.g., Gompers et al., 2003). Cuñat et al. (2012, 2016) and Flammer (2015)

[8] Aggarwal et al. (2023) study shareholders' motivations for voting against corporate directors and find that shareholders hold directors accountable for a wide range issues, with governance being the main driver.

[9] Holland et al. (2023) show that it is difficult to infer the value impact of SOP votes directly from stock prices: option-implied volatility decreases before shareholder meetings, suggesting the market internalizes the vote outcomes in advance.

show a causal (positive) relation between adopting provisions that improve governance and firm value. My paper shows how (and by how much) a particular governance mechanism improves firm value in practice. Johnson and Swem (2021) shows that, although proxy contests are rare, the threat of their initiation is enough to influence firm behavior beneficially for shareholder value, my results show that SOP operates similarly.

My paper relates to how institutional investors impact executive compensation. Mehran (1995) and Hartzell and Starks (2003) show a negative relation between blockholder ownership and the level of CEO pay. SOP was introduced in the US explicitly to increase (large) shareholders' ability to monitor compensation policy. My estimates show that SOP is successful in lowering the level of CEO pay, even though failures rarely occur. Several papers have argued that passive investors, generally the largest blockholders, are ineffective monitors due to their hesitancy to dissent from management (Heath et al., 2022). My results show that dissenting carries consequences. In subsample analysis, I show that large blockholders *are* effective monitors (the Board cost to SOP failure is larger), yet they also face a larger cost to SOP failure. The argument that passive (large) investors are ineffective monitors is more subtle than previously considered, and depends on the relative magnitudes of these costs.

The study of executive compensation from an empirical, theoretical, or structural perspective is too vast to properly reference here. Taylor (2010, 2013) and Page (2018) are seminal structural papers studying CEO compensation, CEO turnover and board incentives. Lyman (2023) studies CEO turnover and CEO pay policy jointly in a structural model. A structural literature that studies shareholder voting has emerged; e.g., Blonien et al. (2022) study errors in shareholder voting. To the best of my knowledge, this is the first paper to estimate a structural model of executive compensation with a shareholder vote.

Finally, SOP can be seen as a monitoring mechanism with costly punishment. While non-binding in the sense that there is no explicit consequence, the Board's punishment for a negative evaluation arises through a *career concern* or *reputation* channel (Dewatripont et al., 1999). Similar economic settings have been explored in the empirical industrial organization literature, for example Silveira (2017) studies how the threat of trial sentencing (and costs associated for both sides) lead to most criminal cases ending in a plea bargain.

2. Empirical Analysis of CEO Compensation and Say-on-Pay

2.1. Data

For the analysis in Section 2.2 and the estimation described in Section 4, I use data on SOP vote results (Institutional Shareholder Services), CEO compensation (Execucomp), firm accounting data (Compustat), and stock prices (CRSP). The period is 2011-2020, and the sample is S&P1500 firms as I do not observe detailed executive compensation and voting data beyond this group.

Table 1 displays summary statistics for the empirical sample. It displays statistics for firm-level variables, CEO-level variables and outcome of SOP votes. The average vote against is about 9% (i.e., the average support rate is about 91%). Only 6.8% of votes fail (have more than 30% vote against), and 1.8% receive less than 50% support. Firms are on the larger end (due to the focus on S&P1500 firms), so there is a significant right skew in size and revenues.

The average CEO in the sample receives \$855 thousand in salary and \$138 thousand in bonus. However, bonus is not a strong feature of the sample, with only 15% receiving a bonus greater than zero. An important thing to note — the model is silent on the differences between salary and performance-based compensation; see Page (2018) for structural analysis of the CEO's contract. CEO tenure is 7 years at the median, which will inform the separation probabilities in the estimation.

2.2. Empirical Facts

This section documents key empirical facts about SOP and executive compensation that help motivate and discipline the model. Specifically,

1. SOP failure likelihood is driven primarily by CEO pay and company performance.
2. CEOs exert influence over compensation policy via *board capture*.
3. SOP disapproval leads to costly outcomes for directors.
4. SOP voting behavior is consistent with shareholders facing a cost from SOP failure.

Facts 1 and 2 are largely a summary of empirical results known to the literature, collected and framed within my setting, whereas Facts 3 and 4 are new results that motivate the Board and shareholder costs to SOP failure.

Fact 1. *SOP failure likelihood is driven primarily by CEO pay and company performance.*

This introductory fact provides a basis for analysis and will inform how the SOP vote is conducted in the model of Section 3: the probability of SOP failure is increasing in the level of CEO's wage and decreasing in company and stock performance. Table 2 displays regressions in which the dependent variable is an indicator for SOP failure (more than 30% voting against the SOP, in columns 1-4), or the percentage of shareholders voting against the SOP (the continuous measure, columns 5-8). The main independent variable is log CEO compensation. The table shows that SOP failure likelihood and SOP disapproval rates are strongly increasing in the level of CEO pay. This relation is robust to performance controls and fixed effects (even as fine as firm × CEO), as well as lagged pay.

The same table shows that SOP disapproval is *decreasing* in company and stock performance (the firm's return on assets (ROA) and the 12-month stock return, respectively), conditional on the CEO's pay, confirming findings from Fisch et al. (2018).[10] These strong relations provide clarification for the quantitative model. Shareholders fail SOPs when wages are (too) high, given what they believe about the CEO. If the company is doing well, then shareholders are less likely to fail the SOP, even if wages are high. Both of these forces will inform the structure of the SOP vote in the model.

As corroborative evidence that SOP impacts *future* compensation policy, Appendix Table A.2 shows a strong negative relation between changes in CEO pay and SOP disapproval: CEO pay falls by about 4 percentage points following SOP failure. This robust result suggests that SOP failure pushes the Board to make changes to CEO pay.

Fact 2. *CEOs exert influence over their compensation via* board capture.

CEOs can partially determine the compensation-setting process by influencing the Board of Directors (e.g., Graham et al., 2020). Concurrently, CEOs have bargaining power over the firm (e.g., Taylor, 2013). If primarily the latter, then inflated wages may be optimal, so confirming the presence of the former in my data (which SOP is designed to combat) is important. I examine a well-established measure from the literature: *board co-option* (Coles et al., 2014), which

[10] Table A.1 tests the company/stock performance hypothesis separately.

measures the percentage of directors (including independent) that were appointed during the CEO's tenure. Coles et al. (2014) show that board co-option correlates with the level of CEO pay and I confirm this relation in my data in Table 3 Panel A. The level of CEO pay increases with board co-option: pay increases by 7-9 percentages points for each standard deviation increase in board co-option. As in Coles et al. (2014), I include CEO tenure fixed effects in each specification as co-option mechanically rises with tenure.

Panel B of Table 3 presents a result new to the literature. I regress log changes in CEO pay (from t to $t+1$) on an interaction between board co-option and the outcome of the SOP vote (both from year t). The table shows that board co-option modulates the relation between changes in CEO pay and SOP disapproval. In other words, higher board capture lessens the influence that SOP has on compensation policy.

The model incorporates CEO influence on the Board directly into the Board's pay-setting process. In the model, the Board wants to overpay the CEO by a constant proportion (determined by a parameter λ, which will be discussed in detail in Section 3). However, as I show in Appendix D.1, neither the shareholder nor the econometrician is able to separately identify whether board capture is CEO influence or CEO bargaining power.; in subsample estimation (Section 5.4), I show that estimated board capture varies with board co-option (the measure from Coles et al., 2014).

Fact 3. *SOP failure correlates with costly outcomes for directors.*

A basic premise of the model is that SOP failure is costly for directors. I provide new evidence of this cost in three areas. First, Table 4 Panel A shows that director turnover correlates with SOP disapproval. I identify turnover events occurring between SOP votes and regress a director turnover indicator on the SOP vote result from the previous year.[11] Columns 1-3 of Panel A show that director turnover likelihood is 1.5 to 2.3 percentage points (pp) higher after SOP failure. Relative to non-failure, the probability of director turnover is 20% higher. This finding is robust to controlling for company performance (ROA and firm's stock return over the past 12 months), along with a battery of controls covering board composition, and director and CEO features.

[11]Director turnover is identified following the methodologies in Fischer et al. (2009) and Iliev et al. (2015).

Panel B of Table 4 presents a second cost to directors from SOP disapproval. Focusing on the subsample of directors not turned over, I identify cases where compensation committee members leave the compensation committee. SOP failure is associated with a 1.1 to 1.5 pp higher probability of leaving the compensation committee (a 26% increase). Taken together, Panels A and B show that SOP failure is a career concern for directors.

Panel C shows a third cost to directors by evaluating how SOP disapproval affects the *external reputation* of directors — via its effect on the number of outside boards that the director sits on. I focus on compensation committee directors that sit on at least one outside board and then see a reduction in outside board seats the year after the SOP vote. The panel shows that SOP failure is associated with a 1.7 to 1.9 pp increase in the likelihood that the director loses at least one of these outside board positions (a 21% increase). Failing the SOP impacts directors *outside the firm where they work*: external reputation costs result from SOP failure.

Table 4 shows that failing SOP votes is a career and reputation concern for compensation committee directors. In the model, SOP impacts CEO pay policy through SOP failure being costly to the Board. The evidence suggests that the cost (labeled χ_B) is large. These findings support Fos and Tsoutsoura (2014) and Aggarwal et al. (2019), who respectively find that proxy contests have lasting reputational damage on directors and abstained votes in uncontested director elections lead to negative consequences for directors.

Fact 4. *SOP voting behavior is consistent with shareholders facing a cost from SOP failure.*

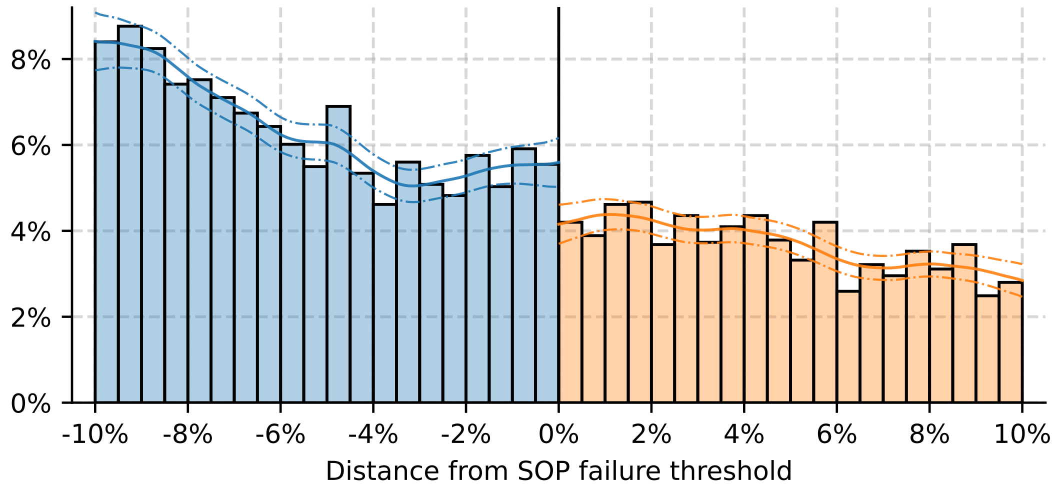
This paper presents empirical evidence that shareholders internalize a cost to SOP failure, estimates its magnitude, and explores its role in the economic mechanism through which SOP influences compensation policy. Edmans et al. (2021) provide survey evidence that of the cost: in interviews, institutional investors express their reluctance to fail SOP votes.[12] SOP failure is viewed as a reputation cost via dissenting from management on a prominent firm policy. Shareholders also feel that dissent constitutes a future monitoring cost, as management will engage with shareholders repeatedly in the future about changing compensation policy.[13]

[12] It is important to note that Edmans et al. (2021) survey UK institutional investors, so the respondents are not discussing their views on SOP in the US. SOP votes in the US and UK receive similar levels of support.

[13] See Online Appendix A of Edmans et al. (2021). Investors also mention they often follow proxy advisors as resource constraints prevent them from fully analyzing compensation policy. Figure A.1 presents anecdotal evidence of future monitoring costs: after failing the 2021 SOP, Netflix engaged with large shareholders about

Figure 2. Density manipulation of SOP outcomes

This figure displays the result of testing for density manipulation of SOP votes at the failure thresholds of $k = \{30\%, 50\%\}$, following the methodology described in Cattaneo et al. (2018). I look for bunching at k in $\Delta^{\text{data}} = \text{share against} - k, \quad \Delta^{\text{data}} \geq 0 \iff \text{SOP fail}$. I focus on SOP votes falling within 10 pp of each failure threshold and test for density manipulation at zero. The blue and orange bars display observed frequencies of Δ^{data} in 0.5% bins and the blue and orange lines (and shaded areas, 95% confidence intervals) display the estimated density.



In the model, SOP failure conveys that shareholders believe the CEO is of low skill or the match quality is poor. An implication from the model is that CEO turnover likelihood should positively correlate with SOP disapproval. However, changing the CEO is costly: Taylor (2010) estimates turnover costs equivalent to 1.3% of assets and Clayton et al. (2005) show that CEO turnover leads to long-term increases in stock return volatility. Hence, reducing the threat of SOP failure and ceding some value through higher CEO wages may be preferable.

In support of this, Table 5 displays a new result: SOP disapproval is associated with large increases in the likelihood of CEO turnover. When SOP votes fail, CEOs 2.3 to 3.2 pp more likely to be turned over, about a 30% increase relative to turnover rate when SOPs pass. This result is robust to nonlinearities in firm/stock performance and fine fixed effects, suggesting that SOP disapproval signals Shareholder dissatisfaction with the CEO.

While the survey and CEO-turnover based evidence are suggestive of the existence of a cost to shareholders from failing SOPs, the model allows me to use bunching of SOP vote outcomes below failure thresholds to reveal information on this cost. A higher occurrence of close passes relative to fails suggests that shareholders strategically avoid failing SOPs.[14]

compensation numerous times throughout the year.

[14]This type of strategic behavior requires coordination across diffuse, or. large pivotal blockholders swinging the outcome by keeping the percentage of dissenting votes below the failure threshold.

Figure 2 displays a result new to the literature. I test for bunching around the SOP failure thresholds of 30% and 50% (the commonly understood failure thresholds, ISS, 2022). The light blue and orange bars show the observed frequencies of SOP vote outcomes in 0.5 percentage point relative to the failure threshold. There is clear bunching and I find a statistically significant difference in density.[15] Although bunching is not definitive evidence of a shareholder cost from failed SOP votes, it is consistent with this cost. Pivotal blockholders have an incentive to pass a close vote if the cost of SOP failure outweighs its benefit. Once it is recognized that the outcome of the vote is a function of the Board's wage policy (see Section 3.3), bunching also provides information on how costly failed votes are to Boards.

To further motivate the existence of these costs, in Appendix C.1, I present a simple structural model (independent of the model in Section 3) which uses the observed bunching in Figure 2 to estimate a reduced-form object related to the costs of SOP failure. Importantly, this simple model does not place enough structure on the data and *cannot separately identify* the Board and shareholder costs to SOP failure: the object maps to a combination of the two. Nevertheless, the outcome of the estimation in Appendix C.1 is similar in magnitude to the costs I estimate in Section 4 (both Board and shareholder), which is reassuring.

The identification of the model's SOP failure cost parameters uses the observed bunching. In the model in Section 3, shareholders weigh the expected cost of SOP failure against its impact on the Board's wage decision when SOP failure is *ex ante* more probable. In turn, the Board is aware of the distribution of shareholders' beliefs and understands that in some states, even slight reductions in wages can significantly reduce the likelihood of the vote failing. While the underlying signal distributions for both parties are continuous, the model predicts that there will be a clustering of vote outcomes directly below the failure threshold with a corresponding gap in the distribution directly above it.

This section presents several new stylized facts about CEO pay and SOP. These facts discipline the model (Section 3), and inform the estimation (Sections 4-5). Particularly important are the motivations for model parameters which embed the Board's bias towards over-paying the CEO (board capture), and the magnitude of the Board and shareholder cost to SOP failure.

[15] Figure A.3 conducts a test where I set "placebo" vote failure thresholds of 20% and 40%, as opposed to the commonly accepted thresholds of 30% and 50%. The figure shows no change in density at these thresholds.

3. Model

This section outlines the model. The key forces are guided by the analysis in Section 2. The subsequent estimation will determine the extent to which these forces matter; for now, the model treats them as parameters. Table A.3 displays model parameters and definitions. The framework, particularly the belief formation process, is inspired by Taylor (2010).

3.1. Technology and Environment

Time is annual and the firm is infinitely-lived.[16] The firm consists of three actors: the Board of directors, that sets the CEO's wage each period; the CEO, who exerts effort for the wage they receive; and a shareholder base, which holds an approval vote of the Board's pay policy (a "Say-on-Pay"). CEO skill is uncertain: the Board and shareholders form beliefs based on the information they observe. Each period, a CEO of tenure τ separates from the firm with (exogenous) probability $f(\tau)$; upon separation, the firm matches (exogenously) with a new CEO.

Effort (n_t) is increasing but concave in the wage w_t,

$$n_t = w_t^{\gamma}, \quad \gamma \in (0, 1].$$

This assumption captures in reduced-form that effort is privately costly for the CEO, so compensation extracts less effort if effort is already high. The firm produces according to

$$y_t = A_t n_t^{\beta}, \quad \beta \in (0, 1),$$

where β is a constant and $A_t > 0$ is the firm's productivity. I am not interested in separately identifying γ and β, so I define $\alpha \equiv \gamma\beta \in (0, 1)$ to describe the shape of the production function.[17] Output is thus

[16] Though SOPs only need to occur once every three years, in practice most firms have them annually. I abstract away from this — if a firm has an SOP every two year three years, in the data analysis, I take only the year that an SOP occurs (rather than averaging across years), but either method works just as well.

[17] Appendix D.1 presents a simple microfoundation of the relation between CEO effort, the wage and output. Beyond this, the CEO is a passive actor: the model is silent on the contracting problem between the Board and the CEO, and instead focuses on the interaction between the Board and shareholders. Page (2018) estimates the effect of CEO attributes and agency issues on the CEO contract.

$$y_t = A_t w_t^{\alpha}. \tag{1}$$

Firm productivity is centered around CEO skill a, but influenced by a mean-zero shock ε_{yt},

$$\ln A_t = a + \varepsilon_{yt}, \quad \varepsilon_{yt} \sim N\left(0, \sigma_y^2\right). \tag{2}$$

Type a is not observed by the Board and shareholders, they make predictions about a based on information they observe. Eq. (2) defines the notion of CEO skill — higher types achieve higher average productivity. Net operating income in year t is revenue minus the CEO wage:[18]

$$\pi_t = A_t w_t^{\alpha} - w_t.$$

The Board of Directors (B) sets the wage w_t. Importantly, the Board does not perfectly maximize firm profits. That is, absent dynamic considerations and any influence from the SOP, the Board would choose w_t to maximize

$$\pi_t^{\mathrm{B}} = A_t w_t^{\alpha} - w_t + \lambda w_t,$$

where $\lambda \in [0, 1)$ governs the influence the CEO has on the Board's decision-making, and more generally captures agency costs in the form of CEO influence on pay, what I refer to as *board capture* (see Section 2.2 and Fact 2). When $\lambda > 0$, the Board's optimal wage is above that which maximizes net operating income.[19] This bias can reflect a large outside option or some other channel which allows CEOs to demand a high wage (Cziraki and Jenter, 2022; Gabaix and Landier, 2008). It can also reflect CEO influence on the pay-setting process, for example via personal relationships with members of the Board (Graham et al., 2020; Coles et al., 2014). The model does not attempt to separate these forces, and in Appendix D.1 I show they are in fact not separately identified; rather λ measures a gap between the wage that would maximize shareholder value and the wage the Board would pay the CEO.

[18] Profits (by assumption) are paid out immediately as dividends (including negative profits), and thus firm size is fixed over time and will not factor into the model (Taylor, 2010).

[19] I could write biased operating income as $(1 - \nu)(A_t w_t^{\alpha} - w_t) + \nu w_t$, so the Board maximizes a weighted average of profits (shareholder value) and the extra wage it pays the CEO. It is equivalent to define $\lambda = \frac{\nu}{1-\nu}$.

As Taylor (2013) shows, CEO wages display *downward rigidity*: risk-averse CEOs accept lower wages if they are protected from downside risk. To match observed patterns in compensation, the model incorporates an adjustment cost into the Board's wage decision:

$$AC(w_t; w_{t-1}, \tau_t) = c_w \times w_t \left(\frac{w_t - w_{t-1}}{w_t} \right)^2 \times \mathbb{1}[w_t < w_{t-1}] \times \mathbb{1}[\tau_t > 0]. \quad (3)$$

The adjustment cost is quadratic, scales with the wage level, is not present if the CEO is in the first year of their tenure, and only activates if the Board decreases the wage from $t-1$ to t; the one-sidedness of the cost is chosen to match the observed downward rigidity in CEO wages. Parameter c_w controls the cost of adjustment, and is to be estimated.[20]

Shareholders hold an approval vote each year on the Board's CEO pay policy, or a Say-on-Pay (SOP).[21] The vote is non-binding (it does not force the Board to set a new wage contract) and occurs at the end of each period (after the wage decision and output have occurred). I assume that a failed vote results in a cost for the Board: $\chi_B \geq 0$. In practice, this cost may include both pecuniary and non-pecuniary components, but in the model it measures the Board's (perceived) aversion to a failed vote. The Board's per-period utility is

$$A_t w_t^\alpha - w_t + \lambda w_t - \chi_B \times \mathbb{1}[\text{SOP fail}_t] - AC(w_t; w_{t-1}, \tau_t). \quad (4)$$

Shareholders in the model seek to maximize net operating income. Thus, if wages are "too high" given shareholders' current beliefs about CEO ability, the SOP vote may fail and the Board must incur the failure cost. Upon vote failure, the shareholders will also face a failure cost. As discussed in Section 2.2, such cost might represent an aversion to dissenting from the Board on compensation policy.[22] The parameter $\chi_S \geq 0$ governs the shareholders' cost of failing the SOP. The shareholders' per-period utility is

$$A_t w_t^\alpha - w_t - \chi_S \times \mathbb{1}[\text{SOP fail}_t]. \quad (5)$$

[20]Table A.2 and the findings from Taylor (2013) show why the adjustment cost is needed. The table shows that CEO pay falls when SOPs fail, whereas Taylor (2013) shows CEO pay is downward rigid; SOP failure *forces* the Board to alter their compensation policy and face the negative effects of lowering the CEO's wages.

[21]While the structure of the CEO's pay package certainly influences SOP outcomes, shareholders predominantly vote in response to the level of CEO pay, as detailed in Fact 1 and Table 2.

[22]Like the Board cost, in the model, the cost is a perceived aversion to failing the SOP.

Eqs. (4) and (5) summarize the differences in Board and shareholder preferences: the Board is biased towards paying a higher wage, their SOP failure costs may differ, and the Board incorporates the one-sided adjustment cost.[23] Shareholders can alleviate the Board's bias (λ) by threatening to fail the SOP and forcing the Board to pay a (perceived) cost (χ_B); however, they also internalize their own (perceived) cost from failed SOP votes (χ_S). The parameters χ_B and χ_S and their respective magnitudes will be the focus of the estimation.

3.2. Model Timeline, Signals, and Beliefs

This section describes the per-period model timeline (Figure 3) and the points at which the Board and shareholders observe information which updates their beliefs about CEO skill a. To start, each period the firm separates from the CEO with exogenous probability $f(\tau)$ and matches with a new CEO of tenure $\tau = 0$. Upon matching, the Board and shareholders begin with a shared prior about the CEO's skill,

$$a \sim N\left(\mu_0, \sigma_0^2\right), \tag{6}$$

which matches the distribution of ability in the CEO talent pool. At the annual compensation committee meeting, the Board receives its private signal about the CEO,

$$z_{bt} = a + \varepsilon_{bt}, \quad \varepsilon_{bt} \sim N\left(0, \sigma_{z_b}^2\right). \tag{7}$$

z_{bt} represents *operational interaction* with the CEO, and it will inform the Board's wage decision. Shareholders do not observe z_{bt}, which means that the Board is asymmetrically informed (has different and more precise beliefs) about CEO skill when they set the wage. Once the wage is set, the CEO receives their wage and exerts effort, and productivity and output realize.

