Board Compensation and Investment Efficiency*

Martin Gregor[†] Beatrice Michaeli[‡]

January 30, 2023

*We thank Michael Ebert, Felix Feng, Phil Stocken, Morten Sorensen, and participants at Stony Brook Game Theory Conference, Dartmouth, and University of Paderborn for helpful comments and suggestions. Martin Gregor acknowledges financial support from the Czech Science Foundation (GAČR 20-03517S) and the Cooperatio Program at Charles University.

[†]Martin Gregor is at the Institute of Economic Studies, Faculty of Social Sciences, Charles University, and can be reached at martin.gregor@fsv.cuni.cz.

[‡]Beatrice Michaeli is at UCLA Anderson School of Management, and can be reached at beatrice.michaeli@anderson.ucla.edu.

Board Compensation and Investment Efficiency

Abstract: We analyze the optimal contracts offered to an empire-building CEO and a reputation-concerned board when the CEO persuades the board to approve an investment project. We show that lack of downward flexibility about the board's or the executive payments generates shareholders' tradeoff between size and share of profits. The shareholders choose between contracts for which profits are large but also compensations of the CEO and board are large and contracts for which profits and compensations are low. Contracts that generate excessive investments and low profits are optimal if the CEO's outside option on the labor market is not very attractive, the CEO's empire-building benefit is large, the board's outside option is high, and board's reputational concern about monitoring is large whereas board's concern about project success is low. We show that the optimal contracts involve stocks but not options and the variable parts of the CEO's and the board's compensations are substitutes. Additionally, given existence of structural changes associated with reallocation of incentives across agents, both CEO's and boards' characteristics affect information quality and company profits in a non-monotonic manner.

Keywords: board monitoring, director compensation, CEO compensation, Bayesian persuasion

1 Introduction

How to motivate corporate boards if their primary task is to approve risky projects that the CEO is interested in pursuing? A large body of literature documents that certain individual directors' characteristics, such as accounting and finance expertise, legal, consulting and industry experience, management experience, prior board experience and independence, enhance the boards' monitoring capacity and corporate outcomes (Field and Mkrtchyan 2017; Adams, Akyol and Verwijmeren 2018; Erel, Stern, Tan and Weisbach 2021). Little is known, however, about the effects of compensation structure (cash, stocks, and options), the interplay between directors' nonfinancial characteristics and financial compensation, and the optimal mix of CEO's and board's compensation structures.

This paper examines the optimal contracts offered to CEOs and boards in a classic economic setting where a centralized (outsider-controlled) board approves or rejects an investment opportunity presented by an empire-building CEO (Adams and Ferreira 2007; Harris and Raviv 2008; Baldenius, Melumad and Meng 2014; Baldenius, Meng and Qiu 2019; Gregor and Michaeli 2022). The CEO has a tendency to overinvest due to private perks and delivers an optimally constructed but credible signal about the investment project to the board (e.g., estimate of the project success based on legal and regulatory advice, an efficiency test or safety experiment). The board has nonfinancial—career or reputation related—concerns; it incurs a private cost when the approved project destroys the company value (monitoring concern) and earns a private benefit when it enhances the value (entrepreneurial concern).

When solving for the optimal contracts, we impose lower bounds on contingent transfers to the agents (limited liability constraints). We ask if the constraints motivate shareholders to offer contracts that generate imprecise project information and excessive investments, even if achieving profit-maximizing investments is contractually feasible. In addition, we study the optimal structure of variable compensation of the board and the CEO in the presence of the bounds. Our key observation is that offering incentive-compatible contracts from a contracting space with limited liability constraints often generates agency rents, and the optimal contracts must balance benefits of incentives (higher information quality) with costs of incentives (agency rents). In contrast, without limited liability constraints, rents disappear, and perfect project information is achieved in the optimum.

We examine two contracting frameworks that involve limited liabilities. First, we analyze optimal contracting in a broad contracting space where ex post contingent transfers are only limited to be non-negative (*limited liability contracting*). Richness of this set of the available offers has implications especially for board compensation; for instance, board's conservatism can be elicited simply by rewarding status quo. In *project ownership contracting*, the agents receive a non-negative salary and shares to the project. Therefore, the contingent transfers are linear in the project value which substantially restrains the contracting space. As a result, board's conservatism cannot be elicited by rewarding specifically status quo but only by providing enough amount of shares. In addition, when board's private monitoring concerns are strong, shares crowd out this nonfinancial motivation which effectively decreases board's conservatism. Irrespective of these differences, however, we demonstrate that both frameworks yield qualitatively identical predictions.

We provide two sets of results: positive and normative. Our positive results are about the effects of variable financial compensation (bonuses and penalties) on the incentives of the players, i.e., on the CEO's willingness to prepare a precise signal and the board's willingness to approve the project. We show that overinvestments (arising due to low precision of the CEO's signals and the board's willingness to approve projects with imprecise information) can be addressed either *directly* or *indirectly*. The direct way is to incentivize the CEO to produce precise information, and the indirect way is to make the board highly skeptical and consume only precise information, which subsequently forces the CEO to produce precise information (Gregor and Michaeli 2022).

The direct way aligns the CEO's preferences over project adoption with those of the shareholders. When variable compensation is determined by project ownership, the direct way is to offer a sufficiently large ownership to the CEO. When variable compensation is determined by limited liability constraints, the direct way is to reward the CEO for the status quo. The indirect way to increase the quality of information is to make the board highly conservative which motivate the CEO to send a more precise signal. Again, this requires either a reward for the status quo (limited liability contracting) or shares (project ownership contracting). However, shares have a dual effect on information. On the one hand, board ownership increases the board's stakes involved in the approval decision which, all else equal, motivate the CEO to send a more precise signal. On the other hand, providing shares to directors crowds out their nonfinancial (e.g., career-related) concerns and this may be detrimental to information quality. In our stylized model of ownership, this difference delivers that boards never receive shares irrespective of whether the shareholders find it optimal offer shares to the CEO or not.