At the annual shareholder meeting, each shareholder in the continuum of shareholders draws a signal about CEO type that is private knowledge, but correlated across shareholders. The standard voting model with incomplete information assumes that signals are completely

[23] The assumption that shareholders do not incorporate the adjustment cost keeps the shareholders' problem static, which simplifies the numerical solution. Moreover, Table 2 shows that lagged log pay does not have an impact on SOP outcomes: it is likely that shareholders vote in a "static" sense.

private. However, in shareholder voting, signals are correlated (this correlation could reflect proxy advisors' recommendations.) This correlated signal structure among the firm's shareholders makes it informationally equivalent (from the econometrician's perspective) to focus on a representative shareholder, as microfounded in Appendix D.2. I henceforth refer to the single representative Shareholder, labeled S. At the meeting, which occurs at the end of each period t, S aggregates information from the shareholder base into the signal:

$$z_{st} = a + \varepsilon_{st}, \quad \varepsilon_{st} \sim N\left(0, \sigma_{z_s}^2\right). \tag{8}$$

At the same point, S receives the firm's 10-K and proxy statement, which reveal output y_t, realized productivity A_t and the CEO's wage w_t. Importantly, A_t serves as a public signal about the CEO's ability: when productivity is high (eq. 2), B and S will revise their beliefs about the CEO upward. I label this signal:

$$z_{yt} = \ln A_t = a + \varepsilon_{yt}, \quad \varepsilon_{yt} \sim N\left(0, \sigma_y^2\right). \tag{9}$$

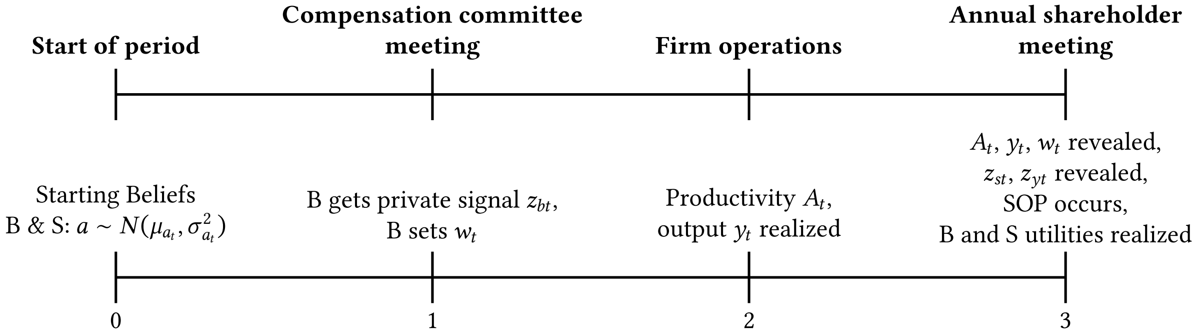
Both the private signal z_{st} and the public signal z_{yt} will affect the SOP result, which incorporates company performance into the vote outcome (Fact 1 and Fisch et al., 2018).

Model timeline. Figure 3 displays the sequence of events within the model. At the start of each period, B and S each believe that CEO ability $a \sim N\left(\mu_{at}, \sigma_{at}^2\right)$. As described in Appendix D.4, due to signal disclosure in the wage-SOP game, B and S share the same beliefs at the beginning of each period because B's wage choice fully reveals their private signal and the outcome of the SOP vote fully reveals S' signal.

At the compensation committee, B receives its signal z_{bt}, which informs their wage decision. Then, operations take place: the CEO receives their wage and expends effort, and productivity and output realize. At the annual shareholder meeting, S receives the private signal z_{st}, and output, productivity and wages are revealed; productivity reveals the private signal z_{yt}. Finally, the SOP vote occurs and Board and Shareholder utilities are realized.

Figure 3. Model timeline

This figure displays the within-period model timeline. The top timeline displays the timeline as it maps to practice; the bottom as it maps to the sequencing of events within each period t. Figure A.5 displays an in-depth timeline which incorporates the timing of the strategies by the Board and Shareholder (See Appendix D.4).



Board and Shareholder Beliefs. Both B and S use Bayes' rule to update beliefs about CEO ability after they see signals. I use the subscript a to refer to beliefs shared by B and S, so $\left(\mu_{at}, \sigma^2_{at}\right)$ refers to shared beliefs at the beginning of period t. I use the subscripts b and s when B and S can have different beliefs. CEO tenure fully determines the variance of beliefs (see Appendix E.2 and Taylor, 2010), so I define the function $\sigma^2_a(\tau)$ to track how the variances of beliefs decreases across tenure. Given the CEO's tenure τ_t in year t, the variance evolves according to

$$\sigma^2_{at+1} = \sigma^2_a(\tau_t + 1) = \sigma^2_0\left[1 + (\tau_t + 1) \times \sigma^2_0\left(\sigma^{-2}_{z_b} + \sigma^{-2}_{z_s} + \sigma^{-2}_y\right)\right]^{-1}. \tag{10}$$

The mean evolves according to

$$\mu_{at+1} = \sigma^2_a(\tau_t + 1)\left[\frac{\mu_{at}}{\sigma^2_a(\tau_t)} + \frac{z_{bt}}{\sigma^2_{z_b}} + \frac{z_{st}}{\sigma^2_{z_s}} + \frac{z_{yt}}{\sigma^2_y}\right]. \tag{11}$$

The rate of decline of the variance σ^2_{at} means that μ_{at} tends toward the CEO's true ability.

3.3. The Say-On-Pay Vote

Each period, the Board sets the wage and the Shareholder decides whether to fail the SOP. These decisions are informed by each party's private signal and how they view each other's beliefs. This section details the Shareholder's strategy, holding the Board's wage choice fixed. In Appendix D.4, I detail several assumptions made about the SOP vote; these assumptions are intended to keep the game tractable, while also remaining realistic about B and S strategies.

3.3.1. The Shareholder's Strategy

Informally, S will fail the SOP if the CEO's wage is "too high" given their beliefs. Fixing the wage choice of the Board, the notion of "too high" will incorporate S' current beliefs about CEO ability and how costly vote failure is to Shareholders. Formally, S sets a threshold posterior belief about CEO ability for which they would be indifferent between the vote failing and passing, which is equivalent to setting a threshold in S' signal distribution that leads to this posterior belief. As such, a higher threshold implies a higher probability of SOP failure. Via the Board's expected failure cost, this will lead to lower wages on average, but also raises the Shareholder's expected failure cost. S' strategy can be described as setting a probability (threat) of SOP failure which maximizes S' expected utility,

$$\Pr(\text{SOP fail}_t) = \Pr\big(Z_{syt} \le k_{st}\big).$$

The signal Z_{syt} incorporates both the private signal (z_{st}) and the effect of firm productivity (z_{yt}) on S' beliefs. I assume the threshold S chooses takes the form

$$k_{st} = s_t \times w_t. \tag{12}$$

Fact 1: Pr(SOP fail) is increasing in the wage. Eq. (12) is chosen to match Fact 1, which shows that a higher CEO wage leads to a higher probability that the SOP vote fails. The threshold is thus increasing in the wage choice of the Board, and the choice variable s_t controls the *sensitivity* of the SOP failure likelihood to changes in the wage.

As in Figure 3, at the annual shareholder meeting, output and the wage are revealed to shareholders. S receives two signals about CEO ability: their private signal z_{st} and the productivity signal z_{yt}. The Shareholder uses all information available and considers the average of these signals, with weights determined by their relative precision. Let $p = \frac{\sigma_{z_s}^{-2}}{\sigma_{z_s}^{-2}+\sigma_y^{-2}}$ be the relative precision of ε_{st}. Hence, *ex ante* the Shareholder's signal is distributed according to

$$Z_{syt} = pz_{st} + (1-p)z_{yt} = a + p\varepsilon_{st} + (1-p)\varepsilon_{yt}, \quad Z_{syt} \sim N\left(\mu_{at}, \sigma_{at}^2 + \frac{\sigma_{z_s}^2\sigma_y^2}{\sigma_{z_s}^2 + \sigma_y^2}\right). \tag{13}$$

This is the distribution that matters for the probability of vote failure: S incorporates both signals, placing more weight on the signal with better precision. At the time that they commit to their threshold, S has beliefs about CEO ability $\left(\mu_{at}, \sigma^2_{at}\right)$. Given this, the signal Z_{syt} has distribution as in (13). Further, B knows this is the distribution that from which S' signal will be drawn; B takes this into account when setting the wage.

Fact 1: Pr(SOP fail) is decreasing in company performance. Eq. (13) is how firm performance affects SOP outcomes in the model: better performance leads to a lower probability of failure (Fisch et al., 2018). In the model, if the firm's productivity is high, S is unable to distinguish whether it is due to the CEO's expertise or a shock affecting output. A higher z_{yt} will lower the probability of SOP failure, even if the wage w_t is large.

Distance from the unbiased wage. With no board capture, the profit-maximizing, or *unbiased wage* that the Shareholder would pay is

$$w^{\mathrm{U}}_t = \arg\max_{w_t} \quad E_{st}\left[\exp\left(a + \varepsilon_{yt}\right)\right] w^{\alpha}_t - w_t = \left(\alpha E_{st}[\exp\left(a + \varepsilon_{yt}\right)]\right)^{\frac{1}{1-\alpha}}. \tag{14}$$

The goal of the Shareholder in the model is to get the Board's wage choice as close to the unbiased wage as possible, given the costliness of SOP failure. SOP failure should be determined via *distance* in the observed wage from the unbiased wage. The random variable w^{U}_t is lognormally distributed, with distribution determined by belief tuple $\left(\mu, \sigma^2\right)$ and parameters

$$w^{\mathrm{U}}_t \sim \log N\left(\frac{\mu}{1-\alpha} + C, \frac{\sigma^2}{(1-\alpha)^2}\right), \quad C = \frac{\log\alpha + \frac{1}{2}\sigma^2_y}{1-\alpha}. \tag{15}$$

Thus, given the distribution of Z_{syt} in (13), there is a random variable $w^{\mathrm{U}}_t\left(Z_{syt}\right)$ given by (15) that is the conversion of Z_{syt} to its unbiased wage counterpart.[24] I refer to the CDF of this distribution as F^{U}_{st}, where st signifies the Shareholder's period t beliefs about CEO ability.[25]

[24] The distribution of $w^{\mathrm{U}}_t\left(Z_{syt}\right)$ is found by plugging μ_{at} and $\sigma^2_{at} + \frac{\sigma^2_{z_s}\sigma^2_y}{\sigma^2_{z_s}+\sigma^2_y}$ into (15).

[25] Conveniently, the transformation to the lognormal, unbiased wage distribution ensures that S' strategy s_t is just a non-negative, real number, and that the threshold is always increasing in the wage. The wage is guaranteed to be positive (due to lognormal productivity), however CEO ability can be both positive and negative (and hence, draws from the distribution of S beliefs about CEO ability can be both positive and negative.

3.3.2. Determining the Probability of SOP Failure

If Z_{syt} leads to S' posterior belief falling below the chosen the threshold, the vote fails. Given the previous discussion, the *ex ante* probability of failure, given w_t is

$$\Pr(\text{SOP fail}_t) = \Pr\left(w_t^{\text{U}}\left(Z_{syt}\right) \leq s_t \times w_t\right) = F_{st}^{\text{U}}(s_t \times w_t). \tag{16}$$

Fixing the Board's best response w_t for now, S chooses s_t to maximize expected net operating income, conditional on their beliefs at the start of period t, $a \sim \left(\mu_{at}, \sigma_{at}^2\right)$. Importantly, S influences expected wages. When setting the vote policy, conditional on the shared belief μ_{at} at the beginning of period t, S takes expectations over signals z_{bt}. At the same time, given z_{bt}, B updates beliefs to $\mu_{bt|z_b}$ following standard updating. B then optimally offers $w_t(z_{bt}, s_t)$, which will be detailed in Section 3.4. The Shareholder's problem is

$$\max_{s_t} \quad \int_{z_b} f(z_b) \left[\underbrace{E_{st}[A_t] w_t(z_{bt}, s_t)^{\alpha} - w_t(z_{bt}, s_t)}_{\text{Expected operating income}} - \underbrace{\chi_S \times F_{st}^{\text{U}}(s_t \times w_t(z_{bt}, s_t))}_{\text{Expected cost of SOP failure}} \right] dz_b. \tag{17}$$

The Shareholder commits to an *ex ante* threat of vote failure intended to reduce the Board's bias that is increasing in the wage and decreasing in observed productivity. The realizations of z_{bt} (determining the wage), z_{st} and z_{yt} will determine the outcome of the vote.

3.4. The Compensation Committee

Each period, the Board receives its signal about CEO ability z_{bt}, and then decides the CEO's wage. Their beliefs at the beginning of t are $a \sim N(\mu_{at}, \sigma_{at}^2)$. Upon receiving z_{bt}, their beliefs become $\left(\mu_{bt|z_b}, \sigma_{bt|z_b}^2\right)$, where

$$\begin{aligned}
\mu_{bt|z_b} &= \sigma_{bt|z_b}^2 \left(\frac{\mu_{at}}{\sigma_{at}^2} + \frac{z_{bt}}{\sigma_{z_b}^2} \right) \\
\sigma_{bt|z_b}^2 &= \left(\sigma_{at}^{-2} + \sigma_{z_b}^{-2}\right)^{-1} = \frac{\sigma_{at}^2 \sigma_{z_b}^2}{\sigma_{bt}^2 + \sigma_{z_b}^2},
\end{aligned} \tag{18}$$

which is standard Bayesian updating (see Appendix D.3). If B revises its beliefs about CEO ability downwards, they will want to decrease w_t relative to w_{t-1}. To match dynamics in wages, I include the wage adjustment cost from (3) in the Board's problem. At the compensation committee meeting, B chooses the wage for the upcoming year by solving the following dynamic program

$$V(\mu_{at}, \tau_t, w_{t-1}) = \max_{w_t} \quad E_{bt|zb}[A_t]w_t^{\alpha} - w_t + \lambda w_t - \chi_B \times F_{st}^{\mathrm{U}}(s_t \times w_t) - AC(w_t, w_{t-1}; \tau_t) + \delta_B\Big[(1 - f(\tau_t))E_{bt|zb}[V(\mu_{at+1}, \tau_t + 1, w_t)] + f(\tau_t)V^R\Big]. \tag{19}$$

The state consists of the two variables that track the Board's beliefs about the CEO: the current belief about the mean μ_{at} and the CEO's tenure τ_t (which determines the variance of beliefs σ_{at}^2, eq. 10). The third is the previous period's wage w_{t-1}, which tracks the history of wages paid to the CEO (which is set to zero if $\tau_t - 1 = 0$). To be clear, w_t is a function of both z_{bt} and the shareholder's strategy s_t, however for tractability this notation is omitted from (19). $F_{st}^{\mathrm{U}}(s_t \times w_t)$ specifies the probability of SOP failure as detailed in Section 3.3. Operator $E_{bt|zb}[\cdot]$ is taken with respect to B's beliefs about CEO ability after it receives the signal z_{bt} (so beliefs are distributed according to eq. 18).

At the heart of the Board's problem is the trade-off between paying a higher wage (board capture λ) against the higher probability of SOP failure. The Board must calculate the expected productivity of the firm A_t, (also influenced by the distribution of ε_{yt}); the likelihood the Shareholder will fail the SOP vote; the adjustment cost; and the continuation value. The hazard function $f(\tau_t)$ controls how often the firm separates from the CEO and is an input to the model. Pooling all CEO spells, $f(\tau_t)$ is the frequency of turnover after τ years, conditional on the CEO surviving $\tau - 1$ years.[26] V^R describes the termination value. Upon separating from the CEO, the Board accesses the CEO talent pool and beliefs reset to (μ_0, σ_0),

$$V^R = V(\mu_0, \tau = 0, 0), \tag{20}$$

so the value function returns to its starting value (prior beliefs) and there is no previous wage.

[26] I follow Taylor (2010) in the computation of the hazard rates. For simplicity, $f_0 = 0$ in the estimation, and $f(\tau_t) = 1$, where $\mathbf{T}$ is the cap on the length of CEO tenure. Further, the estimation sample excludes CEO spells that only last the first year.

3.4.1. Objective Firm Value

The Board's optimal wage policy admits the model's definition of objective firm value. Given the state and the Board's choice of the wage, firm value is

$$V^{\text{OBJ}}\Big(w_t, \mu_{at}, \tau_t, w_{t-1}\Big) = \pi_t - AC(w_t; w_{t-1}, \tau_t) + \delta_B \times E_{at}\Big[V^{\text{OBJ}}\Big(w_{t+1}, \mu_{at+1}, \tau_t + 1, w_t\Big)\Big], \quad (21)$$

where $\pi_t = E_{at}[A_t]w_t^{\alpha} - w_t$ is the firm's true operating income given w_t. In contrast to the Board's problem, objective value does not include board capture. In general, the Board's policy w_t will be above the value-maximizing wage. Secondly, firm value does not contain any inputs from the SOP vote, it merely represents the discounted cash flows of the firm. When I undertake counterfactuals, (21) will allow me to analyze how changes to SOP affect firm value (via its effect on the Board's compensation policy).

3.5. Model Solution and Predictions

I use Bayes' rule to derive Board and shareholder beliefs about CEO ability and substitute these beliefs into the Board's Bellman equation (19) and the Shareholder's objective function (17). Appendix D.5 gives the full derivation of the solution. I now discuss the model's predictions relating to the Shareholder's SOP-voting strategy. I focus on the static version of the model, so the adjustment cost and continuation value in (19) are dropped and (17) remains the same.

3.5.1. The Shareholder's Strategy

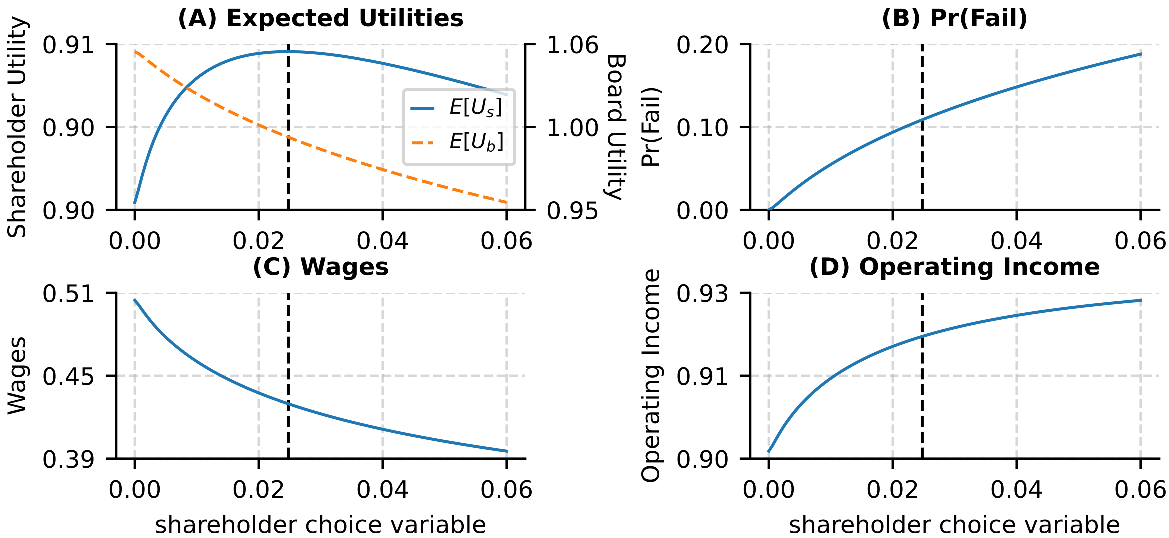
To illustrate how the SOP vote influences Board compensation policy, I explore how varying the Shareholder's strategy influences model outcomes. Figure 4 displays comparative statics of the shareholder's choice of s. For each point, I set S' strategy to $s \geq 0$, and then plot B's best response *as if* the threshold S plays were the equilibrium.

Panel A shows the Shareholder's maximization problem as a function of their strategy s; the solid blue line (left y-axis) displays Shareholder expected utility. The Shareholder balances the expected cost of failure against bringing the wage closer to the profit-maximizing wage. The dashed orange line (right y-axis) displays the Board's expected utility. If S' threshold is set to zero, the Board sets the fully biased wage. Shareholders undo the effects of board capture

Figure 4. Comparative statics over Shareholder strategy s

This figure shows how shareholder strategy s influences per-period expected outcomes. To produce the figure, I fix $s \geq 0$ and produce the Board's best response for that s. Each plot shows expected values taken over the Board's signal z_b. For example, Panel A (blue line) displays shareholder utility averaged over the Board's signal z_b, $\int_{zb} f(z_b)\left(E_s[A]w(z_b)^{\alpha} - w(z_b) - CDF_s^{\mathrm{U}}(s \times w(z_b))\right)dz_b$. The vertical, black and dashed line displays the equilibrium: S' best response.

Parameters: $\mu_0 = 0,\ \sigma_0 = 1,\ \sigma_y = 1.5,\ \sigma_{z_b} = 2.5,\ \sigma_{z_s} = 3,\ \chi_B = 0.45,\ \chi_S = 0.1,\ \alpha = 0.25,\ \lambda = 0.3,\ c_w = 0$



λ via increasing the *ex ante* probability of failure. Panel B displays the expected probability of failure, along with the optimal s from Panel A (the black dashed line, about 10%). Panel C shows the expected wage as a function of the strategy. In this example, S brings wages down by about 15%. Panel D displays operating income $\pi = E[y - w]$, showing the effect of the Shareholder cost: operating income would be closer to its maximum if the cost were smaller.

4. Estimation

I estimate the parameters of the structural model presented in Section 3 using indirect inference (McFadden, 1989; Smith, 2016): I choose the vector of structural parameters which minimizes the difference between the reduced-form outcomes of an auxiliary model estimated on observed and simulated data (from the structural model). The auxiliary model, although misspecified, focuses on features of the data which are highly informative about structural parameters. Details of the estimation are presented in Appendix E. Section 4.1 outlines the identification strategy. I present the quality of the model's fit in Section 4.2 and present the estimated structural parameters (and their economic implications) in Section 5.

4.1. Identification Strategy

I show there is a tight relation between the reduced-form outcomes of the auxiliary model and structural parameters, which is key to the success of the indirect inference approach. While identifying each structural parameter is important, the discussion will focus on the parameters λ (board capture), and χ_B and χ_S (the Board and Shareholder SOP failure costs, respectively). Table E.1 displays the reduced-form outcomes and the parameter(s) each outcome targets.

Output and CEO skill parameters. In Appendix E.1, I show how I extract the CEO component of company revenues, which is useful for identification:

$$\log y_{it} = \log \eta + a_i + \alpha \log w_{it} + \varepsilon_{yit} \implies y_{it} = \eta A_{it} w_{it}^{\alpha} = \eta \exp\left(a_i + \varepsilon_{yit}\right) w_{it}^{\alpha}. \tag{22}$$

y_{it} is CEO-driven firm revenues and w_{it} is the CEO's observed compensation. η is a factor which scales output to its appropriate level and is important in the estimation as it allows for appropriate comparison across subsamples (Page, 2018). Average CEO skill is only identified relative to the constant $\log \eta$ in (22), so I normalize μ_0 to zero.

The following (pooled) regression in the data maps exactly to company output in the model

$$\log y_{it} = y_0 + y_1 \log w_{it} + \epsilon_{it}^{y}, \tag{23}$$

Given $\mu_0 = 0$, $\hat{y}_0$ (average observed revenues) identifies $\log \eta$. The curvature of output with respect to the wage/effort (α) is identified via $\hat{y}_1$, and σ_y via the variance of the residual $\widehat{Var}\left(\epsilon_{it}^{y}\right)$. Netting out the effect of CEO effort/wage on output and taking expectation across the years CEO i spent in office exactly pins down σ_0 (variation in CEO skill):

$$E_i[\tilde{y}_{it}] = E_i[\log y_{it} - \alpha \log w_{it}] = E_i\left[a_i + \varepsilon_{yit}\right] = a_i \implies Var(E_i[\tilde{y}_{it}]) = \sigma_0^2. \tag{24}$$

Parameters that drive the Board's decision. The optimal wage depends on the Board's current beliefs about CEO skill (expected productivity), the degree of board capture, the probability of SOP failure give the wage, and an adjustment cost if the Board lowers the wage.

These forces are reflected in the following approximation to the optimal log wage, which illustrates clearly how estimable parameters drive variation in CEO pay:

$$\begin{aligned}\log w_{it} \quad \approx \quad & \underbrace{\log(\alpha E_{bt}[A_t])}_{\text{Expected productivity}} \quad - \quad \underbrace{\log(1-\lambda)}_{\text{Board capture}} \\ & \underbrace{- \log\left(1 + \frac{\chi_B}{(1-\lambda)} \times pdf^{\mathrm{U}}_{sit}(s_{it} \times w_{it}) s_{it}\right)}_{\Pr(\text{SOP fail})} \quad + \quad \underbrace{g(w_{it}, w_{it-1})}_{\text{Adjustment cost}} \ ,\end{aligned}$$

where $pdf^{\mathrm{U}}_{sit}(\cdot)$ is the likelihood function of the Shareholder's signal distribution.[27]

The following regression in the data is tightly linked to this expression:

$$\log w_{it} = b_0 + b_1 \mathbb{1}[\text{SOP fail}_{it}] + b_2 \log w_{it-1} + \epsilon^b_{it}. \tag{25}$$

$\hat{b}_0$ maps to the average observed wage and is influenced by cross-sectional productivity and the Board's bias. The former is determined by identified output/skill parameters. Absent bias, (counterfactual) wages would solely reflect expectations of CEO skill: $\hat{b}_0$ thus identifies λ. $\hat{b}_1$ helps to identify χ_B as it indicates how different wages are in SOP failure relative to SOP pass. Fixing other parameters, a small χ_B (close to zero) implies that b_1 must be close to zero: the Board cares little about SOP and will set a similar wage in SOP pass and failure. As χ_B gets larger, the Board must have better beliefs about the CEO (higher expected productivity) to offset the higher expected cost of failure, resulting in a larger b_1.

The Board's wage choice is determined by their signal z_{ibt}, so $\widehat{Var}\left(\epsilon^b_{it}\right)$ informs about the precision of the Board's signal. Lastly, $\hat{b}_2$ corners the dynamic aspect of the Board's problem (persistence in wage across periods) and identifies c_w.

Parameters that drive the Shareholder's decision. The model's definition of SOP failure can be written closed-form as

[27] The expression for $\log w_{it}$ results from taking w_{it-1} as given, fixing the Shareholder's strategy s_{it} and abstracting from dynamics (setting $\delta_B = 0$). The Board's first-order condition from this simple program is the approximation. The partial derivative of the adjustment cost with respect to w_t can be written as as $AC'(w_t, w_{t-1}) = -2c_w(w_t - w_{t-1})\mathbb{1}[w_t < w_{t-1}]$. Then, $g(w_t, w_{t-1}) \approx \log\left(2 + \frac{AC'(w_t, w_{t-1})}{1+\chi_B \times (1-\lambda)^{-1} s_{it} f(s_{it} w_t)}\right)$.

$$\mathbb{1}[\text{SOP fail}_{it}] = \mathbb{1}\left[s_{it}w_{it} - w_t^{\text{U}}\left(pz_{sit} + (1-p)z_{yit}\right) \geq 0\right],$$

where $w_t^{\text{U}}\left(pz_{sit} + (1-p)z_{yit}\right)$ is a linear combination of the two signals z_{sit} and z_{yit} transformed to the relevant distribution as in (13), and s_{it} is the Shareholder's choice variable.

The model-implied determination of SOP failure maps to the regression in the data

$$\mathbb{1}[\text{SOP fail}_{it}] = s_0 + s_1 \log w_{it} + s_2\epsilon_{it}^y + \epsilon_{it}^s, \tag{26}$$

where ϵ_{it}^y is the residual from the output regression (23). $\hat{s}_0$ maps to the unconditional failure rate and is most informative for the parameters χ_S and λ. All else equal, higher χ_S will lower the observed rate of SOP failure and higher λ will raise it (via increasing the wage). $\hat{s}_1$ describes the sensitivity of SOP failure likelihood to the wage, which is highly informative about χ_S and χ_B: s_1 is decreasing in χ_S as it lowers the sensitivity of the threat of SOP failure to the wage and increasing in χ_B as the Shareholder internalizes the threat has a larger impact on wages.

While the Board's wage choice reveals z_{bit}, the Shareholder's signal is unobservable in the data. As the distribution of ϵ_{it}^y is determined by other parameters (σ_y and σ_0), $\widehat{Var}(\epsilon_{it}^s)$ and $\hat{s}_2$ jointly identify σ_{z_s}. $\hat{s}_2$ corners how changes in productivity influence Shareholder beliefs about the CEO, which helps corner how much of SOP is driven by the private signal z_{sit}.

Bunching in Shareholder votes. The observed bunching in SOP vote outcomes is informative about χ_B and χ_S. Before continuing, I define the data- and model-distances from the SOP failure threshold:

$$\Delta^{\text{data}} = \text{share against} - k, \quad \Delta^{\text{data}} \geq 0 \iff \mathbb{1}[\text{SOP fail}] \tag{27}$$

$$\Delta^{\text{model}} = F_{st}^{\text{U}}(s_{it} \times w_{it}) - F_{st}^{\text{U}}\left(Z_{syit}\right), \quad \Delta^{\text{model}} \geq 0 \iff \mathbb{1}[\text{SOP fail}], \tag{28}$$

where k is the empirical failure threshold (i.e., 30% or 50%). Focusing on the region close to the failure threshold (where bunching occurs) illustrates the identification argument: matching the degree of bunching observed in the distribution of Δ^{data} in Δ^{model} helps to identify χ_B and χ_S.

In the model, the Shareholder commits to a single s_{it}, thereby making the realized threshold a function of the Board's signal z_{bit}. The Board has an incentive to *bunch* wage choices if the reduced expected cost of SOP failure outweighs the utility gained by a higher wage: bunching must be a function of the Board's cost to SOP failure χ_B. At the same time, χ_S dictates the location of the thresholds in the distribution function of Z_{syit}. A high χ_S will push the threshold toward zero and bunching will not occur; a low χ_S will push the threshold towards the middle of the distribution function and bunching similarly cannot occur.

It is useful to compare the model's notion of bunching and the bunching that occurs in Figure 2. In the data, this type of bunching is partially driven by large pivotal blockholders that can swing the outcome of a vote from a close fail to a close pass (as in Pinnington, 2022). There is no notion of blockholders in the model (just a single representative Shareholder). However, the *economic* force is the same: the blockholder (in the data) and the Shareholder (in the model) must have a low posterior belief about CEO skill for the vote to fail. The estimation targets a simple measure of bunching (Antill, 2021), which is similar to the estimator used in Figure 2, but easier to implement within the estimation; Appendix E.2 describes in detail.

4.2. Estimated Model Fit

Table 6 Panel A displays the closeness of auxiliary-model outcomes estimated on the observed and simulated data. The final column displays the test statistic from a two-way t-test comparing each outcome. Overall, the fit is quite good and importantly, the estimation matches the reduced-form outcomes which identify key structural parameters λ, χ_B and χ_S.

Outcomes which identify output and skill parameters are closely matched (outcomes 1-4). For the Board, average log wages (outcome 5, $\hat{b}_0$) and the log difference in wages in SOP failure (outcome 6, $\hat{b}_1$) are both matched well. The closeness in these outcomes is reassuring as they are key to identifying λ and χ_B. Persistence in log wages and variance of the wage regression residual (outcomes 7 and 8) are both over-estimated; implying that the estimation requires too-large an adjustment cost c_w and Board-signal volatility σ_{z_b}.

The estimation matches the observed SOP failure rate very closely (outcome 9): 7% and 6.7% in the observed and simulated data, respectively. The sensitivity of SOP failure to the wage (outcome 10, $\hat{s}_1$) is slightly under-estimated in the model, but there is no statistically significant difference. These are first-order reduced-form outcomes to match and the closeness is again reassuring of the estimation's success. The sensitivity of SOP failure to the output residual is well over-estimated in the model (outcome 11, $\hat{s}_2$). By incorporating the effect of company performance (through it being a signal of CEO ability) into the SOP vote outcome (Fact 1 and Fisch et al., 2018), it becomes too dependent on the productivity shock; this is natural given the model's parsimony. The simulated data matches the variance of the SOP regression residual (outcome 12) closely.

Lastly, bunching in shareholder votes (outcome 13) is matched closely in magnitude (0.121 *vs.* 0.116 in the estimation), though there is a statistically significant difference between the data and model. Bunching is very informative of the cost parameters χ_B and χ_S, so the closeness suggests these parameters are identified.

5. Results

5.1. Estimated Structural Parameters and Economic Implications

Table 6 Panel B displays the estimated parameters and quantifies their economic magnitudes.

5.1.1. Board Capture

The estimated value for λ is 0.612. I can translate this into how the Board splits the surplus between the Board and shareholders. In Appendix E.7, I show that the split of the surplus the Board wants to pay the CEO can be written as

$$\theta_{\text{CEO}} = \frac{\lambda w_t}{E_t[\pi_t] + \lambda w_t} = \frac{\lambda w_t}{E_t[A_t] w_t^{\alpha} - w_t + \lambda w_t}. \tag{29}$$

θ_{CEO} would equal zero without board capture and would equal one if the CEO captured all profits. Focusing on a CEO of average skill, I estimate $\theta_{\text{CEO}} = 40.7\%$. This is similar to Taylor (2013), who estimates that CEOs capture around 50% of surplus on the upside, but bear no downside risk. These estimates suggest that board capture is substantial at public companies. In Section 5.4.1, I show that estimated board capture varies with an empirical measure of CEO influence on the Board (board co-option, Coles et al., 2014).

5.1.2. The Board and Shareholder Costs to SOP Failure

I estimate that the Board considers SOP failure to be equivalent to 2.06% of firm value. For shareholders, this cost is 0.76% of value (or of a shareholder's equity stake), and both estimates are statistically different from zero.[28] It is important to note that these are utility costs. SOP failures do not affect output or value directly, the Board and shareholders must behave *as if* they do for the model to match observed outcomes. Thus, the shareholder cost to SOP failure makes shareholders pass some SOP votes that would fail if this cost did not exist.[29] Further, both costs are considerably lower in expectation as the unconditional failure rate is 6.7% in the simulated data: the Board (Shareholder) expected cost is closer to 0.14% (0.05%) of value.

These estimates highlight a key finding of this paper and clarify the economic mechanism of Say-on-Pay votes. SOP resembles a costly punishment mechanism: shareholders can punish the Board for overpayment, but internalize a cost from doing so.[30] The threat of costly SOP failure disciplines the Board even when failure is unlikely. As I show in Section 5.2 providing shareholders with a punishment technology improves firm value considerably, *even though* punishing the Board is conditionally very costly.

5.1.3. Economic Implications of Other Parameters

The mean of CEO skill is normalized to zero (see Section 4.1). The volatility of CEO skill is 0.542, implying that a CEO at the 75th percentile of ability is about twice as productive as the 25th percentile.[31] This implies that CEO skill matters (supporting Bertrand and Schoar, 2003).

The standard deviations of the Board's and shareholder's private signals are 1.996 and 0.697, respectively. While the volatility of the innovation in the Board's signal is larger than the Shareholder's, it is important to remember that the Board receives its signal in advance of making its wage choice: at the point when B and S set their strategies, the Board has more

[28]The parameters capturing the failure cost to the Board χ_B and Shareholder χ_S are estimated to be 0.240 and 0.088, respectively. To interpret these magnitudes, I normalize them by average firm value (in Appendix E.7, I show that average firm value V_0 can be derived in closed form).

[29]The exact source of the shareholder cost from SOP failure cannot be determined from the estimated model (see Fact 4 for possible sources of this cost).

[30]Costly punishment is a common, naturally occurring mechanism that facilitates cooperation between economic actors, and has been analyzed by a large experimental literature (e.g., Ambrus and Greiner, 2012).

[31]By CEO skill being normally distributed, the 25th (75th) percentile of productivity is ≈ 0.67 standard deviations below (above) the mean. Hence, the relative productivity of the 75th to 25th percentile CEO is $\approx \exp(1.34 \times \sigma_0)$.

precise beliefs than the Shareholder. The output shock volatility σ_y is 1.043. This implies that a large portion of observed variation in output comes from randomness, rather than CEO skill. Figure A.6 displays how the variance of (Board and Shareholder) beliefs decline over the CEO's tenure. While uncertainty about CEO ability decreases relatively quickly, there is still quite a lot of uncertainty through the median length of the CEO's tenure ($\tau = 7$, as in Table 1).

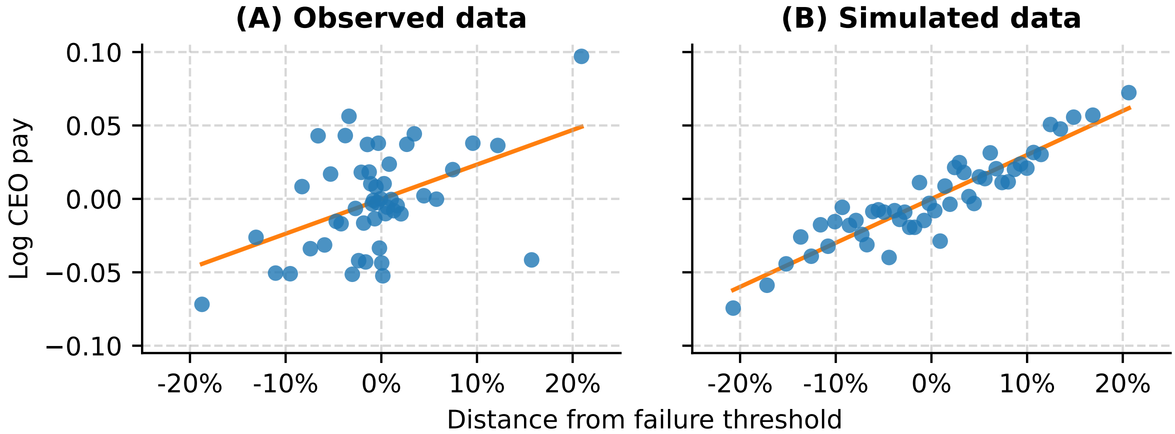
5.2. How Much Does SOP Impact CEO Pay and Firm Value?

The Board SOP failure cost suggests that SOP impacts compensation policy, but the estimated magnitude does not reveal this impact directly. Setting $\chi_B = 0$, simulating a counterfactual dataset and comparing quantities reveals the full impact of SOP, and also allows me to benchmark my estimation against empirical work on how the adoption of SOP as a governance mechanism impacted compensation policy and firm value.

Table 7 displays the results. As this counterfactual is equivalent to removing SOP, I do not display the SOP failure rate. The table displays the percentage that wages would increase if SOP were removed. It shows that, on average, SOP brings wages down by 4.4%, with considerable heterogeneity in the impact: the decrease in wages is 8.4% at the 75th percentile, with no change at the 25th. This is consistent with the evidence from Correa and Lel (2016) who show (in a cross-country analysis) that total CEO pay decreased by 7% upon the adoption of SOP; the similarity in our estimates is reassuring. The table also shows that SOP increases firm value by 4.6% on average. This is strikingly similar to the estimates from Cuñat et al. (2016), who find that the adoption of SOP increased market value by 5%.

This analysis benchmarks the key outcomes of the estimation against two important papers studying how the adoption of SOP affected compensation policy and value. At the same time, it shows that shareholder voice via a regularly-occurring opportunity to dissent from the Board on compensation policy is valuable to shareholders. Even though SOP failure is conditionally costly to shareholders, they do not have to use the punishment technology often in order to impact compensation policy and value considerably.

Figure 5. The relation between CEO pay and SOP vote outcomes
This figure displays the relation between the level of CEO pay and the SOP vote outcome. In both panels, I display a binned scatterplot estimated from a regression of log CEO pay on SOP disapproval, expressed as the vote's distance from the failure threshold. Each regression includes CEO and CEO tenure fixed effects.



5.3. Model Estimation Validation

5.3.1. Untargeted Features of the Data

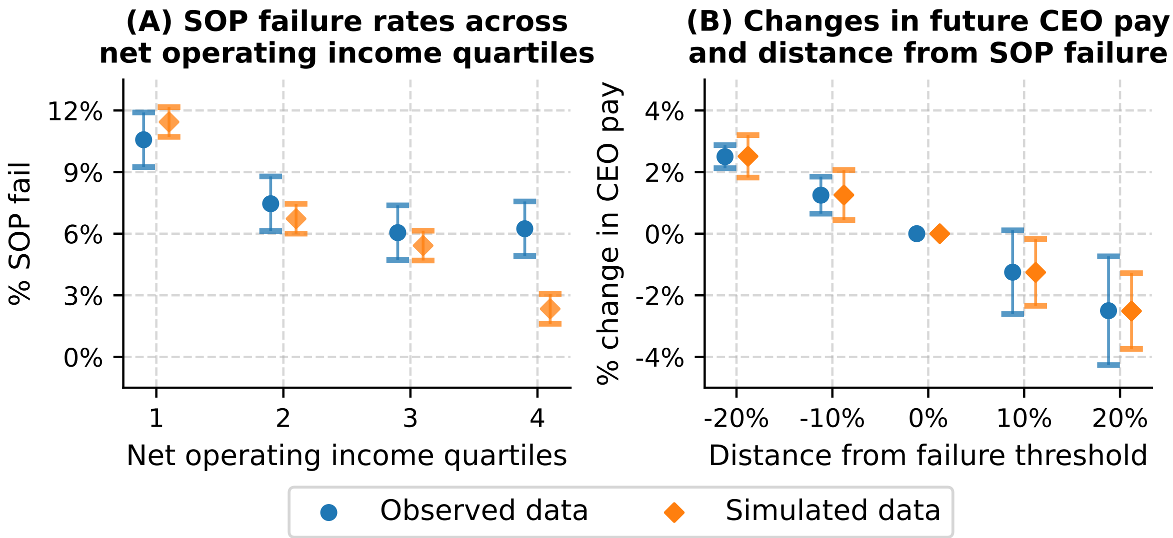
Confidence in the model's implications will be buttressed if the simulated and observed data yield similar results when examining outcomes not targeted in the estimation.

The relation between CEO pay and SOP vote outcomes. In Figure 5, I explore the relation between CEO pay levels and SOP vote outcomes. For the observed and simulated data, I estimate a regression of log CEO pay on the outcome of the SOP vote (expressed as distance from the failure threshold, eqs. 27 and 28). The figure shows a striking similarity in the slope relation between CEO pay and the vote outcome, though the relation is tighter in the model.

SOP failure across the distribution of operating income. Figure 6 Panel A displays a comparison of observed SOP failure rates in the observed and simulated data conditional on different levels of operating income. The estimation only targets the unconditional SOP failure rate and how the productivity shock affects SOP results, leaving untargeted how SOP results vary by operating income. The SOP failure rates in the observed and simulated data line up closely in the first three quartiles of operating income, but the relation deteriorates in the top quartile: 6.1% and 2.7% in the observed and simulated data, respectively.[32]

[32]The reason for the higher failure rate in the data in the top quartile of operating income is that CEOs in the top quartile receive higher compensation, both current and long-term compensation; these are the CEOs at the

Figure 6. SOP failure by firm performance and changes in CEO pay after SOP disapproval
This figure displays two model and estimation validation exercises. I simulate a dataset from the model using the parameters presented in Table 6. Panel A displays observed SOP failure rates across different quartiles of net operating income (industry-adjusted revenue less CEO compensation). Panel B displays estimated changes in CEO compensation in response to how far the previous year's SOP was from the SOP failure threshold. That is, I estimate the regression % Change in Compensation$_{i,c,t,t+1} = \alpha + \beta$Distance from SOP failure$_{i,c,t}$ for firm i, CEO c and year t, and display the predicted change in compensation for different SOP vote outcomes. For both the model and data, I normalize the change in compensation to be 0% at vote failure.



Changes in CEO pay following SOP disapproval. Figure 6 Panel B displays how the observed and simulated data compare in terms of *changes* in CEO compensation in response to different SOP disapproval rates, or the relation between the SOP disapproval rate (relative to the failure threshold) and the change in CEO compensation from t to $t+1$. The panel shows that the slope of this relationship is very similar in the model and data. A key prediction of the model is that SOP disapproval conveys that shareholders believe the CEO is low-type. The figure shows that the Board endogenously internalizes shareholder beliefs into their future compensation decisions, even though the model does not directly incorporate how SOP failure influences future compensation policy decisions.

5.3.2. Is the Shareholder Cost to SOP Failure Necessary?

A key innovation of this paper is presenting evidence of shareholder cost to SOP failure and estimating the precise magnitude of this cost. Despite the empirical and survey evidence presented in Fact 4, direct evidence of the magnitude of the cost comes entirely from the structural

most productive firms and thus demand higher pay. Shareholders react to the level of CEO pay (see Table 2), which can help explain why the simulated data is different.

model. In Table A.4, I estimate a reduced version of the model without the shareholder cost to SOP failure (i.e., $\chi_S = 0$) to highlight the importance of a positive shareholder failure cost. The data soundly reject this model. For example, the SOP failure rate (outcome 9) is too low: 7% and 4.6% in the observed and simulated data, respectively.

With no shareholder cost, shareholders are willing to fail the SOP in any state. To match the low failure rate, in this alternative specification, the model must push the degree of board capture down towards zero. With $\lambda = 0.092$, this implies that the Board wants to shift only 10% of surplus to the CEO (one fourth of the value from the main estimation and against previous research, such as Taylor, 2013). The Board SOP failure cost shoots up to 7.15% of firm value (relative to 2.06% in the main estimation). Taken together, these findings further imply that a positive shareholder cost to SOP failure is a key feature of the data.

5.4. Subsample Analysis

In this section, I use subsample analysis to explore how structural parameters and their implications vary with empirical measures of board capture (board co-option, Coles et al., 2014) and blockholder concentration (Hartzell and Starks, 2003). To accomplish this, I estimate the model on each subsample and display the resulting parameters from each split in tandem in Table 8, along with t-statistics from tests of difference in parameters.[33]

5.4.1. Board Co-Option

A key result of my main estimation is that there needs to be a high degree of board capture for the model to fit the data. While the model takes no stance on the channel through which board capture arises, Table 3 shows that *board co-option* (Coles et al., 2014), which measures the percentage of the Board appointed during the tenure of the CEO, plausibly plays a role. If CEOs influence director selection to tilt Board decisions in their favor, then estimated board capture should vary with empirical board co-option. Importantly, this would suggest the existence of the agency problem (CEO influence on the Board) which SOP is designed to mitigate, and that estimated board capture is not merely CEO bargaining power.

I split the sample by the degree of board co-option. To net out the mechanical increasing

[33]Table A.5 displays the parameters (with standard errors) and fit for each subsample.

relationship between co-option and CEO tenure, I regress the degree of board co-option in my sample on CEO tenure fixed effects and save the residuals. As the model requires an entire CEO spell (from first year of tenure to separation), I take the average of the residualized board co-option across a CEO's tenure as my splitting variable. I sort firms into low (high) co-option if they are below (above) median average residualized co-option.

Table 8 columns 1-3 display the results of this subsample estimation. The model estimates a much larger degree of board capture in the high board co-option sample (row 1, 0.357 *vs.* 0.632). This means that low co-option CEOs capture 30.5% of the surplus produced by the match, and high co-option CEOs capture 51.3%. This evidence suggests that CEOs who have influence over the Board can distort compensation design and extract higher rents from the firm.

Interestingly, the Board cost is smaller in the high co-option sample, whereas the shareholder cost is larger (rows 11 and 12). In Table 3 Panel B, I show via reduced-form analysis that board co-option lessens the impact of SOP votes on future compensation policy. My estimates suggest this is driven by the smaller Board cost and larger shareholder cost to SOP failure. This possibly suggests that powerful CEOs reduce the effectiveness of SOP as a governance mechanism via their influence on the Board.

5.4.2. Institutional Ownership Concentration

Institutional owners, by their size and consequent influence on corporate policies, often take on the role of disciplining management (Kakhbod et al., 2023; Appel et al., 2016; Duan and Jiao, 2016; Brav et al., 2008). Hartzell and Starks (2003) find that institutional ownership concentration is negatively related to levels of CEO pay: the presence of large blockholders disciplines compensation policy. However, recent research argues that the largest blockholders (passive funds) may be ineffective monitors (Heath et al., 2022), as they tend to vote with management more regularly. My model and estimates can help shed light on this apparent tension.

If large blockholders discipline compensation policy, the model predicts that the Board's SOP failure cost should be higher with the presence of large blockholders. The model also implies that the Shareholder SOP failure cost should increase with blockholder concentration. When the shareholder base is dispersed, no single investor is focal enough to take the brunt of a failed vote; large blockholders are more likely to feel the brunt of SOP failure. As such, the shareholder cost to SOP failure should also increase with blockholder concentration.

I use two measures of blockholder concentration, as inspired by Hartzell and Starks (2003). The first is the percentage of the market capitalization held by the top five institutional investors (top 5 inst. ownership). The second is the HHI of institutional investor base. Columns 4-6 of Table 8 display the estimated parameters for the sample split into "low" and "high" based on the median average top 5 inst. ownership over the CEO's tenure; columns 7-9 display the same for the HHI of the institutional shareholder base.

Both measures show that the Board's failure cost is higher when there is more concentration of institutional investors. For example, columns 4-5, rows 11-12 show that the Board cost is 2.6% (5.6%) of firm value for the low (high) split based on top 5 inst. ownership, and the difference is statistically significant. The Shareholder cost also increases with concentration, going from 0.4% to 2.3% of firm value in the low vs. high sample. Interestingly, for both sample splits in the table, the degree of Board capture is not statistically significantly different, suggesting that this split hones in on how the SOP failure costs vary in the data.

The estimation reveals that large blockholders do discipline compensation policy, as the punishment they can inflict on the Board is larger. However, the cost of *giving* this punishment is also larger. The largest blockholders (passive funds) are not ineffective monitors *per se*, rather the negative consequences for going against the Board are higher.

6. Counterfactual Say-on-Pay Mechanism: Granting a Focal Shareholder an Advisory Board Seat

My analysis so far has taken as given the way SOP is implemented in practice. SOP is an *ex post* approval vote of realized compensation and not an *ex ante* advisory vote on proposed compensation, shareholders generally do not partake or share their views with the compensation committee during the wage-setting process. Thus, asymmetric beliefs about the CEO arise naturally and influence the outcomes of SOP votes, beyond any conflict of interest between the Board and shareholders. The efficacy of SOP could plausibly be improved if the Board and shareholders could coordinate their beliefs *in advance* of the compensation-setting process.