The key implications of the ownership transfers and rewards for the status quo is that the incentivized agents earn rents. This implies that the direct and indirect ways to reduce investment inefficiency are not used jointly: incentives to executive and non-executive directors (board) are *substitutes*. The shareholders' core contracting decision can be then presented as a decision on which player deserves the financial incentives. When making this choice, the shareholders compare project profits and rents. Typically, a tradeoff exists. The shareholders choose between (i) high company profits and high rents (this outcome is associated with shares or rewards provided only to the CEO) versus (ii) low company profits and low rents (this outcome is associated with rewards provided only to the board). We focus on conditions under which the shareholders sacrifice profits for rents. This occurs when the CEO's private (empire-building) benefit from approval is high, the CEO's labor market value (outside option) is low, the board's outside option is high, and the board has high monitoring concerns and low entrepreneurial concerns. In these situations, eliminating the CEO's bias directly is too costly to the shareholders, and the shareholders are willing to tolerate excessive investments instead.

Our paper contributes to the literature on career concerns of non-executive directors. Prior literature has documented that such concerns exist when directors' reputation for high-quality monitoring is rewarded in the labor market, mainly in the form of outside directorships (which bring additional compensation, prestige, and experience) but also in lower regulatory sanctions imposed in case of company frauds (Jiang, Wan and Zhao 2016). Career concerns are found to be high for young directors, directors with large numbers of independent directorships, directors with high media exposure and in companies with high market capitalization (Masulis and Mobbs 2014). Prior literature finds that career-concerned directors do not receive performance-sensitive compensation (Fama and Jensen 1983). Such substitution effect arises also in our model. We find that variable financial compensation negatively affects the willingness of boards with high career concerns to approve projects, which decreases the shareholders' willingness to financially compensate directors by stocks. This implies that, for directors, financial and nonfinancial incentives are substitutes. At the same time, as the shareholders jointly choose both the CEO's and the board's contracts, we identify a cross-effect of the boards' career concerns on executive compensation due to substitution of financial incentives of the CEOs and the boards. This cross effect may eventually increase the shareholders' willingness to financially compensate directors by stocks.

Our model introduces two dimensions of nonfinancial (career) concerns, namely reputation cost of project failures and reputation benefit of project successes. When nonfinancial concerns reflect reputation for general firm performance (Yermack 2004), the structure of nonfinancial incentives is very similar to the structure of financial incentives. In a knife-edge case when the reputation benefits are linear in the company value, more intensive career concerns are equivalent to receiving higher variable compensation in stocks. Typically, however, intense career concerns have a different structure than financial incentives: Reputation benefits are non-linear in company value because directors' reputation is affected only in specific reputation-relevant outcomes (e.g., lawsuits, proxy contest nominations, or successful rescissions of takeover defenses). On the side of CEOs, we suppose their nonfinancial benefits are mostly dominated by their interest in carrying out pet projects or similar empire-building benefits (Décaire and Sosyura 2021). In addition, existing CEOs' reputation considerations seem to be directly related to the financial side of incentives: Edmans, Gosling and Jenter (2021) signal that the executive compensation is constructed with the idea that it is the pay that serves as recognition and a signal for the market.

We also contribute to the literature on the total compensation of non-executive directors. The literature on the role of director's compensation and board monitoring primarily stresses that the director's compensation reflects the market value of director's characteristics (financial expertise, legal and consulting expertise, academic qualifications, management experience and directors' skill set).[1] Within boards, directors with more valuable characteristics are compensated primarily through the assignment of roles in the board: more qualified directors are assigned more roles (board chairman, lead director, serving or chairing committees) which tops their annual retainer (Fedaseyeu et al., 2018). We show that the shareholders find it optimal to allocate financial incentives and rewards primarily to board with a high outside option, and thus more likely allocate rents to initially valuable non-executive directors. This discrimination mechanism reinforces their initial advantages on the valuable directors on directors' labor market.

Regarding executive compensation, our paper focuses exclusively on the shareholders' optimal way to treat managerial overinvestment that follows from limited liability. In

[1] For recent papers about directors' characteristics and corporate outcomes, see Field and Mkrtchyan (2017), Adams et al. (2018) and Erel et al. (2021).

particular, there is no role for risk-sharing, incentivizing costly implementation effort, or for limited liability as protection of the players again unforseen risks. Our perspective is thus orthogonal to classic executive contracting issues, especially in a multi-tasking context (Göx and Hemmer 2021). Given an exogenous project type, we do not address the role of CEO's equity incentives at the project selection stage (e.g., when project selection signals CEO's quality as in Dominguez-Martinez, Swank, and Visser, 2008), and focus exclusively on the role at the signaling stage. The differential effects of executive compensation on the different board roles are analyzed, among others, in Chen, Guay and Lambert (2022). Our results on the structure of the CEO's variable compensation schemes are close to Laux (2014), where the options increase the CEO's incentives to manipulate information. Our analysis thus adds to the recently observed adverse role of options provided to the management (Shue and Townsend 2017; Liu, Masulis and Steinfeld 2021).

Our paper also speaks to the CEO-director compensation nexus: Empirically, the CEO's and the board's compensation levels are positively related, and this association is stronger with greater CEO's control and power, manifested either in co-optation of the directors by the CEO (Coles, Daniel and Naveen 2014), the CEO-chairman duality (Fedaseyeu, Linck and Wagner 2018), the low extent of monitoring by institutional investors (Chen, Goergen, Leung and Song 2019), or the excessive use or related-player transactions (Hope, Lu and Saiy 2019). However, the association may also reflect other unobserved time-varying firm effects such as nature of projects (most studies account for firm fixed effects). Kim, Kwak, Lee and Suk (2019) find that CEO and director equity compensation are substitutes when the outcome variable are financial disclosure policies.

Finally, we provide a novel perspective on the CEO-board interactions that combines persuasion and optimal contracting (Göx and Michaeli 2019). Persuasion perspective on CEO-board interactions is built on the idea that with proliferation of data analytic techniques and rich underlying data (both internal and external), the management is better off with selecting a (credible) signaling technology instead of leaving information transmission to soft communication (Gregor and Michaeli 2022). Therefore, with the explosion of analytical technologies, the board's advisory role is less important and the board's monitoring problem becomes of central importance. In the extreme, the advisory role is fully eliminated by the CEO's unrestricted and costless access to signaling structures.

2 Model

We consider a CEO ("she") and a corporate board of directors. The CEO comes across an investment opportunity ("project") which is approved or rejected by the board. The project requires an upfront investment normalized to one. The project can be successfully implemented only if a certain exogenous event (e.g., a regulatory change) is realized. We denote this event by $\omega \in \{0, 1\}$. In case of success ($\omega = 1$), the project yields a known return of $r > 0$. In case of failure ($\omega = 0$), the firm loses the investment.

Information structure. The players share a common prior belief $\mu \equiv \Pr(\omega = 1) > 0$ about the realization of the exogenous event and success of the project. We assume that the prior belief is bounded from above, $\mu < \frac{1}{1+r}$. This assumption implies that the project's expected value is negative and is rejected by the board in the absence of further information.[2] After coming across the project, the CEO obtains a signal about ω (e.g., seeks expert opinion about a regulatory change). Since the board's decision is binary—approve or reject the project—it is sufficient to consider a binary signal with high and low realizations, $s \in \{h, l\}$. The signal can be characterized either by the probabilities of the realizations, (p_l, p_h) where $p_s \equiv \Pr(s)$ or, equivalently, by the induced posterior beliefs, (μ_l, μ_h), where $\mu_s \equiv \Pr(\omega = 1 \mid s)$ and $\mu_l \leq \mu \leq \mu_h$. The two characterizations are linked

[2] When the expected value is positive, the solution to the CEO's problem is interior only if financial incentives are sufficiently strong. This does not affect our main results. For details see footnote 10.

by the martingale property, which is $p_l\mu_l + p_h\mu_h = \mu$ for a binary state space.[3] Subject to the martingale constraint, the CEO chooses the properties of the signal (e.g., chooses an expert). In line with the practical setting we have in mind and the Bayesian persuasion literature, the signal properties are observable (e.g., expert qualification is known) and the signal realization is verifiable (e.g., written expert opinion is available within the company and can be verified).[4]

Contracts. There are three contractible outcomes: the project is rejected (indexed by "$\varnothing$"), the project is approved but fails (indexed by "0") and the project is approved and succeeds (indexed by "1"). As frequently observed in practice, contracts cannot depend on signal properties and realization (e.g., the CEO's contract can not specify the expert that she needs to seek advice from in case she encounters an investment project; it also cannot depend on a future expert opinion). The CEO's outcome-contingent salary is $(x_0, x_\varnothing, x_1)$ and that of the board is $(y_0, y_\varnothing, y_1)$. A possible interpretation of the salaries is that $x_\varnothing$ and $y_\varnothing$ are base/fixed pay, $x_\varnothing - x_0$ and $y_\varnothing - y_0$ are liability payments (penalties) in the event of failed investment, and $x_1 - x_\varnothing$ and $y_1 - y_\varnothing$ are payments (bonuses) for investment success.[5]

We solve the optimal contracting problem in two settings. In *Limited liability contracting*, all salaries are restricted by a uniform low bound normalized to zero. Formally, $(x_0, x_\varnothing, x_1) \in \mathbb{R}^3_+$ and $(y_0, y_\varnothing, y_1) \in \mathbb{R}^3_+$. In *Project ownership contracting*, the payoffs after rejection (fixed salaries) are again non-negative, $x_\varnothing \geq 0$ and $y_\varnothing \geq 0$. But the penalties and bonuses follow from the project ownership shares of the CEO and

[3] Another way of describing the public signal is by considering the probability of a signal realization conditional on the state ω. This can easily be derived from the distribution (p_l, p_h) and the beliefs (μ_l, μ_h) using Bayes rule, e.g., $\Pr(h \mid \omega) = \frac{\Pr(\omega|h)\Pr(h)}{\Pr(\omega)}$ for $\omega \in \{0, 1\}$. For instance, $\Pr(h \mid \omega = 1) = \frac{\mu_h p_h}{\mu}$.

[4] In our model, the board does not gather information. As in Gregor and Michaeli (2022), if this assumption is relaxed, the CEO adjusts the properties of the signal just enough to discourage the board from learning. Our main results remain qualitatively similar.