In this section, I alter the framework of my structural model to allow information-sharing between the Board and shareholders. This information-sharing emulates granting a focal shareholder a non-voting, advisory seat on the Board, a governance mechanism often put forth to align the beliefs (and hence actions) of management and shareholders (Kakhbod et al., 2023).[34] This can also be interpreted as giving shareholders an *ex ante* say on *proposed* compensation policy, as opposed to an *ex post* opportunity to ratify the Board's decision.

In the following exercise, it is important to note that I keep the same set of structural parameters presented in the main analysis in Section 5: I am able to implement this counterfactual solely by changing the way information is revealed in the model. Figure 7 explains the intuition of the counterfactual. As shown in the top timeline, the baseline model inherently implies *belief disagreement*, as the Board and Shareholder signals are private information when strategies are set. In the counterfactual, B and S share their signals in advance of the vote, thus mitigating disagreement. Sharing of private signals means the SOP vote is solely a vote on performance *vs.* pay, as the vote is determined by the wage and productivity.

It should be mentioned that this counterfactual has its limitations. For example, investors state that they prefer not to vote against in SOPs because of the monitoring cost associated with SOP failure (repeated meetings with the compensation committee to discuss future compensation policy, Edmans et al., 2021). More stringent monitoring would imply a larger cost.

6.1. The Compensation Committee and SOP Vote

Like in Section 3.4, each period t the Board meets and receives its signal z_{bt} about CEO ability. However, now the Shareholder S shares its signal z_{st} with B and *vice versa*. Given beliefs $a \sim N(\mu_{at}, \sigma^2_{at})$ at the start of t and denoting $\mathbf{z}_t = \begin{pmatrix} z_{bt} & z_{st} \end{pmatrix}$ as the shared signals, the shared beliefs at the compensation committee will be

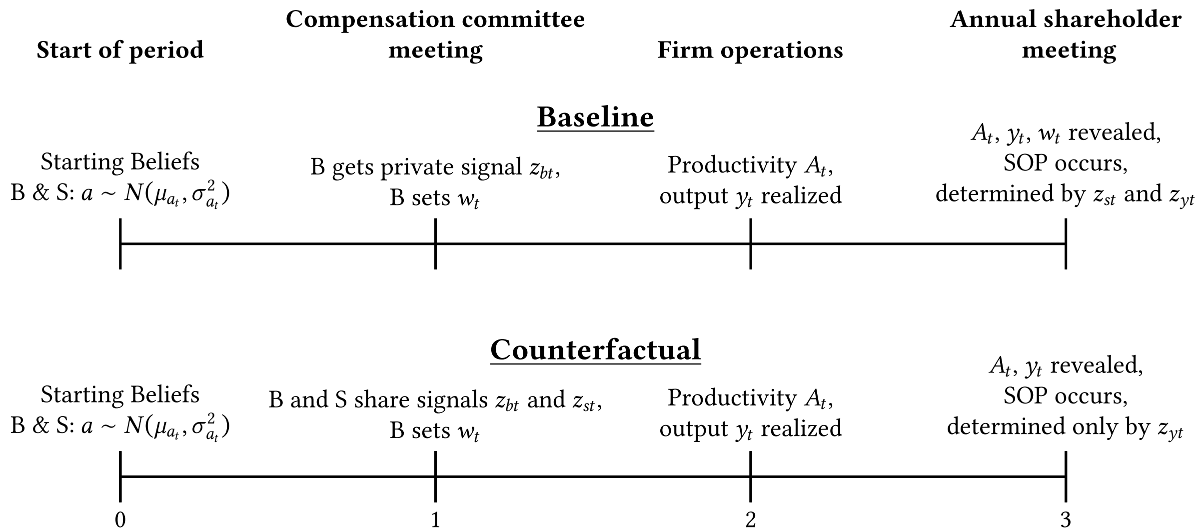
$$\mu_{at|\mathbf{z}_t} = \sigma^2_{at|\mathbf{z}_t} \left[\frac{\mu_{at}}{\sigma^2_{at}} + \frac{z_{bt}}{\sigma^2_{z_b}} + \frac{z_{st}}{\sigma^2_{z_s}} \right]$$

$$\sigma^2_{at|\mathbf{z}_t} = \left[\sigma^{-2}_{at} + \sigma^{-2}_{z_b} + \sigma^{-2}_{z_s} \right]^{-1}. \tag{30}$$

[34]Granting a focal shareholder a non-voting board seat may resemble venture capitalists will often take on a "board observer" role, where they attend meetings and share their views, but hold no voting rights. See Kakhbod et al. (2023), Section 3.3.2 for a discussion.

Figure 7. Sharing of beliefs: Counterfactual model timeline

This figure displays the within-period model timeline of the counterfactual, where shareholders have a non-voting position on the compensation committee. The top timeline ("Baseline") displays the timeline from the main version of the model (re-printed from Figure 3), the bottom timeline ("Counterfactual") displays the counterfactual timeline.



Now, the Board's wage decision is a function of both z_{bt} and z_{st} (i.e., $\mathbf{z}_t$). The Board's problem is very similar to (19), yet their beliefs are as in (30).[35] Because B and S share their signals, S no longer needs to integrate out B's private information, so they choose s_t to maximize

$$\max_{s_t} \quad E_{at|\mathbf{z}_t}[A_t]w_t(\mathbf{z}_t, s_t)^{\alpha} - w_t(\mathbf{z}_t, s_t) - \chi_S F^{\mathrm{U}}_{st}(s_t \times w_t(\mathbf{z}_t, s_t)) \tag{31}$$

The information sharing removes the possibility of belief disagreement between B and S: the operator $E_{a_t|\mathbf{z}_t}[\cdot]$ implies that B and S have the same beliefs when they set their strategies.

Two positive effects occur. First, there is a *cooperation effect.* By sharing their beliefs, B and S "meet in the middle," removing the possibility of disagreement over the CEO's skill: B and S arrive at a midpoint in cases when they would have very different beliefs, and in cases when their signals ultimately agree, the wage is set at a more appropriate level. Second, there is a *precision effect*, as beliefs mechanically become more precise: the Board's compensation policy converges faster to a wage appropriate for the CEO's true type.

[35]Formally, the Board's Bellman equation is

$$\begin{aligned} V(\mu_{at}, \tau, w_{t-1}) = \quad & \max_{w_t} E_{at|\mathbf{z}_t}[A_t]w_t^{\alpha} - (1-\lambda)w_t - \chi_B F^{\mathrm{U}}_{st}(s_t \times w_t) - AC(w_t, w_{t-1}; \tau_t) + \\ & \delta_B\Big[(1 - f(\tau_t))E_{at|\mathbf{z}_t}[V(\mu_{at+1}, \tau + 1, w_t)] + f(\tau_t)V^R\Big] \end{aligned}$$

The only difference to (19) is that the expectation operator follows from (30), as opposed to (18).

I solve this version of the model using the parameters in Table 6. The counterfactual admits the same outcomes as the baseline, so I can compare observed quantities. Table 9 displays the results: the counterfactual SOP failure rate and the average percentage changes in the CEO wage and firm value. The table also displays the distribution of percentage changes.

The SOP failure rate falls from 6.7% in the main estimation to 5% in the counterfactual. While the change is moderate, shareholder welfare increases as the punishment technology is used less often. Wages also fall on average, but this is not a given. When the Board and Shareholder agree that the CEO is good, wages rise (at the 75th percentile, the wage increase is 5%). On average, they fall because of the conflict of interest in the model. The Board's bias leads to suboptimal (from the shareholders' perspective) over-production (empire-building). When the Board learns that the Shareholder thinks the CEO is low-type, this has a relatively stronger effect on decreasing the wage than when the Shareholder thinks the CEO is high-type, which occurs via the curvature of the production function. As such, the 25th percentile change in wages (10.8% decrease) is larger in magnitude than the 75th (5% increase).

Firm value increases on average by 4.9%, which is additive to the estimated impact of SOP from the baseline model (Section 5.2). At the lower end, firm value still increases considerably (at the 25th percentile, the increase is 3.7%). This is because wages fall on average, in most cases operating income is brought closer to its profit-maximizing level. Moreover, because of the precision effect, Board beliefs converge faster to the CEO's true ability, so a bad (good) CEO is less likely to be overpaid (underpaid) early on in tenure.

All in all, my model predicts that information-sharing between the Board and shareholders, actualized by granting a focal shareholder on the compensation committee, would positively impact firm value. However, the structure of the counterfactual implies perfect information-sharing by the Board and Shareholder. Partial information-sharing is more likely in practice, so the impacts on wages and firm value can be considered upper bounds. Further, advising on proposed compensation, via a non-voting Board seat or otherwise, may imply large monitoring costs.

7. Conclusion

CEO influence on the Board of directors induces an agency problem in compensation policy. Say-on-Pay, *the* prominent shareholder voice mechanism in corporate governance, provides shareholders with a platform to discipline the Board and curb CEO influence. As compensation arises as the key tool to mitigate the agency problem afflicting managerial decision-making, SOP votes are a potentially important governance mechanism. Yet, given their non-binding nature and low failure rate, the impact of SOP on compensation and value is unclear.

This paper establishes the impact of SOP votes and clarifies the economic mechanism by which this impact occurs. Through my estimated structural model, I show that SOP resembles a costly punishment mechanism: shareholders can punish the Board, but doing so is costly. These costs are equivalent to 2.06% and 0.76% of firm value for the Board and shareholders, respectively. The shareholder's cost of giving punishment explains the low failure rate of SOP, but does not mitigate its value-creation. I find that providing shareholders with a punishment technology through SOP reduces wages by 4.4% and increases firm value by 4.6% on average.

I also document what these costs are. SOP failure is a career and reputation concern for compensation committee directors. Shareholders internalize a cost to dissenting because this may damage the relationship with the Board and increase the likelihood of CEO turnover. Bunching in SOP votes provides objective evidence of these costs.

I use my estimates to show that SOP as a governance mechanism can be improved. I construct a counterfactual which emulates giving a focal shareholder a non-voting position on the Board, which induces sharing of private information. This counterfactual leads to a lower SOP failure rate, decreases wages and increases firm value on average.

My results provide insight about shareholder voting more generally, suggesting that high support rates in shareholder votes may not imply ineffective monitoring: the unobservable (off-equilibrium) threat of a failed vote may have a large impact on corporate policies, even if this impact is not directly observable in the data. A policy implication is, if corporate decision-makers internalize a cost to failing environmental or social shareholder proposals, then a mandated, regular vote on these issues similar in spirit to SOP may positively impact shareholder and social welfare, even if these votes were to have a high observed pass rate.

References

Aggarwal, R., Dahiya, S., and Prabhala, N. R. (2019). The power of shareholder votes: Evidence from uncontested director elections. *Journal of Financial Economics*, 133(1):134–153.

Aggarwal, R., Dahiya, S., and Yilmaz, U. (2023). Why do investors vote against corporate directors? *Working Paper.*

Alvero, A., Ando, S., and Xiao, K. (2023). Watch what they do, not what they say: Estimating regulatory costs from revealed preferences. *The Review of Financial Studies*, 36(6):2224–2273.

Alvero, A. and Xiao, K. (2023). Fuzzy bunching. *Working Paper.*

Ambrus, A. and Greiner, B. (2012). Imperfect public monitoring with costly punishment: An experimental study. *American Economic Review*, 102(7):3317–3332.

Antill, S. (2021). Are bankruptcy professional fees excessively high? *Available at SSRN 3554835.*

Appel, I. R., Gormley, T. A., and Keim, D. B. (2016). Passive investors, not passive owners. *Journal of Financial Economics*, 121(1):111–141.

Armstrong, C. S., Gow, I. D., and Larcker, D. F. (2013). The efficacy of shareholder voting: Evidence from equity compensation plans. *Journal of Accounting Research*, 51(5):909–950.

Arnoud, A., Guvenen, F., and Kleineberg, T. (2019). Benchmarking global optimizers. Technical report, National Bureau of Economic Research.

Babenko, I., Choi, G., and Sen, R. (2019). Management (of) proposals. *Available at SSRN 3155428.*

Balsam, S., Boone, J., Liu, H., and Yin, J. (2016). The impact of say-on-pay on executive compensation. *Journal of Accounting and Public Policy*, 35(2):162–191.

Barrero, J. M. (2022). The micro and macro of managerial beliefs. *Journal of Financial Economics*, 143(2):640–667.

Bebchuk, L. A. and Fried, J. M. (2003). Executive compensation as an agency problem. *Journal of economic perspectives*, 17(3):71–92.

Bertrand, M. and Mullainathan, S. (2001). Are ceos rewarded for luck? the ones without principals are. *The Quarterly Journal of Economics*, 116(3):901–932.

Bertrand, M. and Schoar, A. (2003). Managing with style: The effect of managers on firm policies. *The Quarterly journal of economics*, 118(4):1169–1208.

Blonien, P., Crane, A. D., Crotty, K., and De Angelis, D. (2022). Errors in shareholder voting. *Working Paper.*

Bonatti, A., Cisternas, G., and Toikka, J. (2017). Dynamic oligopoly with incomplete information. *The Review of Economic Studies*, 84(2):503–546.

Brav, A., Jiang, W., Partnoy, F., and Thomas, R. (2008). Hedge fund activism, corporate governance, and firm performance. *The Journal of Finance*, 63(4):1729–1775.

Cai, J. and Walkling, R. A. (2011). Shareholders' say on pay: Does it create value? *Journal of Financial and Quantitative Analysis*, 46(2):299–339.

Cattaneo, M. D., Jansson, M., and Ma, X. (2018). Manipulation testing based on density discontinuity. *The Stata Journal*, 18(1):234–261.

Chetty, R., Friedman, J. N., Olsen, T., and Pistaferri, L. (2011). Adjustment costs, firm responses, and micro vs. macro labor supply elasticities: Evidence from danish tax records. *The quarterly journal of economics*, 126(2):749–804.

Clayton, M. C., Hartzell, J. C., and Rosenberg, J. (2005). The impact of ceo turnover on equity volatility. *The Journal of Business*, 78(5):1779–1808.

Coles, J. L., Daniel, N. D., and Naveen, L. (2014). Co-opted boards. *The Review of Financial Studies*, 27(6):1751–1796.

Correa, R. and Lel, U. (2016). Say on pay laws, executive compensation, pay slice, and firm valuation around the world. *Journal of Financial Economics*, 122(3):500–520.

Cuñat, V., Gine, M., and Guadalupe, M. (2012). The vote is cast: The effect of corporate governance on shareholder value. *The journal of finance*, 67(5):1943–1977.

Cuñat, V., Giné, M., and Guadalupe, M. (2016). Say pays! Shareholder voice and firm performance. *Review of Finance*, 20(5):1799–1834.

Custódio, C., Ferreira, M. A., and Matos, P. (2013). Generalists versus specialists: Lifetime work experience and chief executive officer pay. *Journal of Financial Economics*, 108(2):471–492.

Cziraki, P. and Jenter, D. (2022). The market for ceos. *Working Paper.*

Dalton, D. R. and Dalton, C. M. (2008). Corporate governance in the post sarbanes–oxley period: Compensation disclosure and analysis (cd&a). *Business Horizons*, 51(2):85–92.

Dewatripont, M., Jewitt, I., and Tirole, J. (1999). The economics of career concerns, part i: Comparing information structures. *The Review of Economic Studies*, 66(1):183–198.

Dey, A., Starkweather, A., and White, J. T. (2023). Proxy advisory firms and corporate shareholder engagement. *Working Paper.*

Duan, Y. and Jiao, Y. (2016). The role of mutual funds in corporate governance: Evidence from mutual funds' proxy voting and trading behavior. *Journal of Financial and Quantitative Analysis*, 51(2):489–513.

Edmans, A., Gosling, T., and Jenter, D. (2021). Ceo compensation: Evidence from the field. *CEPR Discussion Paper No. DP16315.*

Ewens, M., Xiao, K., and Xu, T. (2023). Regulatory costs of being public: Evidence from bunching estimation. *Working Paper.*

Ferri, F. and Maber, D. A. (2013). Say on pay votes and ceo compensation: Evidence from the uk. *Review of Finance*, 17(2):527–563.

Fisch, J., Palia, D., and Solomon, S. D. (2018). Is say on pay all about pay: The impact of firm performance. *Harv. Bus. L. Rev.*, 8:101.

Fischer, P. E., Gramlich, J. D., Miller, B. P., and White, H. D. (2009). Investor perceptions of board performance: Evidence from uncontested director elections. *Journal of Accounting and Economics*, 48(2-3):172–189.

Flammer, C. (2015). Does corporate social responsibility lead to superior financial performance? a regression discontinuity approach. *Management science*, 61(11):2549–2568.

Fos, V. and Tsoutsoura, M. (2014). Shareholder democracy in play: Career consequences of proxy contests. *Journal of Financial Economics*, 114(2):316–340.

Foster, F. D. and Viswanathan, S. (1996). Strategic trading when agents forecast the forecasts of others. *The Journal of Finance*, 51(4):1437–1478.

Gabaix, X. and Landier, A. (2008). Why has ceo pay increased so much? *The quarterly journal of economics*, 123(1):49–100.

Gillan, S. L. and Starks, L. T. (2007). The evolution of shareholder activism in the united states. *Journal of Applied Corporate Finance*, 19(1).

Gompers, P., Ishii, J., and Metrick, A. (2003). Corporate governance and equity prices. *The quarterly journal of economics*, 118(1):107–156.

Graham, J. R., Kim, H., and Leary, M. (2020). Ceo-board dynamics. *Journal of Financial Economics*, 137(3):612–636.

Hartzell, J. C. and Starks, L. T. (2003). Institutional investors and executive compensation. *The journal of finance*, 58(6):2351–2374.

Hauder, E. A. (2019). Bouncing back from a low say-on-pay vote. https://corpgov.law.harvard.edu/2018/11/05/bouncing-back-from-a-low-say-on-pay-vote/ [Accessed: 2023-02-18].

Heath, D., Macciocchi, D., Michaely, R., and Ringgenberg, M. C. (2022). Do index funds monitor? *The Review of Financial Studies*, 35(1):91–131.

Hirschman, A. O. (1970). *Exit, voice, and loyalty: Responses to decline in firms, organizations, and states*, volume 25. Harvard university press.

Holland, K., Lim, C., and Yi, I. (2023). Shareholder meeting uncertainty: Evidence from the options market. *Working Paper*.

Iliev, P., Lins, K. V., Miller, D. P., and Roth, L. (2015). Shareholder voting and corporate governance around the world. *The Review of Financial Studies*, 28(8):2167–2202.

ISS (2022). United States proxy voting guidelines. https://www.issgovernance.com/file/policy/active/americas/US-Voting-Guidelines.pdf [Accessed: 2023-02-25].

Johnson, T. L. and Swem, N. (2021). Reputation and investor activism: A structural approach. *Journal of Financial Economics*, 139(1):29–56.

Kakhbod, A., Loginova, U., Malenko, A., and Malenko, N. (2023). Advising the management: A theory of shareholder engagement. *The Review of Financial Studies*, 36(4):1319–1363.

Kaplan, S. N. (2013). Ceo pay and corporate governance in the us: Perceptions, facts, and challenges. *Journal of Applied Corporate Finance*, 25(2):8–25.

Levit, D. (2019). Soft shareholder activism. *The Review of Financial Studies*, 32(7):2775–2808.

Levit, D. and Malenko, N. (2011). Nonbinding voting for shareholder proposals. *The Journal of Finance*, 66(5):1579–1614.

Liu, T. (2021). Bargaining with private equity: implications for hospital prices and patient welfare. *Available at SSRN 3896410*.

Lyman, N. (2023). Reputation, entrenchment, and dynamic managerial incentives. *Working Paper*.

Matveyev, E. (2017). Sorting in the us corporate executive labor market. *Working Paper*.

McFadden, D. (1989). A method of simulated moments for estimation of discrete response models without numerical integration. *Econometrica: Journal of the Econometric Society*, pages 995–1026.

Mehran, H. (1995). Executive compensation structure, ownership, and firm performance. *Journal of financial economics*, 38(2):163–184.

Netflix, I. (2022). Netflix 2022 proxy statement. https://www.sec.gov/Archives/edgar/data/1065280/000119312522115102/d202881ddef14a.htm#toc202881_21 [Accessed: 2023-02-23].

Novick, B. (2019). Executive compensation: The role of public company shareholders. https://corpgov.law.harvard.edu/2019/07/31/executive-compensation-the-role-of-public-company-shareholders/ [Accessed: 2023-02-18].

Novick, B. (2020). "the goldilocks dilemma": A response to lucian bebchuk and scott hirst. In *Colum. L. Rev. Forum*, volume 120, page 80. HeinOnline.

Page, T. B. (2018). Ceo attributes, compensation, and firm value: Evidence from a structural estimation. *Journal of Financial Economics*, 128(2):378–401.

Pastor, L. and Veronesi, P. (2009). Learning in financial markets. *Annu. Rev. Financ. Econ.*, 1(1):361–381.

Pinnington, J. (2022). Are passive investors biased voters? *Working Paper*.

Saez, E. (2010). Do taxpayers bunch at kink points? *American economic journal: Economic policy*, 2(3):180–212.

Shleifer, A. and Vishny, R. W. (1997). A survey of corporate governance. *The Journal of Finance*, 52(2):737–783.

Silveira, B. S. (2017). Bargaining with asymmetric information: An empirical study of plea negotiations. *Econometrica*, 85(2):419–452.

Smith, A. A. (2016). *Indirect Inference*, pages 1–6. Palgrave Macmillan UK, London.

Taylor, L. A. (2010). Why are ceos rarely fired? Evidence from structural estimation. *The Journal of Finance*, 65(6):2051–2087.

Taylor, L. A. (2013). Ceo wage dynamics: Estimates from a learning model. *Journal of Financial Economics*, 108(1):79–98.

Table 1. Summary statistics

This table displays descriptive statistics of the variables used in the empirical analysis and estimating the model. The sample is based upon a merge of Compustat, Execucomp and ISS for the years 2011-2020. I present statistics for the firm, SOP outcomes and the CEO. There are a total of 2,528 CEO spells in the dataset. I limit to CEO spells of greater than one year and at most 25 years.

	N	Mean	Std Dev	25%	50%	75%
Firm						
Assets ($b)	10,001	22.717	128.168	0.879	2.858	9.416
Revenues ($b)	10,001	7.703	21.147	0.596	1.749	5.612
Return on assets (%)	10,001	0.124	0.094	0.070	0.119	0.172
12-month stock return (%)	10,001	0.132	0.323	-0.056	0.113	0.293
Say-on-Pay						
% voting against in SOP	10,001	0.090	0.121	0.023	0.044	0.092
$\mathbb{1}$[Less than 30% support]: **SOP failure**	10,001	0.068				
$\mathbb{1}$[Less than 20% support]	10,001	0.129				
$\mathbb{1}$[Less than 50% support]	10,001	0.018				
CEO						
Salary ($m)	10,001	0.855	0.383	0.600	0.808	1
Bonus ($m)	10,001	0.138	0.640	0	0	0
CEO tenure (years)	10,001	6.502	5.144	2	5	10
Length of CEO tenure (years)	2,528	8.311	5.449	4	7	12

Table 2. SOP results, CEO pay and company performance

This table explores the relation between SOP outcomes and CEO compensation, in support of Fact 1. Panel A estimates the relation between SOP outcomes and the level of CEO pay. The dependent variable in columns 1-4 is an indicator for SOP failure (at least 30% of shareholders voting against the SOP), and in columns 5-8 it is the percentage of shareholders that vote against. Log CEO compensation is the natural logarithm of the CEO's total current pay (salary and bonus). Panel B estimates the relation between changes in CEO compensation (from t to $t+1$) and SOP results (from t). The dependent variable is the log change in CEO compensation from t to $t+1$. SOP fail is an indicator if a SOP vote fails, i.e. the % voting against is above 30%. % vote no in SOP is the proportion of shareholders voting to fail the SOP. All covariates are defined in the appendix. Stock return and Return on assets are standardized to mean zero, unit variance. Standard errors are displayed below coefficients and clustered at the firm × CEO level. ***, **, * denote significance at 1%, 5%, 10%.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	SOP fail {0, 1}				% vote no in SOP			
Log CEO compensation	0.015***	0.014***	0.019***	0.032***	0.007***	0.007***	0.010***	0.015***
	(0.004)	(0.003)	(0.006)	(0.011)	(0.002)	(0.002)	(0.003)	(0.005)
Stock return		-0.013***	-0.011***	-0.004		-0.010***	-0.009***	-0.007***
		(0.003)	(0.003)	(0.004)		(0.001)	(0.001)	(0.002)
Return on assets		-0.021***	-0.022***	-0.020**		-0.016***	-0.017***	-0.014***
		(0.006)	(0.007)	(0.008)		(0.003)	(0.003)	(0.004)
Log firm assets		0.039***	0.041***	0.030*		0.018***	0.018***	0.009
		(0.013)	(0.014)	(0.018)		(0.006)	(0.006)	(0.008)
Lagged log CEO compensation				-0.014*				-0.005
				(0.008)				(0.004)
Observations	9,841	9,841	9,556	6,736	9,841	9,841	9,556	6,736
R-squared	0.313	0.322	0.378	0.3c86	0.392	0.410	0.468	0.487
Firm FE	Yes	Yes			Yes	Yes		
Year FE		Yes	Yes	Yes		Yes	Yes	Yes
CEO tenure FE		Yes	Yes	Yes		Yes	Yes	Yes
Firm × CEO FE			Yes	Yes			Yes	Yes

Table 3. Board capture, CEO compensation and SOP

This table displays how board co-option (Coles et al., 2014), an important empirical measure of *board capture* influences the level of CEO pay and modulates the effect of SOP results on changes in CEO compensation, in support of Fact 2. Panel A presents correlations between the level of CEO pay and the degree of board co-option. Panel B presents similar analysis to Table 2, with an interaction between board co-option and our two measures of SOP disapproval: an indicator for SOP failure (30% or greater vote against in the SOP), and the percent of votes against in the SOP. All covariates are standardized to mean zero, unit variance. Standard errors are displayed below coefficients and clustered at the firm × CEO level. ***, **, * denote significance at 1%, 5%, 10%.