[5] We will show that bonuses for failed investments are not imposed in the optimum, i.e., $x_\varnothing - x_0 > 0$ and $y_\varnothing - y_0 > 0$. But penalties for investment success can be optimal in certain cases, i.e., $x_1 - x_\varnothing$ and $y_1 - y_\varnothing$ can be positive or negative.

the board denoted $\alpha \in [0,1]$ and $\beta \in [0,1]$, respectively. In this setting, the vector of CEO's payments is $(x_0, x_\varnothing, x_1) = (x_\varnothing - \alpha, x_\varnothing, x_\varnothing + \alpha r)$ and that of the board is $(y_0, y_\varnothing, y_1) = (y_\varnothing - \beta, y_\varnothing, y_\varnothing + \beta r)$. Thus, there are two differences to limited liability contracting: penalties and bonuses are set less arbitrarily (satisfy a fixed proportion), but the liability constraints can be shifted; in particular, the lower bounds in the event of project failure are not zero but $x_\varnothing - \alpha$ and $y_\varnothing - \beta$.[6]

Nonfinancial incentives and outside options. In addition to their salaries, the players have nonfinancial incentives. The CEO's outcome-contingent nonfinancial incentives are $(c_0, c_\varnothing, c_1)$ and those of the board are $(b_0, b_\varnothing, b_1)$. We let $c_\varnothing = b_\varnothing = 0$. The CEO's nonfinancial payoffs from project approval are positive and $0 < c_0 \leq c_1$. This ordering reflects the CEO's empire-building tendency. For the board we assume $b_0 < 0 < b_1$. Put differently, b_1 is a nonfinancial (e.g., reputation) benefit from a project success and $-b_0$ is a disutility from project failure. To avoid corner solutions, we assume that the expected board's nonfinancial incentive is negative, $\mu < \frac{-b_0}{b_1 - b_0}$.

The total expected payoffs of the CEO and board are denoted U and V and their outside options (reservation payoffs reflecting labor market values) are $\underline{U}$ and $\underline{V}$, respectively. The outside options for executive and non-executive directors are sufficiently attractive, $\underline{U} > \mu c_1$ and $\underline{V} > \mu b_1$. This assumption means that nonfinancial benefits from working for a fully-informed company are insufficient and, without monetary compensation, both agents would leave. In addition, the ex ante expected payoff of the shareholders is denoted S, and the total payoffs for all players (total value) is denoted W, where $W = S + U + V$. Surplus is a difference between the total value and reservation values, $W - \underline{U} - \underline{V}$.

CEO's types and regimes. Based on her total (financial and nonfinancial) payoffs, the CEO is either "normal" or "empire-builder." We say that the CEO is normal if

[6] We assume project ownership and not company ownership. In other words, salaries of the agents are paid by the initial shareholders and therefore agents owning company shares don't internalize these sunk costs. Inclusion of salaries into the contractible company value doesn't change the results. Analysis is available upon request.

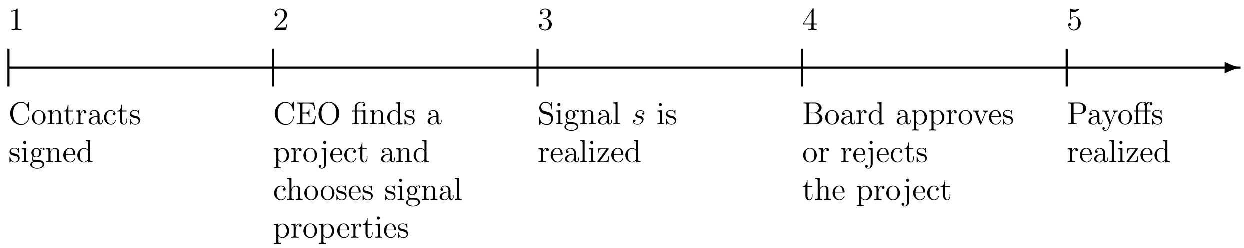


Figure 1: Timeline of the events

$x_1 + c_1 \geq x_{\varnothing} \geq x_0 + c_0$, i.e., if her ex post payoff (weakly) increases when the project is approved and succeeds and (weakly) decreases when the project is approved and fails. The CEO is empire-builder when $x_\omega + c_\omega > x_{\varnothing}$ for $\omega \in \{0, 1\}$, i.e., if her ex post payoff increases when the project is approved, regardless of the project success. The assumption $c_0 < 1$ ensures that financial compensation can change the CEO's type to normal.[7] Board type is defined by analogy but it turns out that only a normal board is relevant in the optimum and the other types can be disregarded.[8] Throughout the analysis, we therefore differentiate between two *regimes*: under "A-form" both players are normal (have aligned interests) and under "M-form" the CEO is an empire-builder and the board is normal (have misaligned interests). Regimes can be introduced as sets of feasible contracts that induce players' types as defined above.

Timeline. Figure 1 illustrates the timeline of events. At date 1, the shareholders offer contracts to the CEO and the board.[9] If they accept, the company is established; otherwise, the game ends and all players receive their reservation payoffs (outside options). At date 2, the CEO finds a project with a publicly observed success probability μ and

[7]In the case of project ownership, a CEO compensated with a sufficiently large amount of shares, $\alpha \in (c_0, 1]$, is normal.

[8]In particular, because $b_0 < 0 < b_1$, the board is normal in the absence of financial compensations. In the project ownership contracting, normality is preserved under any feasible contract.

[9]We briefly discuss the outcome if shareholders contract with the board and the latter with the CEO in footnote 20.

potential return r and chooses the signal properties. At date 3, the CEO's signal is realized and observed by the board. At date 4, the board approves or rejects the project. At date 5, all players receive their ex post payoffs. We restrict attention to weakly undominated strategies; therefore, we avoid miscoordination on a Pareto-dominated equilibrium which occurs when each agent expects that the other player rejects the contract, and therefore both reject the contract.

3 Preliminaries

3.1 Board's approval

At date 5, after observing the CEO's signal, the board approves the project if and only if its interim (post-signal) belief about project success, μ_h or μ_l, exceeds a threshold

$$\tau \equiv \frac{y_{\varnothing} - (y_0 + b_0)}{y_{\varnothing} - (y_0 + b_0) + (y_1 + b_1) - y_{\varnothing}}.$$

The board's threshold τ depends on the relative magnitude of the total (financial and nonfinancial) loss from approving a failing project, $y_{\varnothing} - (y_0 + b_0)$, and the total gain from approving a successful project, $(y_1 + b_1) - y_{\varnothing}$. Note that $\tau \in [0, 1]$ since the board is normal. Because τ can be interpreted as the extent to which the board is prudent when approving the project, we refer to this cutoff posterior as the board's "prudence."

3.2 CEO's signal

We next consider the CEO's choice of signal properties at date 3. Because the CEO's preferences over outcomes are regime-specific (i.e., depend on whether we are under the A-form or under the M-form), her signaling choices are also regime-specific. Under the A-form, the CEO is normal—thus, she prefers that the board's project decisions avoid unprofitable investments and approve all profitable investments. A sufficient condition for this is that the (normal) board knows whether the project is successful or not. Therefore, in a weakly undominated equilibrium, the CEO chooses a perfectly informative signal,

$$(\mu_l^A, \mu_h^A) = (0, 1).$$

From ex ante perspective, the board approves the project after a high signal h (with frequency μ) and rejects it after a low signal (with frequency $1 - \mu$).

Under the M-form, the empire-building CEO seeks to maximize the probability that the project is approved. The solution to this classic CEO's persuasion problem is to send a binary signal that is a (Bayes-plausible) lottery over posteriors[10]

$$(\mu_l^M, \mu_h^M) = (0, \tau).$$

Ex ante, the board now approves the projects after a high signal (with frequency $\frac{\mu}{\tau}$) and rejects after a low signal (with frequency $1 - \frac{\mu}{\tau}$). The signal properties are such that the posterior belief after high signal is optimally adjusted to the board's prudence—just high enough for the board to approve the project. The most precise signal under the M-form is thus when τ achieves its highest value of one.

Under both forms, $\mu_l = 0$, so there are no Type-I errors (false rejections). The information quality of the signal is characterized only by μ_h and we refer to it as the *precision* (quality) of the signal. When interests are misaligned (M-form), there is a one-to-one mapping between board's prudence and CEO's quality of information. When interests are aligned (A-form), the board's prudence is irrelevant.

[10]Our model assumes that μ is low enough so that the prior expected values of the project and that of the board's nonfinancial benefit are negative. This implies that $\tau > \mu$ and therefore the constraint $\mu_h > \mu$ is always satisfied. If any of the two above-mentioned expected values were positive, we might obtain $\tau < \mu$. Then, the constraint $\mu_h \geq \mu$ is binding, and the CEO sends a binary signal as a lottery over posteriors $(0, \max\{\mu, \tau\})$. This only flattens the effect of financial incentives on the quality of information but doesn't change our main results.

3.3 Procedure for deriving the optimal contracts

In both contracting settings, we solve the shareholders' contracting problem in two steps. We first derive the contracts that are optimal under each regime ("regime-optimal" or "regime-specific" contracts) and then consider the shareholders' preference over the regimes (i.e., preference over outcomes induced by the regime-optimal contracts).

Step 1: Regime-specific contracts. The players' values induced by the regime-optimal contracts in regime $k \in \{A, M\}$ are denoted U^k, V^k, S^k and W^k. The CEO's rent is $R_C^k = U^k - \underline{U}$ and the board's rent is $R_B^k = V^k - \underline{V}$. In any regime, we construct the regime-optimal contract for an agent by employing another two-step procedure. First, we find the shareholders' payoff-maximizing contract for an agent that complies with the agent's regime-specific incentive constraints (e.g., the agent's normality) but not necessarily with the agent's participation constraint. The agent's ex ante expected payoff associated with this contract, denoted $\underline{U}^k$ and $\underline{V}^k$, can be interpreted as the minimal agent's payoff that generates agent's incentives required for the existence of the regime. Second, we consider participation constraint of the agent. (i) If the participation constraint is satisfied with the contract found in the first step, $\underline{U}^k \geq \underline{U}$, respectively $\underline{V}^k \geq \underline{V}$, the contract is regime-optimal for the agent and the agent receives a rent, $R_C^k = \underline{U}^k - \underline{U}$, respectively $R_B^k = \underline{V}^k - \underline{V}$. The rent level depends on the looseness of the participation constraint. (ii) If the participation constraint is not satisfied with that contract, $\underline{U}^k < \underline{U}$, respectively $\underline{V}^k < \underline{V}$, a more attractive contract is offered.[11]. In such case, the participation constraint binds and the agent earns zero rent. To summarize, under the regime-optimal contracts

$$(U^k, V^k) = \left(\max\{\underline{U}^k, \underline{U}\}, \max\{\underline{V}^k, \underline{V}\}\right).$$

[11]Given that transfers are not restricted from above, this is always possible without violating incentive constraints

Step 2: Regime choice. The shareholders' regime choice maximizes

$$S^k = W^k - U^k - V^k = W^k - R_C^k - R_B^k - \underline{U} - \underline{V}$$

over $k \in \{A, M\}$ and depends on how the outcomes generated by regime-specific contracts compare in two dimensions: the total value W and the total rents $R_C + R_B$.

3.4 Unconstrained contracting benchmark

Before analyzing the optimal contracts in depth, we briefly present a benchmark where the contracting space is not restricted, $(x_0, x_\varnothing, x_1) \in \mathbb{R}^3$ and $(y_0, y_\varnothing, y_1) \in \mathbb{R}^3$.