Panel A. Board capture and the level of CEO pay

	(1)	(2)	(3)	(4)
	Log CEO compensation			
Board co-option	0.081***	0.096***	0.095***	0.070***
	(0.029)	(0.024)	(0.024)	(0.023)
Return on assets		0.213***	0.213***	0.135***
		(0.023)	(0.023)	(0.024)
Stock return		0.020*	0.020*	0.036***
		(0.012)	(0.012)	(0.013)
Log firm assets		0.568***	0.577***	0.644***
		(0.023)	(0.030)	(0.033)
Log board size			-0.013	0.018
			(0.024)	(0.023)
Observations	8,865	8,865	8,865	8,865
R-squared	0.023	0.277	0.277	0.333
CEO tenure FE	Yes	Yes	Yes	Yes
Year FE				Yes
Industry FE				Yes

Table 3. Continued

Panel B. Board capture modulates the effect of SOP disapproval on changes in CEO pay

	(1)	(2)	(3)	(4)	(5)	(6)
	Log change in CEO compensation					
Board co-option	0.014	0.010	0.006	0.015	0.016	0.012
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
SOP fail $\{0, 1\}$	-0.245***	-0.257***	-0.248***			
	(0.035)	(0.037)	(0.038)			
Board co-option × SOP fail $\{0, 1\}$		0.067*	0.063*			
		(0.037)	(0.037)			
% vote no in SOP				-0.078***	-0.081***	-0.079***
				(0.009)	(0.009)	(0.010)
Board co-option × % vote no in SOP					0.019**	0.019**
					(0.009)	(0.009)
Return on assets			-0.037***			-0.041***
			(0.008)			(0.008)
Stock return			0.056***			0.052***
			(0.009)			(0.009)
Log firm assets			-0.013			-0.007
			(0.013)			(0.013)
Log board size			0.002			-0.000
			(0.007)			(0.007)
Observations	6,388	6,388	6,388	6,388	6,388	6,388
R-squared	0.020	0.021	0.034	0.026	0.027	0.039
CEO tenure FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE			Yes			Yes
Industry FE			Yes			Yes

Table 4. Evidence of costs to directors from SOP disapproval

This table displays correlations between costly outcomes for directors and SOP disapproval rates. I focus on directors that serve on the compensation committee during the year of an SOP vote. In Panel A, director turnover occurs when a director is no longer on the Board the year after an SOP vote, conditional on the next year not being the year the director's term ends. In Panel B, Compensation committee turnover occurs when a director is no longer on the compensation committee the year after an SOP vote, conditional on the director remaining as a member of the Board. In Panel C, a reduction in outside Board positions occurs when the number of outside Boards the director sits on decreases in the year after an SOP vote, conditional on the director sitting on at least one outside Board and the director remaining on their current Board the next year (i.e., it is an indicator variable). SOP fail is an indicator if a SOP vote fails, i.e. the % voting against is above 30%. % vote no in SOP is the proportion of shareholders voting to fail the SOP. All covariates are defined in the appendix; all continuous covariates are standardized to mean zero, unit variance. Standard errors are displayed below coefficients and clustered at the director level. ***, **, * denote significance at 1%, 5%, 10%.

Panel A. Director turnover

	(1)	(2)	(3)	(4)	(5)	(6)
	Director turnover {0, 1}					
SOP fail {0, 1}	2.303***	1.755***	1.512***			
	(0.537)	(0.504)	(0.513)			
% vote no in SOP				0.823***	0.673***	0.584***
				(0.176)	(0.168)	(0.173)
Stock return		-0.404**	-0.381**		-0.385**	-0.363**
		(0.174)	(0.173)		(0.174)	(0.174)
Return on assets		-1.460***	-1.625***		-1.443***	-1.603***
		(0.179)	(0.181)		(0.179)	(0.182)
Log firm assets		-0.354**	-1.032***		-0.386**	-1.033***
		(0.179)	(0.202)		(0.179)	(0.201)
Log board size			0.332**			0.342**
			(0.160)			(0.160)
Log director tenure			1.363***			1.364***
			(0.159)			(0.159)
Log director age			2.394***			2.391***
			(0.184)			(0.184)
Log CEO tenure			-1.199***			-1.204***
			(0.163)			(0.163)
Log CEO pay			0.567***			0.521***
			(0.150)			(0.151)
Constant	10.128***			10.418***		
	(0.173)			(0.162)		
Observations	33,213	33,213	33,213	33,213	33,213	33,213
R-squared	0.001	0.174	0.186	0.001	0.174	0.186
Year FE		Yes	Yes		Yes	Yes
Industry FE		Yes	Yes		Yes	Yes

Table 4. Continued

Panel B. Compensation committee turnover, conditional on remaining on Board

	(1)	(2)	(3)	(4)	(5)	(6)
	Compensation committee turnover {0, 1}					
SOP fail {0, 1}	1.462***	1.126**	1.227***			
	(0.449)	(0.452)	(0.459)			
% vote no in SOP				0.640***	0.519***	0.572***
				(0.156)	(0.157)	(0.161)
Stock return		-0.481***	-0.470***		-0.460***	-0.445***
		(0.141)	(0.141)		(0.141)	(0.141)
Return on assets		-0.514***	-0.545***		-0.495***	-0.515***
		(0.148)	(0.152)		(0.148)	(0.152)
Log firm assets		0.097	-0.112		0.071	-0.107
		(0.153)	(0.192)		(0.153)	(0.192)
Log board size			0.326**			0.336**
			(0.140)			(0.140)
Log director tenure			0.193			0.195
			(0.145)			(0.145)
Log director age			-0.234			-0.240
			(0.152)			(0.152)
Log CEO tenure			-0.795***			-0.805***
			(0.140)			(0.140)
Log CEO pay			0.091			0.032
			(0.156)			(0.158)
Constant	5.460***			5.646***		
	(0.144)			(0.137)		
Observations	29,752	29,752	29,752	29,752	29,752	29,752
R-squared	0.000	0.008	0.009	0.001	0.008	0.010
Year FE		Yes	Yes		Yes	Yes
Industry FE		Yes	Yes		Yes	Yes

Table 4. Continued

Panel C. Reduction in outside Board positions, conditional on remaining on Board

	(1)	(2)	(3)	(4)	(5)	(6)
	Reduction in outside board positions {0, 1}					
SOP fail {0, 1}	1.933**	1.879**	1.722**			
	(0.854)	(0.861)	(0.860)			
% vote no in SOP				0.488*	0.463*	0.398
				(0.262)	(0.265)	(0.266)
Log director tenure			-0.187			-0.192
			(0.274)			(0.274)
Log director age			1.935***			1.937***
			(0.290)			(0.290)
Log board size			0.203			0.200
			(0.257)			(0.257)
Outside firm average ROA			-0.126			-0.130
			(0.264)			(0.265)
Constant	9.486***			9.704***		
	(0.293)			(0.282)		
Observations	13,469	13,469	13,469	13,469	13,469	13,469
R-squared	0.000	0.002	0.006	0.000	0.002	0.006
Year FE		Yes	Yes		Yes	Yes
Industry FE		Yes	Yes		Yes	Yes

Table 5. CEO turnover and SOP disapproval

This table analyzes how CEO turnover changes with SOP disapproval. In all specifications, the dependent variable is a CEO turnover indicator in the year following a SOP vote. In columns 1-4, the main independent variable is an indicator for SOP failure, in columns 5-8 it is the percentage of shareholders who vote against the CEO's compensation in the SOP. All controls variables are from the year of the SOP. In columns 5 and 8, I include 5th polynomials of the firm's stock return and return on assets to control for possibly non-linear effects of performance on CEO turnover. Standard errors are displayed below coefficients and clustered at the firm× CEO level. ***, **, * denote significance at 1%, 5%, 10%.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	CEO turnover $t+1$ {0, 1}							
SOP fail {0, 1}	3.169***	3.161***	2.458**	2.327**				
	(1.201)	(1.212)	(1.176)	(1.184)				
% vote no in SOP					1.142***	1.081***	0.806**	0.749*
					(0.377)	(0.382)	(0.383)	(0.386)
Log CEO compensation		-2.550***	-3.279***	29.524		-2.597***	-3.315***	29.119
		(0.629)	(0.684)	(24.560)		(0.631)	(0.689)	(24.553)
Stock return		-1.728***	-1.482***	-1.215		-1.695***	-1.459***	-1.200
		(0.349)	(0.353)	(1.183)		(0.349)	(0.353)	(1.181)
Return on assets		-1.197**	-1.654***	-0.277		-1.150**	-1.618***	-0.242
		(0.505)	(0.557)	(2.622)		(0.506)	(0.558)	(2.620)
Log firm assets		1.034***	1.136	1.168		1.059***	1.131	1.170
		(0.311)	(1.226)	(1.299)		(0.312)	(1.227)	(1.300)
Constant	9.435***				9.752***			
	(0.114)				(0.006)			
Observations	12,378	12,378	12,378	12,378	12,378	12,378	12,378	12,378
R-squared	0.123	0.131	0.214	0.216	0.123	0.131	0.214	0.216
Firm FE			Yes	Yes			Yes	Yes
CEO tenure FE			Yes	Yes			Yes	Yes
Year FE			Yes	Yes			Yes	Yes
Performance Polynomials				Yes				Yes

Table 6. Structural estimation results

This table contains outcomes of the estimation procedure. Panel A displays model and data moments, as well as the difference between each moment. In Panel A, I perform a t-test of the difference in each model and data moment; t-statistics are displayed in the last column. In the last row of the table, I display the result of the χ^2 test of overidentifying restrictions. Panel B displays estimates of the parameters that drive the model in Section 3. As explained in Section 4, μ_0 is normalized to 0, hence this parameter is not estimated. Parameters are estimated using SMM, which is described in detail in Appendix E. The panel also displays the degree of CEO surplus capture implied by the board capture, and the magnitudes of the Board and Shareholder costs to SOP failure as a percentage of the model's average firm value. I compute average firm value in closed form as a function of model parameters, and use the delta method to calculate standard errors (see Appendix E.7 for a derivation).

Panel A. Data and model moments

	Description	Notation	Data Observed	Data Simulated	t-stat
(1)	Average log output	y_0	7.540	7.540	0.001
(2)	CEO-average output variance	$Var(E_i[\tilde{y}])$	0.880	0.829	1.000
(3)	Elasticity of output to wage	y_1	0.832	0.797	0.620
(4)	Output residual variance	$Var(\epsilon^y)$	1.278	1.260	0.235
(5)	Average log wage when SOP passes	b_0	-0.140	-0.137	-0.972
(6)	Change in log wage when SOP fails	b_1	0.042	0.055	-0.838
(7)	Log wage persistence	b_2	0.794	0.873	-6.466
(8)	Wage residual variance	$Var\left(\epsilon^b\right)$	0.059	0.077	-5.683
(9)	SOP failure rate	s_0	0.070	0.067	0.674
(10)	SOP failure—wage sensitivity	s_1	0.061	0.038	1.826
(11)	SOP failure—output residual sensitivity	s_2	-0.019	-0.034	2.456
(12)	SOP failure residual variance	$Var(\epsilon^s)$	0.064	0.063	0.164
(13)	Bunching estimator	$\mathbb{B}$	0.121	0.116	3.909
		χ^2 (p-val)	65.296 (0.000)		

Panel B. Parameter estimates

Description	Notation	Value
Parameters		
CEO board capture	λ	0.612 (0.006)
Board SOP failure cost	χ_B	0.240 (0.007)
Shareholder SOP failure cost	χ_S	0.088 (0.024)
Prior average of CEO ability	μ_0	0
Prior std dev of CEO ability	σ_0	0.542 (0.006)
Output—CEO wage elasticity	α	0.263 (0.011)
Std dev of productivity shock	σ_y	1.043 (0.010)
Std dev of Board signal	σ_{z_b}	1.996 (0.025)
Std dev of Shareholder signal	σ_{z_s}	0.697 (0.014)
Scaling factor	$\log \eta$	7.572 (0.011)
CEO wage adjustment cost	c_w	5.201 (0.373)
Estimated quantities		
CEO surplus capture	θ_{CEO}	40.70% (0.84%)
Board SOP cost (% average value)	χ_B / V_0	2.06% (0.12%)
Shareholder SOP cost (% average value)	χ_S / V_0	0.76% (0.23%)

Table 7. The impact of SOP on compensation policy

This table analyzes the impact of SOP on the Board's pay decisions. I simulate a counterfactual in which the Board cost to SOP failure (χ_B) is set to zero while holding other parameters constant, effectively analyzing compensation policy as if SOP did not exist. As SOP no longer enters the model, there is no counterfactual SOP failure rate to display. Rows 2 and 3 display the counterfactual percentage change in wages and firm value when removing the Board cost.

	Mean	**25%**	**50%**	**75%**
SOP failure rate	—			
Percent change in				
Wages	+4.35%	+0.00%	+2.72%	+8.40%
Firm value	-4.58%	-6.22%	-4.47%	-3.40%

Table 8. Subsample heterogeneity

This table contains outcomes of the estimation on the main sample split by different characteristics. Each subsample split is estimated using the same routine as the main sample (see Table 6). Following Section 5.4.1, "Board co-option" measures the percentage of directors appointed during the CEO's tenure, with CEO tenure fixed effects residualized out (as co-option increases mechanically in tenure). Following Section 5.4.2, "Top 5 inst. ownership" calculates the percentage of firm's equity held by the five largest institutional investors and the HHI of the institutional ownership base, both are measures of institutional ownership concentration (Hartzell and Starks, 2003). I take the average of these measures across a CEO's tenure and split the sample into below/above median, so low (high) refers to below (above) the median taken cross-sectionally across CEO spells. I display the parameters from the estimation on each split, along with the *t*-statistics from a test of equality of the parameters from the split. For example, columns 1 and 2 show the estimated parameters from splitting the sample into above- and below-median Board co-option (Coles et al., 2014), and column 3 displays the *t*-statistic from testing parameter equality. Columns 1-3 focus on board co-option. Columns 4-6 focus on percentage of equity held by the top five largest institutional investors, and columns 7-9 focus on concentration in the institutional shareholder base (as measured by the HHI).

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		Board co-option			**Top 5 inst. ownership**			**HHI inst. ownership**		
	Notation	**Low**	**High**	***t*-stat**	**Low**	**High**	***t*-stat**	**Low**	**High**	***t*-stat**
Parameters										
(1)	λ	0.36	0.63	-25.79	0.54	0.51	0.95	0.59	0.58	0.08
(2)	χ_B	0.41	0.28	5.12	0.40	0.46	-4.16	0.45	0.79	-7.17
(3)	χ_S	0.04	0.18	-1.48	0.07	0.19	-2.43	0.09	0.36	-2.34
(4)	σ_0	0.50	0.36	7.99	0.61	0.43	3.69	0.58	0.62	-2.06
(5)	α	0.43	0.32	8.10	0.28	0.37	-3.80	0.31	0.33	-2.43
(6)	σ_y	1.04	0.92	8.68	1.19	0.94	8.34	1.08	0.93	4.53
(7)	σ_{z_b}	0.73	0.98	-10.90	1.06	0.76	3.17	2.85	0.32	28.49
(8)	σ_{z_s}	1.08	2.22	-7.42	0.64	2.25	-11.39	0.51	3.70	-4.36
(9)	$\log \eta$	7.75	7.76	-0.41	8.08	7.17	21.47	8.31	6.94	32.92
(10)	c_w	4.02	3.23	3.68	5.67	4.12	4.64	5.91	4.65	2.12
Estimated quantities										
(11)	θ_{CEO}	30.5%	51.3%	-9.99	33.6%	41.5%	-4.40	44.0%	45.6%	-0.14
(12)	χ_B / V_0	4.2%	3.4%	3.83	2.6%	5.6%	-7.00	3.7%	8.0%	-13.06
(13)	χ_S / V_0	0.4%	2.2%	-1.62	0.4%	2.3%	-2.95	0.7%	3.7%	-3.03

Table 9. Counterfactual exercise: Granting the focal Shareholder an advisory Board position
This table displays a counterfactual experiment where I re-solve a different version of the model, in which the Board and shareholders are allowed to share their signals before the compensation contract is decided (i.e., the shareholder is given a non-voting, advisory seat on the Board). The first row displays the counterfactual SOP failure rate. Rows 2 and 3 display the counterfactual percentage change in wages and firm value. To compute these changes, I re-solve the counterfactual model, applying the same sequence of shocks to each firm. I solve for optimal choices, and solve for the percentage change in each quantity at the observation level. I then display the average percentage change, along with the 25th, 50th and 75th percentiles.

	Mean	**25%**	**50%**	**75%**
SOP failure rate	4.97%			
Percent change in				
Wages	-2.05%	-10.84%	-2.51%	+5.01%
Firm value	+4.87%	+3.68%	+4.19%	+5.07%

Appendices

A. Appendix Figures and Tables

Figure A.1. Example of monitoring costs arising from SOP failure — 2021 Netflix SOP
This figure presents anecdotal evidence of monitoring costs incurred by shareholders when the SOP fails. The 2021 Netflix SOP saw 49.4% of shares voting against the SOP. Under the 30% failure rule, this presents a clear SOP failure. Netflix directors then repeatedly engaged with large stockholders in the following year over the compensation policy. See Netflix (2022).

Stockholder Engagement and the 2021 Say-on-Pay Vote Result

In 2021, 50.6% of voted shares approved the compensation of our Named Executive Officers. At the time of the vote in 2021, the Compensation Committee had already approved the design of our 2021 executive compensation program. The Compensation Committee reviewed these voting results, and in response, members of the Compensation Committee and management engaged with stockholders to solicit feedback regarding our compensation program.

Figure A.2. Board capture, CEO pay and SOP results: Illustration of Table 3 (Fact 2)

This figure illustrates the results of Table 3. Panel A displays a binned scatterplot of the log of CEO compensation on board co-option (as in Coles et al., 2014). Panel B illustrates the effect of SOP disapproval on changes in CEO compensation for varying levels of board co-option. It uses column 6 of Panel B to estimate the relation between changes in CEO pay and the percentage of shareholders voting against the SOP at different levels of board co-option — going from zero to full board co-option, the regression predicts that the effect of a one standard deviation increase in SOP disapproval on the log change in CEO pay increases from -0.12 to -0.05 log points.

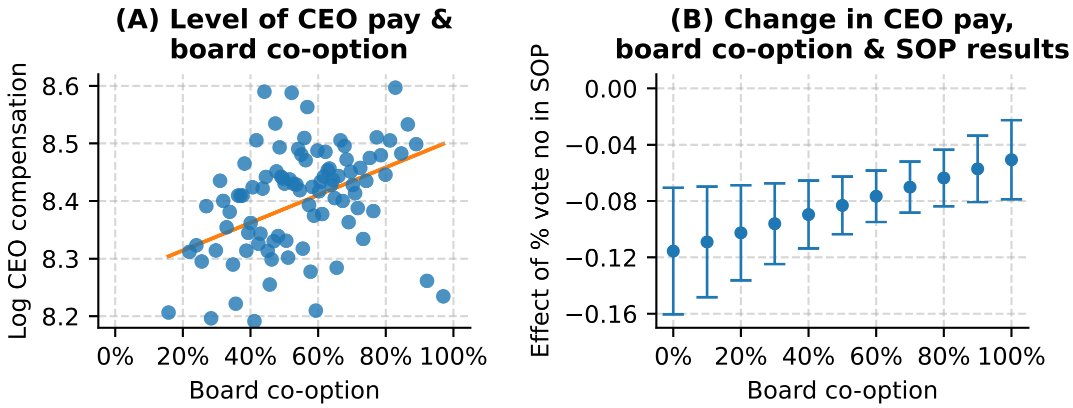


Figure A.3. Placebo test of density manipulation of SOP outcomes (robustness for Figure 2)
This figure displays the results of placebo testing testing for density manipulation of SOP disapproval at placebo thresholds. Whereas in Figure 2, I focus on the publicly accepted important vote failure thresholds of 30% and 50%, in this figure I shift the thresholds to 20% and 40% as a placebo test for density manipulation.

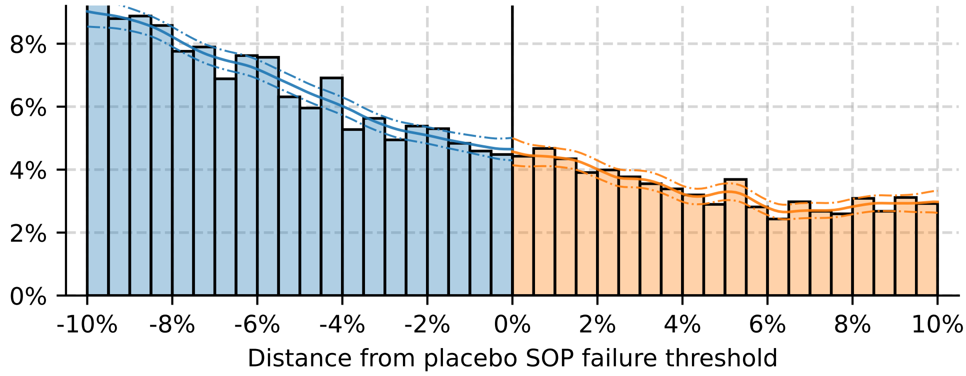


Figure A.4. Correlation between SOP % vote against and firm performance (Fact 1)

This figure displays correlations between SOP disapproval rates and measures of firm performance. Both panels display binned scatterplots. Panel A displays results from a regression of SOP disapproval (% vote against in SOP) on the firm's return on assets (ROA). Panel B displays results from a similar regression, where the independent variable is the firm's 12-month stock return. In both panels, I include year and industry fixed effects, and control for log CEO compensation and CEO tenure.

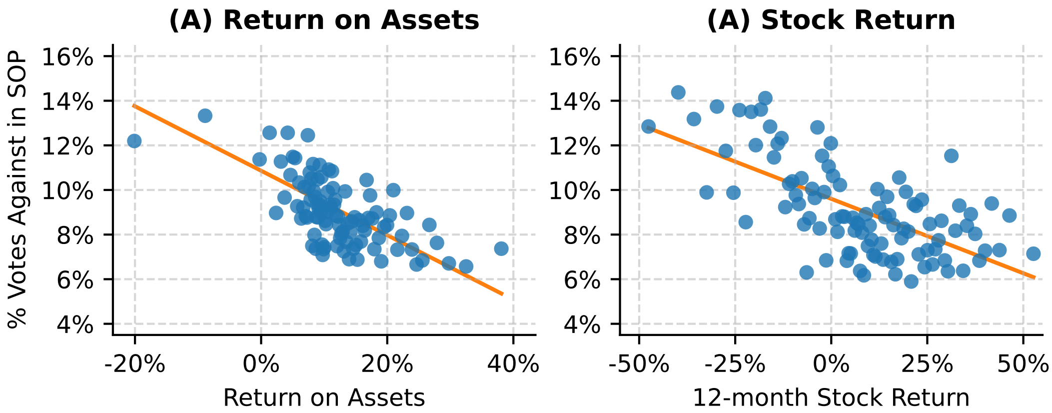


Figure A.5. Model timeline with exact time that strategies are played

This figure displays a more detailed model timeline, with mappings to the relevant assumptions, and when the Board and Shareholder play their strategies. See Figure 3 in the main text for the timeline as it maps to real-world outcomes. See Appendix D.4.

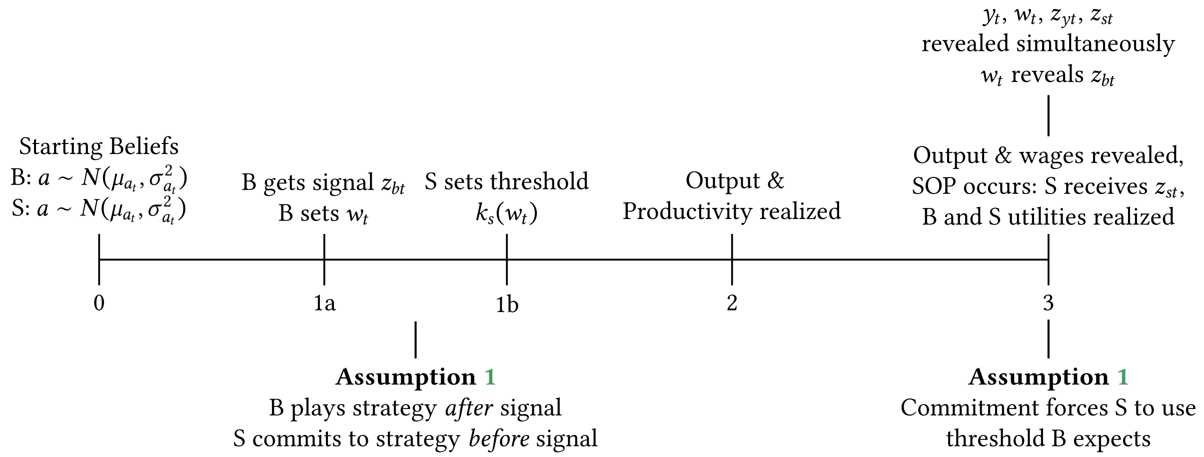


Figure A.6. Rate of decline of the variance of beliefs about CEO ability

This figure displays the rate of decline of the variance Board and shareholder beliefs about CEO ability as a function of CEO tenure τ. The figure uses the parameter estimates from Table 6. Volatility $\sigma_a(\tau)$ is defined in (D.1)

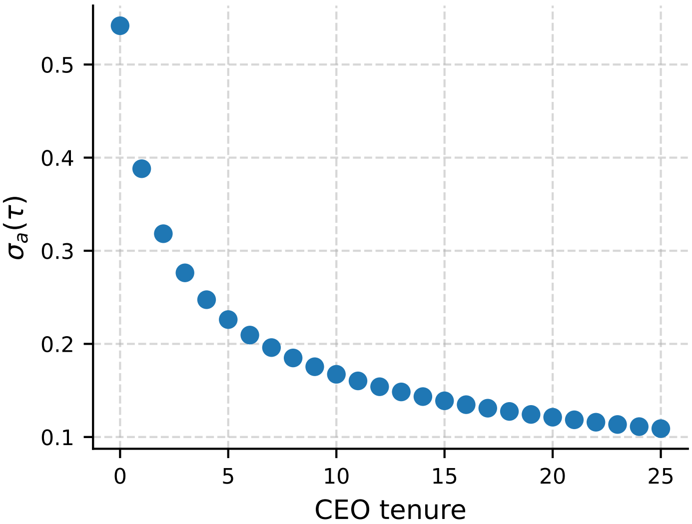


Table A.1. SOP disapproval and company performance

This table displays regressions of SOP vote outcomes (failure and the percentage of shareholders voting against the SOP) on measures of firm performance: the firm's accounting return (return on assets), and the firm's market return (12-month stock return in between SOP votes), in support of Fact 1 and Figure A.4. All covariates are defined in the appendix; all continuous covariates are standardized to mean zero, unit variance. Standard errors are displayed below coefficients and clustered at the director level. ***, **, * denote significance at 1%, 5%, 10%.

	(1)	(2)	(3)	(4)	(5)	(6)
	SOP fail {0, 1}			% vote no in SOP		
Return on assets	-0.027***		-0.024***	-0.020***		-0.018***
	(0.007)		(0.007)	(0.003)		(0.003)
Stock return		-0.016***	-0.014***		-0.012***	-0.011***
		(0.003)	(0.003)		(0.001)	(0.001)
Log firm assets	0.061***			0.030***		
	(0.023)			(0.011)		
Log CEO compensation		0.053***	0.055***		0.027***	0.028***
		(0.009)	(0.010)		(0.005)	(0.006)
Observations	9,864	9,864	9,864	9,864	9,864	9,864
R-squared	0.330	0.329	0.331	0.417	0.417	0.422
CEO tenure FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes

Table A.2. Changes in CEO compensation following SOP disapproval

This table explores the relation between changes in CEO compensation (from t to $t+1$) and SOP results (from t). The dependent variable is the log change in CEO compensation from t to $t+1$. SOP fail is an indicator if a SOP vote fails, i.e. the % voting against is above 30%. % vote no in SOP is the proportion of shareholders voting to fail the SOP. Stock return and Return on assets are standardized to mean zero, unit variance. Standard errors are displayed below coefficients and clustered at the firm × CEO level. ***, **, * denote significance at 1%, 5%, 10%.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Log change in CEO compensation							
SOP fail {0, 1}	-0.037***	-0.032***	-0.027**	-0.031**				
	(0.012)	(0.012)	(0.011)	(0.014)				
% vote no in SOP					-0.016***	-0.014***	-0.012***	-0.013***
					(0.003)	(0.003)	(0.003)	(0.004)
Stock return		0.006**	0.005*	0.005		0.005*	0.004	0.004
		(0.003)	(0.003)	(0.003)		(0.003)	(0.003)	(0.003)
Return on assets		-0.003	-0.007	-0.006		-0.004	-0.008	-0.007
		(0.005)	(0.005)	(0.005)		(0.005)	(0.005)	(0.005)
Log firm assets		-0.020**	-0.024**	-0.015		-0.020*	-0.024**	-0.015
		(0.010)	(0.011)	(0.012)		(0.010)	(0.011)	(0.012)
Lagged log CEO compensation				-0.039***				-0.039***
				(0.007)				(0.007)
Observations	7,134	7,134	6,845	4,903	7,134	7,134	6,845	4,903
R-squared	0.176	0.193	0.224	0.226	0.179	0.195	0.226	0.228
Firm FE	Yes	Yes			Yes	Yes		
Year FE		Yes	Yes	Yes		Yes	Yes	Yes
CEO tenure FE		Yes	Yes	Yes		Yes	Yes	Yes
Firm × CEO FE			Yes	Yes			Yes	Yes

Table A.3. Model parameters

This table displays the parameters of the model, both those to be estimated and those externally calibrated.

Description	**Notation**
Parameters to be estimated	
CEO board capture	λ
Board SOP failure cost	χ_B
Shareholder SOP failure cost	χ_S
Prior average of CEO ability a	μ_0
Prior std dev of CEO ability a	σ_0
Output—CEO wage elasticity	α
Std dev of productivity shock ε_{yt}	σ_y
Std dev of Board signal ε_{bt}	σ_{z_b}
Std dev of Shareholder signal ε_{st}	σ_{z_s}
Scaling factor for estimation	$\log \eta$
CEO wage adjustment cost parameter	c_w
Calibrated parameters	
Board's discount factor	δ_B
Separation probability for CEO of tenure τ	$f(\tau)$

Table A.4. Structural estimation results: No shareholder cost

This table contains outcomes of estimation where I remove the shareholder cost to SOP failure as a model parameter. Panel A displays the model fit. In the last row of the panel, I display the result of the χ^2 test of overidentifying restrictions. Panel B displays estimates of parameters.

Panel A. Data and model moments

	Description	Notation	Observed	Simulated	t-stat
(1)	Average log output	y_0	7.540	7.539	0.117
(2)	CEO-average output variance	$Var(E_i[\tilde{y}])$	0.880	0.895	-0.961
(3)	Elasticity of output to wage	y_1	0.832	0.847	-0.678
(4)	Output residual variance	$Var(\epsilon^y)$	1.278	1.308	-2.006
(5)	Average log wage when SOP passes	b_0	-0.140	-0.149	3.101
(6)	Change in log wage when SOP fails	b_1	0.042	0.057	-0.991
(7)	Log wage persistence	b_2	0.794	0.916	-12.502
(8)	Wage residual variance	$Var\left(\epsilon^b\right)$	0.059	0.074	-5.981
(9)	SOP failure rate	s_0	0.070	0.046	8.106
(10)	SOP failure—wage sensitivity	s_1	0.061	0.062	-0.076
(11)	SOP failure—output residual sensitivity	s_2	-0.019	-0.020	0.347
(12)	SOP failure residual variance	$Var(\epsilon^s)$	0.064	0.052	4.572
(13)	Bunching estimator	$\mathbb{B}$	0.121	0.051	56.535
		χ^2 (p-val)	380.120 (0.000)		

Panel B. Parameter estimates

Description	Notation	Value
Parameters		
CEO board capture	λ	0.092 (0.000)
Board SOP failure cost	χ_B	0.697 (0.001)
Shareholder SOP failure cost	χ_S	—
Prior average of CEO ability	μ_0	0
Prior std dev of CEO ability	σ_0	0.423 (0.000)
Output—CEO wage elasticity	α	0.521 (0.000)
Std dev of productivity shock	σ_y	1.087 (0.001)
Std dev of Board signal	σ_{z_b}	2.430 (0.002)
Std dev of Shareholder signal	σ_{z_s}	0.561 (0.001)
Scaling factor	$\log \eta$	7.612 (0.002)
CEO wage adjustment cost	c_w	3.180 (0.013)
SOP failure costs		
Board SOP cost (% average value)	χ_B / V_0	7.15% (0.01%)
Shareholder SOP cost (% average value)	χ_S / V_0	—

Table A.5. Parameter estimates and model fit for subsample splits

This table displays the parameter estimates with standard errors and model fit for each subsample split presented in Table 8. For brevity, I omit descriptions of parameters and moments from the table.

Panel A.1. Low co-option

Parameters		Model fit			
Notation	**Value**	**Notation**	**Observed**	**Simulated**	***t*-stat**
λ	0.357 (0.008)	y_0	7.698	7.698	0.000
χ_B	0.408 (0.026)	y_1	0.939	0.972	-0.818
χ_S	0.041 (0.019)	b_0	-0.141	-0.137	-1.127
μ_0	0.000 (0.000)	b_1	0.044	0.055	-0.445
σ_0	0.500 (0.018)	b_2	0.840	0.860	-1.415
α	0.428 (0.012)	s_0	0.055	0.050	1.207
σ_y	1.045 (0.006)	s_1	0.045	0.036	0.732
σ_{z_b}	0.730 (0.010)	s_2	-0.009	-0.030	4.252
σ_{z_s}	1.075 (0.017)	$Var(E_i[\tilde{y}])$	0.913	0.914	-0.036
$\log\eta$	7.753 (0.018)	$Var(\epsilon^y)$	1.266	1.228	1.493
c_w	4.017 (0.175)	$Var(\epsilon^s)$	0.051	0.057	-1.229
χ_B / V_0	4.17% (0.18%)	$Var\left(\epsilon^b\right)$	0.049	0.061	-3.265
χ_S / V_0	0.42% (0.19%)	$\mathbb{B}$	0.046	0.046	-0.160
		χ^2 (p-val)	2.329 (0.507)		

Panel A.2. High co-option

Parameters		Model fit			
Notation	**Value**	**Notation**	**Observed**	**Simulated**	***t*-stat**
λ	0.632 (0.007)	y_0	7.729	7.729	0.001
χ_B	0.277 (0.000)	y_1	0.753	0.667	2.577
χ_S	0.178 (0.090)	b_0	-0.110	-0.118	1.708
μ_0	0.000 (0.000)	b_1	0.029	0.052	-1.099
σ_0	0.356 (0.002)	b_2	0.762	0.884	-8.242
α	0.316 (0.007)	s_0	0.080	0.054	5.294
σ_y	0.918 (0.013)	s_1	0.079	0.058	1.607
σ_{z_b}	0.984 (0.021)	s_2	-0.046	-0.032	-2.697
σ_{z_s}	2.223 (0.154)	$Var(E_i[\tilde{y}])$	0.488	0.474	0.524
$\log\eta$	7.763 (0.017)	$Var(\epsilon^y)$	0.967	0.933	1.337
c_w	3.230 (0.123)	$Var(\epsilon^s)$	0.071	0.072	-0.219
χ_B / V_0	3.39% (0.09%)	$Var\left(\epsilon^b\right)$	0.064	0.049	3.666
χ_S / V_0	2.18% (1.07%)	$\mathbb{B}$	0.118	0.118	0.251
		χ^2 (p-val)	468.217 (0.000)		

Table A.5. Continued

Panel B.1. Low top five institutional ownership

Parameters		Model fit			
Notation	**Value**	**Notation**	**Observed**	**Simulated**	***t*-stat**
λ	0.537 (0.004)	y_0	8.071	8.071	0.000
χ_B	0.401 (0.005)	y_1	1.017	1.041	-0.302
χ_S	0.066 (0.026)	b_0	-0.051	-0.046	-1.190
μ_0	0.000 (0.000)	b_1	0.043	0.052	-0.395
σ_0	0.609 (0.047)	b_2	0.818	0.862	-2.683
α	0.278 (0.007)	s_0	0.062	0.072	-1.805
σ_y	1.193 (0.022)	s_1	0.079	0.066	0.706
σ_{z_b}	1.061 (0.080)	s_2	-0.030	-0.032	0.152
σ_{z_s}	0.636 (0.056)	$Var(E_i[\tilde{y}])$	1.061	1.058	0.033
$\log \eta$	8.080 (0.039)	$Var(\epsilon^y)$	1.615	1.618	-0.024
c_w	5.667 (0.312)	$Var(\epsilon^s)$	0.057	0.056	0.018
χ_B / V_0	2.63% (0.20%)	$Var\left(\epsilon^b\right)$	0.048	0.046	0.108
χ_S / V_0	0.43% (0.16%)	$\mathbb{B}$	0.034	0.034	-0.006
		χ^2 (p-val)	1.865 (0.601)		

Panel B.2. High top five institutional ownership

Parameters		Model fit			
Notation	**Value**	**Notation**	**Observed**	**Simulated**	***t*-stat**
λ	0.514 (0.024)	y_0	7.092	7.092	0.000
χ_B	0.462 (0.014)	y_1	0.767	0.739	0.681
χ_S	0.187 (0.042)	b_0	-0.228	-0.225	-0.669
μ_0	0.000 (0.000)	b_1	0.055	0.073	-0.911
σ_0	0.434 (0.008)	b_2	0.757	0.821	-4.008
α	0.368 (0.022)	s_0	0.078	0.023	12.102
σ_y	0.937 (0.021)	s_1	0.089	0.023	4.335
σ_{z_b}	0.756 (0.053)	s_2	-0.016	-0.016	0.051
σ_{z_s}	2.248 (0.130)	$Var(E_i[\tilde{y}])$	0.780	0.663	5.010
$\log \eta$	7.172 (0.017)	$Var(\epsilon^y)$	0.965	1.004	-1.590
c_w	4.121 (0.116)	$Var(\epsilon^s)$	0.070	0.063	2.035
χ_B / V_0	5.63% (0.38%)	$Var\left(\epsilon^b\right)$	0.054	0.091	-8.386
χ_S / V_0	2.28% (0.61%)	$\mathbb{B}$	0.140	0.139	1.088
		χ^2 (p-val)	36.575 (0.000)		

Table A.5. Continued

Panel C.1. Low blockholder concentration

Parameters		Model fit			
Notation	**Value**	**Notation**	**Observed**	**Simulated**	***t*-stat**
λ	0.590 (0.063)	y_0	8.310	8.310	0.000
χ_B	0.446 (0.021)	y_1	0.752	0.816	-0.837
χ_S	0.091 (0.085)	b_0	-0.012	-0.005	-1.377
μ_0	0.000 (0.000)	b_1	0.036	0.056	-0.964
σ_0	0.579 (0.015)	b_2	0.812	0.819	-0.290
α	0.309 (0.007)	s_0	0.069	0.081	-1.793
σ_y	1.078 (0.021)	s_1	0.077	0.042	1.862
σ_{z_b}	2.848 (0.084)	s_2	-0.019	-0.035	0.796
σ_{z_s}	0.512 (0.033)	$Var(E_i[\tilde{y}])$	0.958	0.926	0.391
$\log\eta$	8.307 (0.038)	$Var(\epsilon^y)$	1.401	1.392	0.099
c_w	5.911 (0.125)	$Var(\epsilon^s)$	0.063	0.076	-2.303
χ_B / V_0	3.69% (0.33%)	$Var\left(\epsilon^b\right)$	0.046	0.086	-1.191
χ_S / V_0	0.75% (0.74%)	$\mathbb{B}$	0.046	0.045	0.014
		χ^2 (p-val)	6.769 (0.080)		

Panel C.2. High blockholder concentration

Parameters		Model fit			
Notation	**Value**	**Notation**	**Observed**	**Simulated**	***t*-stat**
λ	0.582 (0.061)	y_0	6.848	6.848	-0.000
χ_B	0.789 (0.043)	y_1	0.858	0.890	-0.798
χ_S	0.365 (0.081)	b_0	-0.267	-0.279	2.987
μ_0	0.000 (0.000)	b_1	0.062	0.095	-1.521
σ_0	0.618 (0.012)	b_2	0.751	0.605	9.470
α	0.328 (0.005)	s_0	0.071	0.047	5.568
σ_y	0.930 (0.024)	s_1	0.090	0.036	3.648
σ_{z_b}	0.318 (0.029)	s_2	-0.030	-0.029	-0.139
σ_{z_s}	3.698 (0.731)	$Var(E_i[\tilde{y}])$	0.836	0.803	0.856
$\log\eta$	6.935 (0.017)	$Var(\epsilon^y)$	1.183	1.175	0.170
c_w	4.655 (0.579)	$Var(\epsilon^s)$	0.064	0.075	-3.308
χ_B / V_0	7.99% (0.05%)	$Var\left(\epsilon^b\right)$	0.056	0.067	-2.285
χ_S / V_0	3.70% (0.64%)	$\mathbb{B}$	0.131	0.120	5.984
		χ^2 (p-val)	42.052 (0.000)		

B. Institutional Details of Say-on-Pay

The 2010 Dodd-Frank Wall Street Reform and Consumer Protection Act, commonly referred to as Dodd-Frank, made SOP compulsory at all US firms from 2011.[1] In the US, SOP is a non-binding vote that must occur at least once every three years on the level and structure of executive compensation. Though SOPs are required only every 3 years, in practice nearly all S&P1500 firms, the main sample, hold the SOP every year; I will commonly refer to SOP being "annual" in the paper, and the model time will be annual. While the vote itself is non-binding, in spirit a low level of shareholder approval for the SOP is likely to lead to tangible changes in the CEO's compensation contract the next year (see Section 2.2 and, e.g., Balsam et al., 2016).

By rule, the SOP vote must cover all executive compensation disclosed pursuant to Item 402 of Regulation S-K. This includes the Compensation Discussion and Analysis (CD&A) section of the proxy statement, which is designed to put into perspective the level of executive pay, its structure (e.g., cash *vs.* stock options) and provide a clear narrative of *why* executives received such pay (Dalton and Dalton, 2008).

A key aspect of SOPs are that they are *backward-looking* and *reactive*. From Novick (2019), "Say-on-pay votes ask shareholders to opine retrospectively on the compensation of named executives that is disclosed in the proxy statement, rather than on the company's compensation program going forward." SOPs in the US are clearly a non-binding confidence vote in the Board's choice of CEO wage for the previous fiscal year, and not a vote in Shareholders' confidence about the next year's compensation contract. This backward-looking aspect will inform the timing of the model. In particular, the practice of the compensation committee setting the wage before and shareholders voting on the wage will play a key role in how the model structures the strategies of the Board and Shareholders.

What constitutes SOP failure? By nature in the US, they are non-binding votes, so there is no threshold at which the compensation committee must make a tangible change. Nevertheless there are three important thresholds for the vote. The most important is 70% support. If support falls below this, Institutional Shareholder Services (ISS) will publicly push the compensation committee and firm more generally to make changes to compensation policy and

[1] Technically, firms with revenue less than $1billion did not have to implement SOP until 2013.

engage with shareholders (ISS, 2022). Further, 80% (the threshold at which Glass-Lewis will pursue the Board) and 50% (the classic simple majority) also represent important thresholds.

Upon SOP failure, the firm's compensation committee will often reach out to the firm's large stockholders with a proposed change to the firm's compensation policy in future years, or simply to discuss how these large shareholders feel about the firm's compensation policy. For example, Figure A.1 displays an example of SOP failure, where the Netflix Board reach out to large shareholders to discuss compensation policy. The model is silent on the repeated nature of this interaction. In the model, there is no retrospective action if SOP fails, rather the Board and shareholders pay the utility cost from failure, and the model moves to the next period. I am not interested in perfectly modeling the game between the Board and shareholders, I merely look to put sensible structure on the data to be able to identify the key parameters driving incentives in this setting.

C. Empirical Appendix

C.1. Estimates of the Shareholder Cost Directly Via Bunching

This appendix presents an alternate structural model which uncovers a reduced-form object which maps to a SOP failure cost, in support of Fact 4 in Section 2.2 and the estimates from the structural model presented in Sections 3 and 4. The magnitudes of the SOP failure cost identified via the model in this Appendix are consistent with my main estimates. However, the key issue is that I cannot separately identify the Board and Shareholder costs to SOP failure here; in my main estimation, I use variation coming from endogenous patterns in CEO pay and SOP vote outcomes to separately identify the Board and Shareholder SOP failure costs.

C.1.1. A simple structural model of costs to SOP failure

Each firm's shareholder base is composed of a group of shareholders, who hold a shareholder approval vote on the Board's pay policy (a SOP vote). The outcome of the vote is $p \in [0, 1]$; $p = 0$ means perfect support for the Board. I abstract away from strategic considerations: the shareholder base coordinate to pick the p that maximizes value. I assume that each p elicits a unique wage and hence each p has a unique effect on firm value, so there is a unique p^*

which maximizes firm value. There is an exogenously decided threshold $\underline{p}$, if $p \geq \underline{p}$ then the SOP fails, i.e. $\underline{p} = 30\%$. The shareholders choose p relative to the undistorted maximum p^* to minimize the cost

$$\min_{p} \quad C(p - p^*) + K(p^*) \times \mathbb{1}\left[p \geq \underline{p}\right] \tag{C.1}$$

The first term captures the cost that shareholders incur if the vote choice p is different from the choice p^* that maximizes firm value (the undistorted vote), i.e. the cost incurred from the CEO receiving wage $w(p)$ instead of $w(p^*)$. C has functional form

$$C(p - p^*) = \frac{1}{2} V(p^*) p^* (1 - p \,/\, p^*)^2 \tag{C.2}$$

where $V(p^*)$ is firm value under the undistorted vote. Thus, $C(p - p^*)/V(p^*)$ represents the cost from choosing vote p (when p^* is optimal in the frictionless sense) in percentage terms of firm value. The quadratic cost is standard in the bunching literature (Ewens et al., 2023), and captures in simple form that the cost increases the further the vote outcome is from the undistorted vote which would maximize firm value.

The second term of the payoff function is the cost of SOP failure to shareholders, which is paid if p is above $\underline{p}$. K is a constant, and the discrete jump in cost directly at the SOP failure threshold incentivizes bunching directly at $\underline{p}$. There is a marginal vote outcome, $\overline{p}$, for which shareholders are indifferent between between bunching at $\underline{p}$ and issuing vote $\overline{p}$. The indifference of the marginal vote reveals the cost of SOP failure

$$k(\overline{p}) = \frac{K(\overline{p})}{V(\overline{p})} = \frac{C\left(\underline{p} - \overline{p}\right)}{V(\overline{p})} = \frac{1}{2} \overline{p} \left(1 - \underline{p} \,/\, \overline{p}\right)^2 \tag{C.3}$$

Thus, knowing $\overline{p}$ reveals the shareholder cost, relative to firm value, of failing the SOP. To estimate $\overline{p}$, I can use the observed degree of bunching. In the absence of SOP failure cost, the distribution of votes would be smooth around the threshold $\underline{p}$. In the presence of the SOP failure cost, blockholders that fall in $\left[\underline{p}, \overline{p}\right]$ bunch at $\underline{p}$ as the SOP failure cost exceeds the benefit of being at the undistorted maximum. Let f_0 denote the density function of the counterfactual distribution of votes as if there were no SOP failure cost. As Saez (2010); Alvero and Xiao (2023); Ewens et al. (2023) point out, the degree of observed bunching is the fraction of agents that fall in $[\underline{p}, \overline{p}]$ under the counterfactual distribution, or

$$\mathbb{B} = \int_{\underline{p}}^{\overline{p}} f_0(x)\, dx = \left(\overline{p} - \underline{p}\right)\overline{f_0}$$

where $\overline{f_0}$ is the average density within the bunching region.[2] Further, bunching can also be written as

$$\mathbb{B} = \int_{p_-}^{p^+} f(x) - f_0(x)\, dx$$

where f is the density function of the observed distribution of votes, and $[p_-, p^+]$ is a narrow region around the threshold $\underline{p}$. The intuition is that this definition of bunching captures the amount of mass that is shifted from $\overline{p}$ to $\underline{p}$, relative to the counterfactual distribution. Note that this definition of bunching is a reduced form object in the data, and we can estimate $\overline{f_0}$ by focusing on the average counterfactual density in $[\underline{p}, p^+]$. Equating the two definitions gives

$$\left(\overline{p} - \underline{p}\right) = \frac{\mathbb{B}}{\overline{f_0}} \tag{C.4}$$

which is a reduced-form object idenfiable in the data (Alvero and Xiao, 2023), and identifies the bunching range, which can be used to estimate the SOP failure cost.