We begin by describing the regime-specific contracts. Under the A-form, the key incentive compatibility constraint is the *CEO's normality*, $x_0+c_0 \leq x_\varnothing \leq x_1+c_1$. Consider a CEO's contract that (i) imposes a financial penalty (negative transfer) $x_0^A = -c_0 < 0$ for project failure to eliminate the effect of a positive nonfinancial benefit under the project failure; (ii) provides financial bonus (positive transfer) $x_1^A = -c_1 + \frac{1}{\mu}\underline{U} > 0$ for project success to motivate CEO's participation; and (iii) pays nothing for project rejection, $x_\varnothing^A = 0$. With this contract, the CEO's normality is achieved since her outcome-contingent total payoffs are $(x_0^A + c_0, x_\varnothing^A, x_1^A + c_1) = \left(0, 0, \frac{1}{\mu}\underline{U}\right)$. In the board's case, nonfinancial benefit under the project failure is negative and therefore the board doesn't need extra financial incentives to become normal, $y_0^A = y_\varnothing^A = 0$. It is only necessary to encourage board's participation, e.g., by providing a bonus $y_1^A = -b_1 + \frac{1}{\mu}\underline{V} > 0$ for project success. Under this contract, the board is normal and its outcome-contingent payoffs are $(y_0^A + b_0, y_\varnothing^A, y_1^A + b_1) = \left(b_0, 0, \frac{1}{\mu}\underline{V}\right)$. As the perfectly informative signal generates a lottery $(1-\mu, \mu)$ over project rejection and project success, the CEO and the board earn exactly their reservation payoffs, $U^A = \underline{U}$, and $V^A = \underline{V}$.[12] In other words, participation

[12]For both agents, the transfer in the event of project success is non-negative, since $\underline{U} \geq \mu c_1$ and $\underline{V} \geq \mu b_1$. Note that the regime-optimal contracts are not uniquely optimal. For each agent, there are several ways to provide transfers such that the expected value in the regime equals the agent's reservation

constraints of both agents are binding, and both agents earn zero rents. In other words, the shareholders appropriate full surplus.

Under the M-form, the key incentive compatibility constraint for the board is the *maximal prudence*, $\mu_h = \tau = 1$, for which the necessary (and sufficient) condition is $y_0 + b_0 < y_\varnothing = y_1 + b_1$.[13] To meet this constraint along with the board's participation constraint, an optimal board's contract offers $y_0^M = y_\varnothing^M = \underline{V} > 0$ and $y_1^M = -b_1 + \underline{V}$, where y_1^M can be negative. With this contract, the board's outcome-contingent payoffs are $(y_0^M + b_0, y_\varnothing^M, y_1^M + b_1) = (b_0, \underline{V}, \underline{V})$. Moving to the CEO, we note that she must remain an empire-builder under the M-form, $x_\varnothing \leq x_1 + c_1$. To preserve her empire-building status and ensure her participation, the CEO is offered a bonus for project success, $x_1^M = -c_1 + \frac{1}{\mu}\underline{U} > 0$ and $x_0^M = x_\varnothing^M = 0$. The CEO's outcome-contingent payoffs are $(x_0^M + c_0, x_\varnothing^M, x_1^M + c_1) = \left(c_0, 0, \frac{1}{\mu}\underline{U}\right)$. Similar to the A-form, the signal precision is perfect, and with these financial transfers, participation constraints of both agents are just binding, $U^M = \underline{U}$ and $V^M = \underline{V}$. As a result, the surplus is maximal, no rents are left to the agents, and the shareholders under the (regime-optimal) M-form appropriate the maximal feasible surplus exactly like under the (regime-optimal) A-form.

To summarize, both regimes generate maximal surplus that the shareholders can *fully* seize (no rents). They are thus indifferent between implementing either of the regimes.

4 Limited liability contracting

The preceding discussion illustrated that the agency problem can be fully resolved if no contracting restrictions exist. Achieving this outcome may require zero base pay and imposing ex post penalties even after the implemented project succeeds. Such contracts are extremely uncommon in practice. In this section, we turn to the more realistic scenario

value and her incentive constraints are not violated.

[13]It is easy to see that less than maximal prudence, $\tau < 1$, is not optimal as it destroys some surplus without saving any rents, because rents under maximal prudence are zero.

where where all outcome-contingent payments are non-negative, i.e., the agents can not be penalized for working in the company.

4.1 A-form contracts

Our preliminary analysis in Section 3.2 illustrated that the A-form is associated with perfect information quality, $(\mu_h, \mu_l) = (1, 0)$ and thereby generates maximal total value $\overline{W}$. As a result, the shareholders' contracting problem reduces to minimization of total rents for the agents.[14]

Lemma 1 (Liability contracting, A-form)**.** *The CEO's A-form contract is*

$$(x_0^A, x_\varnothing^A, x_1^A) = \left(0, c_0, \tfrac{1}{\mu}\max\{\underline{U} - \underline{U}^A, 0\}\right),$$

where $\underline{U}^A = (1-\mu)c_0 + \mu c_1$ *is the CEO's payoff under the contract that complies only with her incentive and liability constraints. The board's A-form contract is*

$$(y_0^A, y_\varnothing^A, y_1^A) = (0, \underline{V} - \mu b_1, \underline{V} - \mu b_1).$$

The CEO's expected payoff is $U^A = \max\{\underline{U}^A, \underline{U}\}$ *and that of the board is* $V^A = \underline{V}$*.*

Under the A-form contracts, the shareholders' payoff is $S^A = \overline{W} - \underline{U} - \underline{V} - R_C^A$. They fail to seize the maximal surplus under the A-form only when incentivizing the CEO's alignment generates a positive CEO's rent.

4.2 M-form contracts

Depending on the agent's compensation, the signal precision under the M-form can be imperfect and yield less than the maximal total value, $W^M \leq \overline{W}$. Now the shareholders'

[14]Since the contracting set of each agent is independent of the contract offered to the other agent, the problem can be decomposed into minimization of the CEO's rent and minimization of the board's rent, each subject to corresponding incentive, liability and participation constraints.

contracting problem is richer as it involves both dimensions, i.e., maximization of total value (or profits) and minimization of rents. To maximize shareholder's payoff in both dimensions, we separate the problem into two natural steps: In this section, we fix precision (and consequently also W) under the M-form which is equivalent to fixing board's prudence τ, and seek contracts that minimize rents conditionally on τ. We call these contracts (optimal) *τ-specific* M-form contracts. In the subsequent section, we pick up the best of these τ-specific contracts.

To find τ-specific M-form contracts, we will proceed in two steps. In Step 1, for each agent, we first derive a contract that minimizes the agent's payoff such that all agent's incentive constraints are satisfied (but not necessarily the agent's participation constraint). We denote these minimized payoffs $\underline{U}_\tau^M$ and $\underline{V}_\tau^M$. Then, in Step 2, we add the participation constraints and obtain minimized payoffs U_τ^M and V_τ^M.

Lemma 2 (Liability contracting, τ-specific M-form)**.** *The optimal CEO's τ-specific M-form contract in liability contracting is*

$$x_{\tau,0}^M = x_{\tau,\varnothing}^M = x_{\tau,1}^M = \max\{\underline{U} - \underline{U}_\tau^M, 0\},$$

where $\underline{U}_\tau^M = \mu\frac{1-\tau}{\tau}c_0 + \mu c_1$ is the CEO's payoff in the optimal CEO's contract that complies only with her incentive and liability constraints. The optimal board's τ-specific M-form contract in liability contracting is

$$y_{\tau,0}^M = y_{\tau,1}^M = \max\{\underline{V}_\tau^M - \underline{V}, 0\}; y_{\tau,\varnothing}^M = \max\{\underline{V}_\tau^M, \underline{V}\},$$

where $\underline{V}_\tau^M = \max\{(1-\tau)b_0 + \tau b_1, 0\}$ is the board's payoff in the optimal board's contract that complies only with board's incentive and liability constraints. The CEO's ex ante expected payoff is $U_\tau^M = \max\{\underline{U}_\tau^M, \underline{U}\}$, and the board's ex ante expected payoff is $V_\tau^M = \max\{\underline{V}_\tau^M, \underline{V}\}$.

Observe that a change in τ changes $\underline{U}_\tau^M$ and $\underline{V}_\tau^M$ in the *opposite* directions. In particular, $\underline{U}_\tau^M$ is decreasing and then flat; a kink is located at the precision level denoted τ_C where $\underline{U} = \underline{U}_\tau^M$. In contrast, $\underline{V}_\tau^M$ is flat and then increasing; a kink is located at the precision level denoted τ_B where $\underline{V} = \underline{V}_\tau^M$. This means that increasing signal precision has (weakly) opposite effects on rents; a higher precision is (weakly) reducing the CEO's rent but also (weakly) increasing the board's rent.[15]

4.3 Optimal precision under the M-form

Once τ-specific M-form contracts (and values induced by these contracts) are known, we can proceed with identification of the optimal τ_M. With an increase in board's prudence (and consequently an increase in signal precision), there are three effects on the shareholders' payoff $S_\tau^M = W_\tau^M - \underline{U} - \underline{V} - R_{C,\tau}^M - R_{B,\tau}^M$: (i) a positive effect due to an increase in the project surplus (as W_τ^M is increasing in τ), (ii) a (weakly) positive effect due to a decrease in the CEO's rent (as $\underline{U}_\tau^M$ is weakly decreasing in τ), and (iii) a (weakly) negative effect due to an increase in the board's rent (as $\underline{V}_\tau^M$ is weakly increasing in τ). Fig. 2 illustrates.

The marginal effect on the project surplus is continuous, whereas the marginal effects on rents are potentially *discontinuous* due to kinks in the rent functions. It is exactly the possible existence of discontinuities in S_τ^M on the interval $\tau \in [\mu, 1]$ that leads to the existence of at most five possible types of the optimum. Two corner types are in the kinks of the rent functions $R_{B,\tau}^M$ and $R_{C,\tau}^M$ (τ_B and τ_C) and two interior types (τ_S and τ_D) are located at levels where marginal effects cancel out; these levels exceed the board's kink τ_B In addition, setting a perfect signal quality is an additional candidate for a (corner type) optimum. Notice that a type is relevant only if it falls into the interval $\tau \in [\mu, 1]$.

[15]The specific values of τ_B and τ_C are derived in Lemma 3. Notice also that $\tau_C < 1$ follows from the assumption that the CEO must be financially compensated if she works in a company where investments are without distortions, $\underline{U} > \mu c_1$. In contrast, the assumption that the board must be financially compensated if she works in this company doesn't imply either $\tau_B < 1$ or $\tau_B \geq 1$.

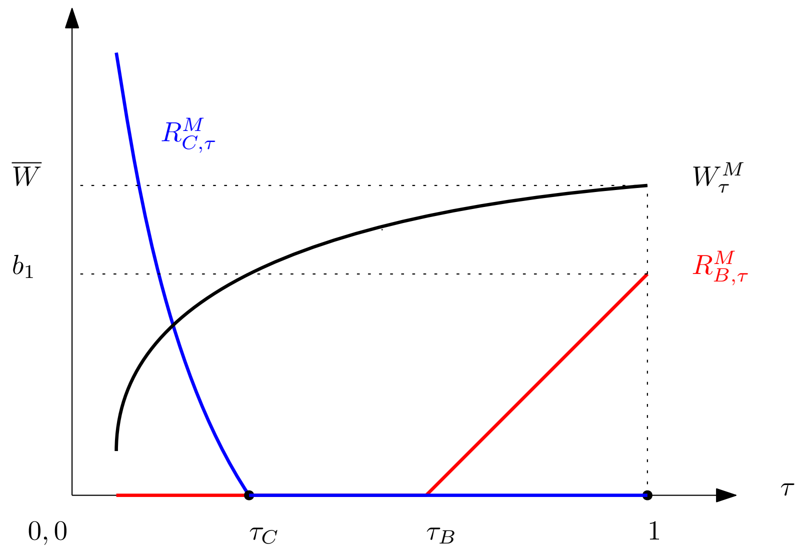


Figure 2: Total project value and rents generated by τ-specific M-form contracts

Lemma 3 (Liability contracting, candidates for the optimal M-form)**.** *In liability contracting, the optimal signal precision generated by the optimal M-form contracts is* $\tau_M \in \{\tau_B, \tau_C, \tau_S, \tau_D, 1\}$*, where*