To proceed, I estimate $\widehat{\mathbb{B}}$ as in Section 4, by choosing a region $\mathcal{E}$ close to the threshold, and estimating the counterfactual distribution function as a polynomial of observed counts $\notin \mathcal{E}$. $\widehat{\overline{f_0}}$ is the average density in $\left[\underline{p}, p^+\right]$ from this counterfactual distribution. The ratio of these two objects gives the bunching range, which is used to estimate (C.3). Table C.1 displays the results. In each column, I set a different region $\mathcal{E}$, from $\left[\underline{p} - 1\%, \underline{p} + 1\%\right]$ to $\left[\underline{p} - 3\%, \underline{p} + 3\%\right]$ increasing by 0.5 percentage points in each column. The choices of $\mathcal{E}$ are motivated by Figure 2, which shows that this is where the bunching is most apparent. To estimate standard errors, I do 500 bootstrap iterations for each $\mathcal{E}$, and display the error below the estimate.

[2]That is, $\overline{f_0} = \left(\overline{p} - \underline{p}\right)^{-1} \int_{\underline{p}}^{\overline{p}} f_0(x)\, dx$.

Table C.1. Estimates of the shareholder cost to SOP failure using bunching

This table displays estimates of bunching in SOP votes, the bunching range that arises from the bunching mass, and the SOP failure cost that arises from the bunching range. In each column, I specify a region around the punching threshold of $\underline{p} = 30\%$, such that $\mathcal{E} = [p_{-}, p^{+}] = \left[\underline{p} - e, \underline{p} + e\right]$, for $e \in \{1\%, 1.5\%, 2\%, 2.5\%, 3\%\}$. In the first column, I display the bunching mass (in percent), as estimated via (E.1) in Section XX. I use a 5th degree polynomial to estimate the counterfactual distribution. The second row displays the estimated bunching range arising from the bunching mass (eq. C.4). The third row displays the estimated SOP failure cost $k(\overline{p})$ (eq. C.3). Bootstrapped standard errors, based on 500 replications, clustered by year to account for time trends in SOP votes, are displayed below the estimates. ***, **, * denote significance at 1%, 5%, 10%.

Interval $[p^{-}, p^{+}]$	(1) $\pm 1\%$	(2) $\pm 1.5\%$	(3) $\pm 2\%$	(4) $\pm 2.5\%$	(5) $\pm 3\%$
Bunching $\mathbb{B}$	16.61***	11.18***	10.09***	9.60***	7.72***
	(3.16)	(2.76)	(3.16)	(3.03)	(2.51)
Bunching range $\overline{p} - \underline{p}$	7.13***	7.31***	9.22***	10.81***	10.64***
	(1.35)	(1.74)	(2.75)	(3.27)	(3.29)
SOP failure cost $k(\overline{p})$	0.85***	0.89**	1.42*	1.95**	1.89*
	(0.33)	(0.42)	(0.78)	(0.99)	(0.99)
Observations	3,938	3,938	3,938	3,938	3,938
Bootstrap replications	500	500	500	500	500

The first row displays the estimated bunching (in percent) for that interval. The degree of bunching ranges from 8% to 17% of observed votes. The second row displays the estimate of the bunching range $\overline{p} - \underline{p}$ (in percentage points). For example, given that $\underline{p} = 30\%$, the first columns shows that the estimated indifference point in the vote is $\overline{p} = 37.13\%$. For each threshold, the degree of bunching and the bunching rage are both statistically significantly different from zero.

The object of interest, the estimated SOP failure cost is displayed in the last row, and ranges from 0.85% to 1.95%. While the magnitude of these costs is identified via the functional form of C, they are entirely consistent with the estimated parameter from my main structural model. However, this simple model cannot disentangle if this is the Shareholder cost or the Board cost. The threshold $\overline{p}$ is a function of the Board's wage best response (which is in part determined by the magnitude of the Board cost) as much as it is the shareholder SOP failure cost.

D. Model Appendix

D.1. CEO Contract and Board Capture Microfoundation

This appendix presents a simple microfoundation of the connection between CEO effort, the CEO wage and output. It also microfounds the Board's bias. I show that I cannot separately identify CEO effort aversion from the parameter that governs output's curvature in CEO effort; and the CEO's outside option from the Board's explicitly bias towards overpayment.

The CEO is effort-averse and will work for any wage. That is, given effort-aversion parameter $\gamma \in (0, 1)$, the amount of effort the CEO gives for a given w_t is

$$n_t = w_t^{\gamma}$$

This captures, in a reduced form sense, that extracting more CEO effort increases as more effort is needed. Output is decreasing returns-to-scale in CEO effort,

$$y_t = A_t (n_t^*)^{\beta} = A_t w_t^{\gamma\beta}, \quad \beta \in (0, 1)$$

As such, $y_t = A_t w_t^{\gamma\beta}$, and γ and β are not separately identified. I define $\alpha = \gamma\beta \in (0, 1)$ as my main parameter of interest, which captures the curvature of production to changes in CEO wage, embedding how the wage affects effort.

In the static model with no adjustment costs and no SOP, the Board solves

$$\max_{w_t} \quad A_t w_t^{\alpha} - \Big(1 - (\overline{u} + \overline{b})\Big)^{1-\alpha} \times w_t$$

where $0 \leq \overline{u} + \overline{b} < 1$ represents *board capture*, or the degree to which the Board wants to overpay the CEO relative to the profit-maximizing wage. Formulating the problem in this manner is convenient, as the bias term becomes a constant in logs. The CEO's outside option is $\overline{u}$, and the Board's explicit bias is $\overline{b}$. This term is raised to $1 - \alpha$ so the exponent drops out in the first-order condition. Solving the Board's problem and taking logs reveals that

$$\log w_t^{\mathrm{B}} = \log\left(\frac{1}{1-\left(\overline{u}+\overline{b}\right)}\right) + \log\left((\alpha A_t)^{\frac{1}{1-\alpha}}\right) = \log\left(\frac{1}{1-\lambda}\right) + \log\left((\alpha A_t)^{\frac{1}{1-\alpha}}\right)$$

As such, $\overline{u}$ and $\overline{b}$ are not separately identified, so I define λ, $0 \leq \lambda \leq 1$ to capture board capture. The Board's bias factor is $\frac{1}{1-\lambda}$ and describes how much more the Board wants to pay the CEO., and in log terms the bias shows up as a constant.

D.2. Microfoundation of Representative Shareholder Assumption

This section microfounds my assumption of a representative shareholder, under the assumption that a diffuse shareholder base receive a correlated private signal of CEO ability (see Section 3.2). Informally, when all atomistic shareholders receive a correlated signal and vote with the same threshold strategy, there is informational equivalence in focusing on a representative shareholder that aggregates information across the shareholder base into a single signal and votes with the same threshold strategy. This assumption of correlated private signals also embeds proxy advisors into the model. If a proxy advisor gives a negative recommendation, this is like a strong, negative signal of CEO ability. While I remain largely silent on the role of proxy advisors in the SOP process, I do acknowledge their importance.

Proposition D.1. *The expected proportion of shareholders voting against the SOP is informationally equivalent to*

$$CDF_s^U(k_s(w))$$

where $CDF_s^U(\cdot)$ is the CDF of the distribution of the random variable which determines the outcome of the SOP vote and $k_s(w) = s \times w$, where w is the CEO's wage and s is the shareholder's choice variable.

Proof. The proof largely follows arguments in Pinnington (2022). In the model, there is a continuum of N_S shareholders, whom each draw a signal z_{si} that is private knowledge, but correlated across shareholders,

$$z_{si} = \overline{z} + \varepsilon_{si}, \quad \varepsilon_{si} \sim N\left(0, \sigma_{si}^2\right).$$

z_i is conditionally normal and independent across shareholders given the common, latent signal $\overline{z}$, distributed according to

$$\overline{z} = a + \varepsilon_{\overline{z}}, \quad \varepsilon_{\overline{z}} \sim N\left(0, \sigma_{\overline{z}}^2\right).$$

The standard voting model with incomplete information assumes that signals are completely private, i.e $z_{it} = a + \varepsilon_{zit}$. With proxy voting, signals are more likely to be correlated. For example, $\overline{z}$ could reflect proxy advisors' recommendations. Note, however, that $\overline{z}$ is not a public signal. Rather, each shareholder shares the same belief about $\overline{z}$. So, it is as if shareholders each receive the proxy advisor's signal with some "noise," which could reflect, e.g. idiosyncratic trust in the proxy advisor across shareholders.

Shareholders play a symmetric cutoff strategy, voting against the proposal if and only if they draw a signal below their cutoff value

$$\mathbb{1}[\text{SOP fail}_i] \iff z_i \leq k_s^i(w).$$

Note — I have abstracted away from the effect of the output shock on the vote, and adjudging failure using lognormals. Given that the output shock is common knowledge, it will affect all shareholers voting in the same way, so does not impact the proof; the conversion to lognormal is a technical assumption that again affects all shareholders equivalently.

Given $\overline{z}$, the probability that a single shareholder votes against is

$$\Pr(\text{SOP fail}_i \mid \overline{z}) = \Phi\left(\frac{k_s^i(w) - \overline{z}}{\sigma_{si}}\right)$$

and the probability I observe N out of N_S shareholders voting against is

$$Pr(N \mid \overline{z}) = C_N^{N_S}\left[\Phi\left(\frac{k_s^i(w) - \overline{z}}{\sigma_{si}}\right)\right]^N \left[1 - \Phi\left(\frac{k_s^i(w) - \overline{z}}{\sigma_{si}}\right)\right]^{N_S - N}.$$

Fixing the unknown type a, I can find the probability of observing N out of N_S against votes,

$$Pr(N \mid a) = \int f(\overline{z} \mid a) Pr(N \mid \overline{z})\, d\overline{z}.$$

Let p be the proportion of shareholders voting against: $p = N/N_S$. Since p is Binomial, as $N_S \to \infty$, the distribution of p becomes increasingly peaked around its mean. Since its mean is the probability any individual shareholder votes against the proposal, the likelihood of observing p vanishes in the limit when $Pr(SOP_i = 1 \mid \bar{z})$ is anything other than p. Given that $\bar{z}$ completely determines $Pr(SOP_i = 1 \mid \bar{z})$, there is a bijection between $\bar{z}$ and p

$$\bar{z}(p) = k_s(w) - \sigma_{si}\Phi^{-1}(p)$$

Using this peakedness, the limit of the density of observing p as $N_S \to \infty$ is

$$f(p) = \int f(a) f(\bar{z}(p) \mid a) \bar{z}'(p)\, da$$

The likelihood of observing p is driven by the likelihood of observing $\bar{z}(p)$, scaled by a change-of-variable term $\bar{z}'(p)$. Since $\bar{z}$ is conditionally normal around the type a, I integrate over all types a and then take the likelihood of observing $\bar{z}(p)$ given the type a. I am more interested in $f(a \mid p)$ — the density of a conditional on observing p,

$$\lim_{N_S \to \infty} f(a \mid p) = \frac{\lim_{N_S \to \infty} f(a) f(p \mid a)}{\int \lim_{N_S \to \infty} f(a) f(p \mid a)\, da}.$$

The intuition is that the posterior likelihood of a is proportional to two components: the prior $f(a)$; and the likelihood that the latent signal $\bar{z}$, given a, is equal to $\bar{z}(p)$, which in the limit is the only $\bar{z}$ for which I would see p. This is a scaled product of Gaussians, so the posterior is also normal,

$$a \mid p \sim N(\mu_{ap}, \sigma_{ap}^2),$$

where

$$\mu_{ap} = \frac{\sigma_{\bar{z}}^2}{\sigma_a^2 + \sigma_{\bar{z}}^2}\mu_a + \frac{\sigma_a^2}{\sigma_a^2 + \sigma_{\bar{z}}^2}\bar{z}(p), \qquad \sigma_{ap}^2 = \frac{\sigma_a^2 \sigma_{\bar{z}}^2}{\sigma_a^2 + \sigma_{\bar{z}}^2}.$$

Thus, observing p is informationally equivalent to observing a signal $z_s = \bar{z}(p) = k_s(w) - \sigma_z \Phi^{-1}(p)$, where $z_s = a + \varepsilon_s$, and $\varepsilon_s \sim N(0, \sigma_{z_s}^2)$.

The proof arises because of the assumptions about the correlated signal and the continuum of shareholders. All shareholders play a symmetric cutoff strategy; in the limit, the exact proportion of shareholders that receive a signal below the cutoff *must* be equivalent to the probability that an informationally equivalent aggregate signal falls below the cutoff. Another way to think about this is to consider a representative shareholder that interacts with the Board, and aggregates the votes or signals of the shareholder base at the shareholder meeting.

■

D.3. Evolution of Board and Shareholder Beliefs

I first detail two Propositions, which define how beliefs update in the model. Then I define exactly how Board and shareholder beliefs change within each period.

D.3.1. Evolution of Beliefs Period to Period

Prop. D.2 shows how beliefs change from t to $t+1$. Prop. D.3 describes the distribution of next period beliefs given today's beliefs, which is used when the Board calculates their (expected) continuation value.

Proposition D.2. *From period t to $t+1$, the variance of beliefs for both the Board and shareholders declines deterministically according to*

$$\sigma_a^2(\tau+1) = \left[\sigma_a^{-2}(\tau) + \sigma_{z_b}^{-2} + \sigma_{z_s}^{-2} + \sigma_y^{-2}\right]^{-1} \tag{D.1}$$

where τ is the tenure of the CEO at year t. Equivalently, I can write the variance of beliefs about CEO ability entirely as a function of CEO tenure τ and model parameters

$$\sigma_a^2(\tau) = \sigma_0^2\left[1 + \tau\left(\kappa_{z_b}^{-1} + \kappa_{z_s}^{-1} + \kappa_y^{-1}\right)\right]^{-1} \tag{D.2}$$

where $\kappa_{z_b} = \sigma_{z_b}^2/\sigma_0^2$, $\kappa_{z_s} = \sigma_{z_s}^2/\sigma_0^2$ and $\kappa_y = \sigma_y^2/\sigma_0^2$

Similarly, from period t to $t+1$, the mean of beliefs for both the Board and shareholders evolves according to

$$\mu_{at+1} = \sigma_a^2(\tau+1)\left[\frac{\mu_{at}}{\sigma_a^2(\tau)} + \frac{z_{bt}}{\sigma_{z_b}^2} + \frac{z_{st}}{\sigma_{z_s}^2} + \frac{z_{yt}}{\sigma_y^2}\right] \tag{D.3}$$

Proof. The formulas are standard results in Bayesian learning (e.g., Pastor and Veronesi, 2009; Taylor, 2010).[3] The Board and shareholder reveal their signals each period. Thus, Board and shareholders share the same beliefs about the variance from period to period. ■

Proposition D.3. *The mean and variance of the mean of $t+1$ CEO beliefs at t are*

$$E_t[\mu_{at+1}] = \mu_{at}$$
$$Var_t[\mu_{at+1}] = \sigma_a^2(\tau) - \sigma_a^2(\tau+1) \tag{D.4}$$

That is,

$$\mu_{at+1} \mid \mu_{at}, \tau \sim N\big(\mu_{at}, \sigma_a^2(\tau) - \sigma_a^2(\tau+1)\big)$$

Proof. I drop time subscripts for convenience, and use $\cdot'$ to denote next period. Via Prop. D.2, the mean evolves as

$$\mu_{a\prime} = \sigma_{a\prime}^2 \left[\frac{\mu_a}{\sigma_a^2} + \frac{z_b}{\sigma_{z_b}^2} + \frac{z_s}{\sigma_{z_s}^2} + \frac{z_y}{\sigma_y^2}\right]$$

where $z_y = \ln A = a + \varepsilon_y$ is the productivity signal. Let $p' = \sigma_{a'}^{-2}$, i.e the next period precision of beliefs. Let p_a, p_b, p_s, p_y be precisions $\sigma_a^{-2}, \sigma_{z_b}^{-2}, \sigma_{z_s}^{-2}, \sigma_y^{-2}$ respectively. Then define $\rho_{X\in\{a,b,s,y\}}$ be each precision divided by p', e.g. $\rho_a = \frac{p_a}{p'}$. I can write,

$$E[\mu_{a'} \mid \mu_a] = \big(\rho_a + \rho_b + \rho_s + \rho_y\big)\mu_a = \mu_a$$

which of course must hold because beliefs are a martingale. I can write $Var(\mu_{a'} \mid \mu_a)$ as

$$\begin{aligned}
Var(\mu_{a'} \mid \mu_a) &= E\Big[\big(\rho_a\mu_a + \rho_b z_b + \rho_s z_s + \rho_y z_y - E[\mu_{a'} \mid \mu_a]\big)^2 \mid \mu_a\Big] \\
&= E\Big[\big(\rho_a(\mu_a - \mu_a) + \rho_b(z_b - \mu_a) + \rho_s(z_s - \mu_a) + \rho_y\big(z_y - \mu_a\big)\big)^2 \mid \mu_a\Big] \\
&= E\Big[\big(\rho_b(z_b - \mu_a) + \rho_s(z_s - \mu_a) + \rho_y\big(z_y - \mu_a\big)\big)^2 \mid \mu_a\Big]
\end{aligned}$$

Note that $E\big[(z_b - \mu_a)^2 \mid \mu_a\big] = \sigma_a^2 + \sigma_{z_b}^2$, which similarly holds for subscript s and y. Hence, I

[3] See also the internet appendix for Taylor (2010).

can write $Var(\mu_{a'} \mid \mu_a)$ as

$$Var(\mu_{a'} \mid \mu_a) = \sigma_a^2\left(\rho_b + \rho_s + \rho_y\right)^2 + \rho_b^2\sigma_{z_b}^2 + \rho_s\sigma_{z_s}^2 + \rho_y\sigma_y^2$$

Note that $\rho_b^2\sigma_{z_b}^2 = \frac{\rho_b}{p'}$, similarly for s and y, and $1 = \rho_a + \rho_b + \rho_s + \rho_y$, so I can again write

$$Var(\mu_{a'} \mid \mu_a) = \sigma_a^2(1-\rho_a)^2 + \frac{1-\rho_a}{p'}$$

Lastly, I note that $\sigma_a^2(1-\rho_a) = \sigma_a^2 - \frac{\sigma_a^2 p_a}{p'} = \sigma_a^2 - \sigma_{a'}^2$, and

$$\begin{aligned}Var(\mu_{a'} \mid \mu_a) &= (\sigma_a^2 - \sigma_{a'}^2)(1-\rho_a) + \sigma_{a'}^2(1-\rho_a) \\ &= \sigma_a^2(1-\rho_a) \\ &= \sigma_a^2 - \sigma_{a'}^2\end{aligned}$$

and I am done. Equivalently, I can write this as $\frac{p'-p}{p'p}$. Further, this expression of the conditional variance of the mean can be used for pair of normal prior + posterior beliefs. This quantity is useful when taking expectation of next period's continuation value ■

D.3.2. Differences in Board and Shareholder Beliefs Within Period

This subsection explains exactly how Board and shareholder beliefs evolve within each period. As the wage and vote perfectly reveal signals z_b and z_s, the Board and shareholders share the same beliefs at the beginning of any period. Let τ_t be the tenure of the CEO at time t. By Prop. D.2, I have that $\sigma_{bt}^2 = \sigma_{st}^2 = \sigma_a^2(\tau)$ from (D.2). At the beginning of the period, let μ_{at} be the beliefs about the mean at the beginning of period t. So, I can describe Board and shareholder beliefs as $\left(\mu_{at}, \sigma_a^2(\tau_t)\right)$ at the beginning of period t.

1. **Board beliefs after the compensation committee meeting**

   At the meeting, the Board receives signal z_{bt}, and Board beliefs update to

$$\mu_{bt|z_b} = \sigma_{bt|z_b}^2\left(\frac{\mu_{at}}{\sigma_a^2(\tau_t)} + \frac{z_{bt}}{\sigma_{z_b}^2}\right) \tag{D.5}$$

$$\sigma^2_{bt|z_b} = \frac{\sigma_a^2(\tau_t)\sigma^2_{z_b}}{\sigma_a^2(\tau_t) + \sigma^2_{z_b}} = \sigma_0^2\left[1 + (\tau_t + 1)\kappa_{z_b}^{-1} + \tau_t(\kappa_{z_s}^{-1} + \kappa_y^{-1})\right]^{-1} \tag{D.6}$$

I use $\mu_{bt|z_b}$ and $\sigma_{bt|z_b}$ to follow conventions in the main text. The Board makes their wage decision based upon these beliefs. Before the wage is revealed, shareholders still maintain beliefs $\left(\mu_{at}, \sigma_a^2(\tau_t)\right)$.

2. **Shareholder beliefs when they commit to signal threshold k_{st}**

   When Board and shareholders play the wage-SOP game, their beliefs differ, in that the Board believes $\left(\mu_{bt|z_b}, \sigma_{bt|z_b}\right)$ and shareholders believe $\left(\mu_{at}, \sigma_a^2(\tau_t)\right)$. But shareholders can discern $\left(\mu_{bt|z_b}, \sigma_{bt|z_b}\right)$ for any z_{bt}, which they factor in when choosing their threshold. Shareholders thus factor in what $\mu_{bt|z_b}$ will be when calculating expected wages in their objective function in (17).

3. **Board and shareholder beliefs about shareholders' *ex ante* signal distribution at the time of the SOP vote**

   Before the SOP vote, when the shareholders commit to their threshold, both B and S know that the shareholders' aggregated signal will be

$$Z_{syt} = a + p\varepsilon_{st} + (1 - p)\varepsilon_{yt} \tag{D.7}$$

   with $Z_{syt} \sim N\left(\mu_{at}, \sigma^2_{at} + \frac{\sigma^2_{z_s}\sigma^2_y}{\sigma^2_{z_s} + \sigma^2_y}\right)$.[4] Notice that shareholder beliefs about a *do not update* to $N\left(\mu_{bt|z_b}, \sigma_{bt|z_b}\right)$. This is because the timing convention in the model states that the wage w_t (and equivalently z_{bt}), productivity z_{yt} and the signal z_{st} are all revealed concurrently. At the exact time that z_{bt} and Z_{syt} are revealed, the Board and Shareholders may disagree about CEO skill. This timing convention is key for determining SOP outcomes.

4. **Board and shareholder beliefs after the annual shareholder meeting and release of 10-K**

   The 10-K and compensation committee report reveals the wage to shareholders, hence reveals z_{bt}. Shareholders vote at the annual meeting and Z_{syt} and thus z_{st} are revealed.

[4] The variance of the signal is $Var(a + p\varepsilon_{st} + (1-p)\varepsilon_y) = \sigma_a^2 + p^2\sigma^2_{st} + (1-p)^2\sigma^2_y$, where $p = \frac{\sigma_{z_s}^{-2}}{\sigma_{z_s}^{-2} + \sigma_y^{-2}}$. Expanding this expression out leads to the expression for the variance.

Hence, B and S beliefs update to $\left(\mu_{at+1}, \sigma_a^2(\tau_t + 1)\right)$, by Prop. D.2.

D.4. Assumptions about Shareholder strategy

See Section 3.3 for the full discussion of the Shareholder's strategy. A primary goal of this paper is to model how the threat of SOP failure influences the Board's wage decision. I model this threat as an *ex ante* probability that the SOP will fail, which is increasing in the wage. In this spirit, the first assumption specifies precisely when shareholders commit to this threat.

Assumption 1. *Shareholders commit to their voting strategy in advance of the annual shareholder meeting.*

S must set their probability of failure *before* they receive their private signal or see wages and productivity. This threat of vote failure influences the Board's wage decision. The threat of vote failure does not need to be revealed to the Board before the annual shareholder meeting, however commitment forces S to play the threshold strategies that the Board expects. Unlike Kakhbod et al. (2023), there is no notion of cheap talk here. Commitment means S cannot choose an *ex ante* optimal non-zero failure probability and then renege at the shareholder meeting once the Board sets their wage.[5]

Assumption 2. *Shareholders seek to optimize operating income, given their beliefs about CEO ability.*

This assumption is a main source of disagreement about CEO ability between the Board and shareholders. The Board's signal z_{bt} causes B to update their beliefs about CEO ability. At the time that the Shareholder commits to their voting strategy, B and S hold different beliefs about CEO ability. This assumption means that S wants to force the Board to pay a wage closer to the unbiased wage, given their beliefs after receiving the signal at the shareholder meeting. Technically, this means that shareholders choose a single s_t for the Board's entire wage schedule — S influence expected wages. Or, put equivalently, S sets an average (across

[5]Based on Assumption 1, Figure A.5 provides a more detailed version of the model timeline (slightly adapting Figure 3). In particular, in period 1 (or 1a and 1b), B and S set their strategies. These strategies are not revealed at this time, but this timing convention defines the notion of the Board's informational advantage. In particular, the Board plays their strategy *after* receiving signal; the shareholder plays their strategy *before*. the assumption of commitment forces S to stick with the strategy that B expects.

the distribution of z_{bt}) probability of SOP failure that the shareholder base is comfortable with.

Assumption 3. *Shareholders are* myopic. *That is, the SOP vote is only influenced by today, and is not a fully dynamic problem.*

Effectively, this means that shareholders play a static game, while the Board plays a dynamic one. This assumption matches reality. There is ample evidence that voting in SOPs is influenced by short-run outcomes, such as current firm or stock performance (see Figure A.4, or Fisch et al., 2018; Novick, 2019, 2020). Further, Table A.2 shows that lagged CEO pay does not influence SOP outcomes. This makes the solution method much simpler, as it avoids higher-order beliefs and an infinite-regress problem in B and S forecasting each other's beliefs (Foster and Viswanathan, 1996; Bonatti et al., 2017).

D.5. Full Derivation of Model Solution

Proposition D.4. *The Board's problem can be written as*

$$V(\mu_a, \tau, w_{-1}) = \max_{w(s)} \quad \exp\left(\mu_{b|z_b} + 0.5\left(\sigma^2_{b|z_b} + \sigma^2_y\right)\right) w(s)^\alpha - (1-\lambda)w(s) - \chi_B F^U_{\tilde{z}_s}(s \times w(z_b, s)) - AC(w(s), w_{-1}; \tau) + \delta_B\left[f(\tau_t)V^R + (1 - f(\tau_t))E_{b|z_b}\left[V(\mu'_a, \tau+1, w(s))\right]\right] \tag{D.8}$$

where

- $\mu_{b|z_b}$ *and* $\sigma^2_{b|z_b}$ *are defined in* (D.5) *and* (D.6),
- $E_{b|z_b}[V] = F^U_{\tilde{z}_s}(s \times w)$ *where* $F^U_{\tilde{z}_s}$ *is the CDF of the following distribution (see 15)*

$$w^U \sim \log N\left(\frac{\mu_s}{1-\alpha} + C, \frac{\sigma^2_s}{(1-\alpha)^2}\right), \quad C = \frac{\log\alpha + \frac{1}{2}\sigma^2_y}{1-\alpha}$$

- $AC(w, w_{-1}; \tau)$ *(adjustment cost) is defined in* (3),
- $f(\tau_t)$ *are CEO tenure-specific hazard rates, with* $f_0 = 0$ *and* $f(\tau_t) = 1$
- $V^R = V(\mu_0, 0, 0)$ *as in* (20)

- $\mu_a' \mid \mu_{b|z_b}, \tau \sim N\left(\mu_{b|z_b}, \sigma^2_{b|z_b} - \sigma^2_a(\tau+1)\right)$ *from Prop.* D.3

The shareholder's problem can be written as

$$\max_s \int_{z_b} f(z_b \mid \mu_a, \sigma_a^2) \left[\exp\left(\mu_a + 0.5\left(\sigma^2_{b|z_b} + \sigma^2_y\right)\right) w(z_b, s)^\alpha - w(z_b, s) - \chi_S CDF_s^U(s \times w(z_b, s)) \right] dz_b \tag{D.9}$$

where $f\left(z_b \mid \mu_a, \sigma_a^2\right)$ *is the density function of* z_b *given prior beliefs about CEO ability, and all other objects are defined as above.*

Proof. I start with (D.8). $\mu_{b|z_b}$ and $\sigma^2_{b|z_b}$ are Board beliefs after receiving their signal, hence are known from the perspective of the Board. As $A = \exp(a + \varepsilon_y)$, with a (and beliefs about a) normally distributed, I can write its expectation in terms of means and variances. The probability of vote failure is described in Section 3.3, but as brief overview it is given by the CDF $F^{\mathrm{U}}_{\tilde{z}_s}$, of the unbiased (lognormal) wage of beliefs implied by realizations of $\tilde{z}_s$. The adjustment cost makes the Board's problem dynamic, as they have to factor in the effect of wages on the continuation value.

V^R is value if the CEO retires, so beliefs reset and there is no adjustment cost. In other words, the Board's problem reverts to its $t = 1$ value; it is constant for any state as the prior belief of ability about the CEO talent pool is distributed $N(\mu_0, \sigma_0^2)$ for any state. Hence, it is a boundary condition.

The distribution of μ_a' conditional on μ_a and τ is given in Prop. D.3. However, because the Board has beliefs $\left(\mu_{b|z_b}, \sigma^2_{b|z_b}\right)$, the variance of next period *mean* beliefs (not the variance of beliefs) at the time the Board makes their decision is $\sigma^2_{b|z_b} - \sigma^2_{a'}$. This quantity wil be used to take expectation over the continuation value. If the CEO continues, the tenure increases by 1, and the Board must consider the adjustment cost in the next period.

For (D.9), the objects are the same as the Board's problem, however the shareholders choose s under the distribution of z_b, while holding belief of average CEO ability μ_a. That is, shareholders figure out the Board's wage decision for each z_b, including how they would react to the choice of a particular s. Under Assumption 3, shareholders do not behave dynamically, and only vote on the current period. Crucially, as the wage, the productivity signal and the shareholder's private signal are all revealed simultaneously (see Section 3.2 and Figures 3 and A.5), the Board and shareholders *disagree* about CEO ability at the point the vote is held. In other words, they hold different beliefs about (mean) CEO ability.

The solution $(w(z_b), s)$ is to be found numerically, each $(w(z_b), s)$ is a best response in equilibrium under commitment (Assumption 1). To sketch the intuition of the solution, fix S' strategy s under commitment. The Board can then back out the probability of failure for each choice of $w(z_b)$, knowing that S must play the threshold. In other words, there is no notion of deviation for the Board. S just needs to maximize (D.9) for their strategy to be a best response; they cannot deviate at the vote and play a lower threshold. ■

E. Estimation Appendix

E.1. Identifying the CEO component of output

To undertake the estimation of CEO skill and output parameters, I need to estimate the CEO component of company output. This process is similar to the analyses undertaken in Matveyev (2017) and Lyman (2023), and the ultimate goal is to give an approximation of how CEO skill (productivity) and effort (via the wage) impact revenues.

I first specify the following functional form for company revenues

$$\log Y_{it} = \underbrace{\log \eta}_{\text{scaling factor}} + \underbrace{a_i + \alpha \log w_{it}}_{\text{CEO component}} + \underbrace{\kappa_1 \log K_{it} + \kappa_2 \log L_{it} + \mu_{IND} + \mu_t}_{\text{non-CEO component}} + \varepsilon_{yit},$$

where i refers to a firm-CEO match, Y_{it} is the revenue generated by the firm, η is a scaling factor, w_{it} is the wage paid to the CEO, a_i is a CEO fixed effect, K_{it} is (PPE), L_{it} is the number of employees, and μ_{IND} and μ_t are industry and time fixed effects. I residualize revenues by netting out the non-CEO component of revenue.

This gives the following form for revenue

$$\log y_{it} = \log \eta + a_i + \alpha \log w_{it} + \varepsilon_{yit} \implies$$

$$y_{it} = \eta A_{it} w_{it}^{\alpha} = \eta \exp\big(a_i + \varepsilon_{yit}\big) w_{it}^{\alpha}.$$

The parameter η is a time-invariant scaling factor which scales operating income to its appropriate level. It can also be thought of as how well the firm is able to translate the CEO's skill and effort into actual revenues, and it allows me to translate how CEO effort and wages ultimately affect revenues. While η is not essential for solving the model, it is important in the estimation as it allows for appropriate comparison across subsamples (Page, 2018).

E.2. Bunching Estimator Used in the Estimation

This appendix describes the bunching estimator used in the estimation (see Section 4.1). It is a simple, reduced-form measure that is simple to implement. Informally, the measure captures how much extra mass is shifted below the failure threshold, relative to a counterfactual density. To start, I bin the data into widths of 0.5% and index each bin by b. I label the bin mid-point as x_b. N_b is the number of SOP vote outcomes that fall in bin b. To estimate a counterfactual density of vote outcomes absent the failure threshold, I first fix a region around the threshold, $\mathcal{E}$, which captures where bunching is most likely to occur

$$\mathcal{E} = \left\{ b \quad \text{s.t.} \quad x_b \in [-e, e] \right\},$$

in the estimation I set $e = 2.5\%$. Excluding $\mathcal{E}$, I estimate the predicted bin counts as a polynomial of the bin midpoints,

$$N_b = \sum_{m=0}^{M} \beta_m \left(x_b^m \right)$$

and then predict $\hat{N}_b$ for bins in $\mathcal{E}$. Thus, $\hat{N}_{b|b\in\mathcal{E}}$ represent a counterfactual count for the number of SOP votes that would fall in bin b given there was no bunching in the data. I use these predicted counts to construct the bunching estimator

$$\mathbb{B} = \underbrace{\frac{\sum_{b\in\mathcal{E}} \left(N_b - \hat{N}_b \right) \times \left(\mathbf{1}[x_b < 0] - \mathbf{1}[x_b \geq 0] \right)}{\sum_{b\in\mathcal{E}} \hat{N}_b}}_{\text{Proportion of mass shifted to below threshold}} . \tag{E.1}$$

$\mathbb{B}$ measures how many SOP votes are shifted from above the failure threshold to below, expressed as a proportion of the sum of the predicted counts. (E.1) is easily estimable on model-simulated data, so can be used as a targeted moment during the estimation step.

E.3. Numerical Solution

The model requires 11 parameters, along with $\mathbf{T}+1$ externally calibrated CEO separation rates. I externally calibrate the Board's discount factor $\delta_B = 0.9$, following Taylor (2010). The CEO separation rates are generated by calculating the cross-sectional proportion of CEOs that separate from their firm for a given tenure. I group the remaining 10 parameters as Θ,

$$\Theta = \begin{pmatrix} \mu_0 & \sigma_0 & \sigma_y & \alpha & c_W & \sigma_{z_b} & \sigma_{z_s} & \lambda & \chi_B & \chi_S \end{pmatrix}$$

The model's solution proceeds as such

1. Start with a given Θ
2. Discretize each idiosyncratic shock into an N_z grid. E.g., fix the possible realizations of $\varepsilon_{z_{bt}}$, $\varepsilon_{z_{st}}$, etc.
3. Discretize the state space into a $(N_u, \mathbf{T}+1, N_w)$ grid, call it $\mathcal{S}$, where each tuple (μ_i, τ_j, w_k) indexes current mean belief about CEO ability, tenure (which fully determines beliefs of variance of CEO ability) and the current wage.
4. Start with a guess of $V_0(\mu, \tau, w)$ as the solution to the static game (i.e., where there is no wage adjustment cost), so V_0 is just the Board's per-period expected utility given optimal choices. Each $V(\mu, \tau, w_{1:N_w})$ starts with the same value.
5. Use Gauss quadrature and Prop. D.2 to estimate the continuation value for each tuple (μ, τ, w)
6. For each element in $\mathcal{S}$, solve (D.8) and (D.9),
   - If $i \,\%\, 10 = 0$
     - Solve B's optimal choice of w' given possible realizations of ε_{z_b}, and how this w' affects the continuation value and adjustment cost.
     - Concurrently backing out S' optimal choice of s for the tuple (μ, τ, w) given B's optimal choices of w'

- Update the guess of the value function

- Else,
  - Update B's optimal choices w'
  - Update the guess of the value function

7. Return to 4 and repeat until $\max|V_i - V_{i-1}| < \epsilon = 1\text{e} - 5$

This process returns the Board's wage policy for each element in $\mathcal{S}$, and each realization on the grid of ε_{z_b}. Concurrently, it returns the shareholder's policy for each element in $\mathcal{S}$.

E.4. Simulation

I set N_f firms, where N_f is chosen to match the number of firms in the data used for estimation. Given $a \sim (\mu_0, \sigma_0)$, I draw a CEO of skill a for each firm. A CEO spell is the length of time the CEO is matched with a firm. Each period, for each firm, I generate realizations of $\varepsilon_{z_{bt}}$, $\varepsilon_{z_{st}}$ and ε_{yt}. Given the state, I use the policies described in Section E.3 to generate optimal choices. Beliefs update given realizations of σ_{z_b}, σ_{z_s} and z_{yt}. At the end of each period, for CEOs with tenure $\tau > 0$, they separate (via firing, quitting or retirement) with exogenous probability f_τ.

I generate N_S samples for each simulation. I "fix" randomness across different simulations. That is, each $n_s \in N_S$ sample has the same seed across iterations, only the variance of each CEO ability and each shock changes.

E.5. Estimation

I estimate the 10 parameters

$$\Theta = \begin{pmatrix} \log\eta & \sigma_0 & \sigma_y & \alpha & c_W & \sigma_{z_b} & \sigma_{z_s} & \lambda & \chi_B & \chi_S \end{pmatrix}$$

As mentioned above, the Board's discount factor δ_B is calibrated to 0.9. (Taylor, 2010), and separation rates are calibrated to match observed separation rates in the sample. I estimate the remaining model parameters by finding a vector Θ of parameters that minimizes the weighting distance between a vector of moments produced by the model and the corresponding moments computed in the data. That is, given model moment $m(\Theta)$ and data moments $m(X)$ and an appropriate weighting matrix W, I minimize

$$\min_{\Theta} \left[d(\Theta, X)\right]' W \left[d(\Theta, X)\right] \tag{E.2}$$

$d(\Theta, X)$ is a 13×1 vector of differences between model-simulated and empirical moments (Barrero, 2022). I set $d(\Theta, x) = m(\Theta) - m(X)$. The weighting matrix is the identity matrix. The model moments can be expressed as the coefficients from the following system of equations, where each regression is indexed by i, c, τ, t

$$\begin{aligned}
\ln y &= y_0 + y_1 \ln \text{wage} + e_y \\
(E_{\text{CEO}}[\ln y] - E[E_{\text{CEO}}[\ln y]])^2 &= Var(E[\ln y]) + e_{\text{CEO}} \\
\ln \text{wage} &= b_0 + b_1 \mathbb{1}[\text{SOP fail}] + b_2 \ln \text{lagged wage} + e_b \\
\mathbb{1}[\text{SOP fail}] &= s_0 + s_1 \ln \text{wage} + s_2 \epsilon^y + e_s \\
(\epsilon^y)^2 &= Var(\epsilon^y) + e_{\epsilon_y} \\
\left(\epsilon^b\right)^2 &= Var\left(\epsilon^b\right) + e_{\epsilon_b} \\
(\epsilon^s)^2 &= Var(\epsilon^s) + e_{\epsilon_s} \\
y_{\mathbb{B}} &= \mathbb{B} x_{\mathbb{B}} + e_{\mathbb{B}}
\end{aligned} \tag{E.3}$$

For the final moment $\mathbb{B}$, I reconstruct (E.1) using a regression specification.[6] In total, there are 13 moments to pin down 10 parameters. I estimate (E.3) jointly, with standard errors clusted at the CEO-spell level, and use the variance-covariance matrix of the moments to estimate standard errors of the parameter and moments. The full list of moments with notation is displayed in Table E.1.

E.6. Optimization algorithm

My goal is to find the global minimum of the SMM/GMM objective function described in Section E.5. To leverage the efficiency of parallel computing, I use a somewhat modified version

[6]That is $x_{i,\mathbb{B}} = \sqrt{\frac{\hat{N}_b}{N_b}}$ and $y_{i,\mathbb{B}} = \left(x_{i,\mathbb{B}}\right)^{-1}(\mathbf{1}[x_b < 0] - \mathbf{1}[x_b \geq 0])\left(1 - \frac{\hat{N}_b}{N_b}\right)$. This expression reconstructs (E.1) in terms of a regression, and conveniently allows me to include (E.1) in our regression system.

Table E.1. Moment targeting exercise
This table displays the notation and description for each targeted moment, along with the parameter(s) it targets.

	Auxiliary model outcome	Description	Target
(1)	$\hat{y}_0$	Average log output	$\log \eta$
(2)	$\hat{y}_1$	Elasticity of output to wage	α
(3)	$\widehat{Var}(\epsilon^y)$	Output residual variance	σ_y
(4)	$\widehat{Var}(E[\ln y - \hat{y}_1 \ln w])$	CEO-average output variance	σ_0
(5)	$\hat{b}_0$	Average log wage when SOP passes	λ
(6)	$\hat{b}_1$	Difference in log wage when SOP fails	χ_B
(7)	$\hat{b}_2$	Persistence in log wages	c_w
(8)	$\widehat{Var}\left(\epsilon^b\right)$	Wage regression residual variance	σ_{z_b}
(9)	$\hat{s}_0$	Observed SOP failure rate	λ, χ_S
(10)	$\hat{s}_1$	Sensitivity of SOP failure to log wage	χ_B, χ_S
(11)	$\hat{s}_2$	Sensitivity of SOP failure to output shock	σ_{z_s}, σ_y
(12)	$\widehat{Var}(\epsilon^s)$	SOP fail regression residual variance	σ_{z_s}
(13)	$\widehat{\mathbb{B}}$	Bunching estimator (E.1)	χ_B, χ_S

of the TikTak global optimization algorithm described in Arnoud et al. (2019).[7] The modifications are designed to take advantage of high performance computing to minimize computing time. The global optimization routine can be described as such:

1. **Parallel local minimization**

   i. Generate bounds for each parameter. This is a holistic step, yet the bounds should be narrow enough to allow for the subsequent quasi-random sequences to adequately cove the space, but wide enough so that I maximize the chance of finding the global minimum.

   ii. Using the bounds, generate a Sobol sequence of length N. Sobol points are quasi-random points which are intended to mimic a draw from from a uniform distribution. In my setup, I set $N = 5000$.

   iii. For each $n \in N$ of the Sobol points, use a minimizer to find the local minimum of each

[7] I modified code from https://github.com/tpapp/MultistartOptimization.jl, which is based upon the original TikTak code: https://github.com/serdarozkan/TikTak. See also Liu (2021) for a recent example.

point. Keep the portion p of the points with the smallest local minima to be used in the global stage. In my setup, I use Nelder-Mead locally, and keep the top 4% of points, so I am left with $N_p = 200$ “promising" candidates for the global minimum.

2. **Parallel global minimization**. This step slightly modifies the TikTak routine to take advantage of parallel computing. I employ SLURM with MPI to enable communication between ranked sets of iterations across the N_p points. This allows me to speed up the TikTak global optimization step, though at the expense of far greater expenditure of computing resources.

   i. Take the $p \in N_p$ candidates for the global minimum from above and sort in ascending order. Set $i = 1$, so the best minimum so far is indexed by i.

   ii. Take the best minimum so far, labeled p_i^*. Generate $N_p - i$ convex combinations using the TikTak methodology. That is, for $j \in N_p - i$, $p_{ji}^{cand} = \theta_{ji} p_i^* + (1 - \theta_{ji}) p_j$, where $\theta_{ji} \in [0, 1]$ and approaches 1 as j increases.

   iii. Compute the local minimum of each $N_p - i$ point in parallel. If p_i^* is the best, then exit the routine and p_i^* is the candidate global minimum. Else,

   iv. For the first j such that function value of p_{ji}^{cand} is less than that of p_i^*, stop all subsequent (unfinished) local minimization routines for $j' \in N_p - i$, and $j' > j$. Update i += p and return to ii.

   This routine will return p_i^* as the global minimum.

3. **Polish global minimum**. Using stricter stopping criteria and a large number of function iterations, polish the global minimum p_i^* using a local minimization routine, i.e. Nelder-Mead.

E.7. Derivation of Model Statistics

This section derives several closed-form model statistics that are useful to interpret the magnitude of the main effects from the model. I can directly derive standard errors for closed-form functions of model parameters, which is useful for comparing across models.

SOP failure cost as a percentage of unbiased value. To interpret the magnitude of the SOP failure cost, I first develop a measure of unbiased firm value. Unbiased firm value is the discounted stream of future cash flows produced by the CEO if the CEO were paid the profit-maximizing wage, under the assumption that Board and shareholder beliefs remain fixed at (μ_0, σ_0^2). First, note that

$$w_0 = \arg\max_{w} E_0[A_0 w^\alpha - w] = \alpha^{\frac{1}{1-\alpha}} \times E_0[A_0]^{\frac{1}{1-\alpha}}$$

is the optimal unbiased wage, absent SOP. Using this, average (unbiased) firm value can be written as

$$\begin{aligned}
\text{Average firm value} = V_0 &= \sum_{t=1}^{\infty} \delta_B^t E_t[y_t - w_t] \\
&= \sum_{t=1}^{\infty} \delta_B^t E_0[y_0 - w_0] \\
&= \sum_{t=1}^{\infty} \delta_B^t E_0[A_0 \times (w_0)^\alpha - w_0] \\
&= \frac{1}{1-\delta_B}\left[\exp\left(\mu_0 + 0.5\left(\sigma_0^2 + \sigma_y^2\right)\right) \times (w_0)^\alpha - w_0\right]
\end{aligned}$$

I can use unbiased firm value to interpret the magnitude of the SOP failure cost parameters χ_B and χ_S

$$\text{SOP failure cost (\% average value)} = \frac{\chi_{\{B,S\}}}{V_0} \tag{E.4}$$

Board capture as a share of surplus. To interpret the magnitude of my board capture parameter, I can express it in terms of how the Board decides to split up the surplus between the Board and shareholder. Focusing on the average CEO in the first year of tenure, and abstracting from dynamics and SOP, suppose the Board places the weight $\nu \in [0, 1]$ on the CEO's utility (pure dollar wage), and $1 - \nu$ on company profits, so that their program is

$$\max_{w_t} \quad (1-\nu) \times E_0\left([A_0] w_t^\alpha - w_t\right) + \nu \times w_t$$

As can be seen, this is the same as $\max_{w_t} E_0[A_0]w_t^\alpha - (1-\lambda)w_t$, with $\lambda = \frac{\nu}{1-\nu}$, the main program from the paper. Equivalently defining $\nu = \frac{\lambda}{1+\lambda}$, if $\lambda = 1$, then the Board sets the wage such that company profits go to zero (perfect capture). If $\lambda = 0$, the Board maximizes profits. The optimal split that the Board decides for the CEO is thus

$$\theta_{\text{CEO}} = \frac{\nu w_t}{(1-\nu) \times (E_0[A_0]w_t^\alpha - w_t) + \nu w_t} = \frac{\lambda w_t}{E_0[A_0]w_t^\alpha - (1-\lambda)w_t}$$

The split θ_{CEO} describes how much the Board tilts the surplus towards the CEO. I can thus describe that the surplus split for the average CEO as

$$\theta_{\text{CEO}} = E_0\left[\frac{\lambda w_t}{y_t - (1-\lambda)w_t}\right] = \frac{\lambda w_0}{y_0 - (1-\lambda)w_0} \tag{E.5}$$

E.8. The Impact of the Shareholder SOP Failure Cost

In companion analysis to Section 5.2, I evaluate the effect of removing the shareholder cost to SOP failure. Removing this shareholder cost represents a *significant* change to the underlying preferences of shareholders. The exercise of changing χ_S while holding other parameters constant is likely not valid. By its nature, SOP is akin to a costly punishment mechanism. In some sense, the cost to shareholders has emerged endogenously as a way validate SOP, even though it is a voice mechanism. By failing the SOP, shareholder *commit* to re-considering the careers of directors (and possibly the CEO); these outcomes incur costs. If SOP were truly costless to shareholders in reality, then the Board would likely view it as "cheap talk." Nonetheless, understanding its impact on CEO pay and firm value is insightful for the model's predictions.

Table E.2 displays the results. When $\chi_S = 0$, the SOP failure rate increases from about 7% to 42%. The reason the failure rate does not go beyond this can be gleaned from Figure 4; shareholders do not want to decrease below the unbiased wage, and for each state there is a uniquely-defined probability of failure that maximizes Shareholder welfare.

CEO wages would fall by 4.7% on average, and at the 25th percentile wages would decrease by 8.6%. Firm value value increases, but marginally. By enforcing a much higher degree of

Table E.2. Counterfactual analysis: Eliminating the Shareholder cost to SOP failure
This table displays a counterfactual related to changing the Shareholder costs to SOP failure. I display the counterfactual in which I change χ_S to 0. The first row displays the counterfactual SOP failure rate. Rows 2 and 3 display the counterfactual percentage change in wages and firm value. To compute these changes, I re-solve the counterfactual model, applying the same sequence of shocks to each firm. I solve for optimal choices, and solve for the percentage change in each quantity at the observation level. I then display the average percentage change, along with the 25th, 50th and 75th percentiles.

	Mean	**25%**	**50%**	**75%**
SOP failure rate	41.68%			
Percent change in				
Wages	-4.74%	-8.64%	-2.97%	0.00%
Firm value	+0.47%	+0.18%	+0.22%	+0.53%

SOP failure, there are states when shareholders over-discipline the Board. That is, while wages being kept low for bad CEOs is good, it may often be the case that the Board's signal means the CEO is talented and should be paid more. It is worth commenting on the relative value effects in Table 7 (removing the Board cost to SOP failure) and Table E.2 (removing the Shareholder cost). The estimation shows that the Board cost is larger: equivalent to 2.06% of value, relative to 0.76% for shareholders. The relative value effect of these two counterfactuals depends on the relative magnitude of these cost parameters.

Summing up, this counterfactual shows that, while the shareholder cost to SOP failure keeps the SOP failure rate low and leads to the Board paying the CEO a higher wage, the impact of removing this cost on value is moderate. SOP is already effective at disciplining the Board — SOP failure is costly enough to the Board to keep wages down. My analysis in Section 6 shows that changing the structure of SOP to give shareholders more input into the compensation decision would lower wages (on average) and positively impact firm value. Further, removing this cost is likely too drastic of a change to preferences, and probably renders this counterfactual invalid.