$$(\tau_B, \tau_C, \tau_S, \tau_D) \equiv \left(\frac{\underline{V}-b_0}{b_1-b_0}, \frac{\mu c_0}{\underline{U}-\mu(c_1-c_0)}, \sqrt{\mu \frac{1-c_0-b_0}{b_1-b_0}}, \sqrt{\mu \frac{1-b_0}{b_1-b_0}} \right).$$

In the optimum, the CEO's rent is positive if and only if $\tau_M < \tau_C$*, and the board's rent is positive if and only if* $\tau_M > \tau_B$*.*

Which of the candidates is optimal? To simplify exposition, we distinguish between parametrical cases (environments) under which perfect precision is optimal, $\tau_M = 1$ (*M-perfect* environment), vs. cases under which imperfect precision is optimal, $\tau_M < 1$ (*M-imperfect* environment).[16]

Lemma 4 (Liability contracting, M-form)**.** *In liability contracting, the environment is M-imperfect if and only if* $\tau_S < 1$ *and* $\tau_B < 1$*. In an M-imperfect environment, the optimal*

[16] Appendix A.1 additionally demonstrates that in an M-imperfect environment, $\max\{\tau_S, \tau_B\} \leq \tau_M \leq \max\{\tau_D, \tau_B\}$. Therefore, τ_B is a lower bound that is often very tight and thus it is reasonable to analyze first and foremost the properties of the candidate τ_B.

signal precision in M-form is characterized in Table 1.

Table 1: **Optimal precision τ_M in an M-imperfect environment**

	$\tau_C < \tau_S$	$\tau_C \in [\tau_S, \tau_D]$	$\tau_C > \tau_D$
$\tau_B < \tau_C$	$\tau_M = \tau_S$	$\tau_M = \tau_C$	$\tau_M = \max\{\tau_B, \tau_D\}$
$\tau_B \geq \tau_C$	$\tau_M = \max\{\tau_B, \tau_S\}$	$\tau_M = \tau_B$	$\tau_M = \tau_B$

4.4 Regime choice

We will analyze the shareholders' regime choice separately in M-perfect and M-imperfect environments.

Regime choice in M-perfect environment. The outcomes under the A-form and the perfect M-form involve identical information and identical project decisions, thus identical surplus, total value and profits, $W^A = W^M$. Therefore, when selecting the preferred regime, the shareholders only compare total rents. They are willing to choose the perfect A-form contract if their margin from selecting the A-form contract is non-negative,

$$S^A - S^M = R_B^M - R_C^A = \max\{\underline{V}^M - \underline{V}, 0\} - \max\{\underline{U}^A - \underline{U}, 0\} \geq 0.$$

To derive the comparative statics of the regime choice in an M-perfect environment, it is sufficient to see that $\underline{U}^A = \underline{U}_1^A = (1-\mu)c_0 + \mu c_1$ and $\underline{V}^M = \underline{V}_1^M = b_1$.

Regime choice in M-imperfect environment. We begin with the shareholders' margin from selecting the A-form contract instead of the (optimal) imperfect M-form contract:

$$S^A - S^M = W^A - W^M - R_C^A + R_C^M + R_B^M = \mu \tfrac{1-\tau_M}{\tau_M}(1 - c_0 - b_0) - R_C^A + R_C^M + R_B^M,$$

where $R_C^A = \max\{(1-\mu)c_0 + \mu c_1 - \underline{U}, 0\}$, $R_C^M = \max\{\mu \frac{1-\tau_M}{\tau_M} c_0 + \mu c_1 - \underline{U}, 0\}$ and $R_B^M = \max\{b_0 + \tau_M(b_1 - b_0) - \underline{V}, 0\}$. Notice that in the parametrical subspace in which the regime choice between A-form and the imperfect M-form is relevant, we have $R_C^A > 0$.[17]

When analyzing how parameters affect the shareholders' margin, we now recognize that, unlike for an M-perfect environment, τ_M is endogenous to the parameters. Therefore, in contrast to the analysis of regime choice in M-perfect environment, we distinguish between a direct and indirect effect of a change in the parameter. A *direct* effect is the derivative of the margin $S^A - S^M$ with respect to the parameter of interest. An *indirect* effect is the effect through the change in the optimal precision level in the optimal M-form contract; in M-perfect environment, the indirect effect was zero. For instance, take a parameter b_1. (i) The direct effect of an increase in b_1 on the regime choice (i.e., the choice of the A-form) is $\frac{\partial S^A - S^M}{\partial b_1}$. The direct effect is *independent* on which type of precision $(\tau_B, \tau_C, \tau_S, \tau_D)$ is optimal.[18] (ii) An indirect effect *depends* on the optimal type of precision. By chain rule, an indirect effect of μ on the regime choice is $\frac{\partial S^A - S^M}{\partial \tau_M} \frac{\partial \tau_M}{\partial b_1} = -\frac{\partial S^M}{\partial \tau_M} \frac{\partial \tau_M}{\partial b_1}$.

Proposition 1 evaluates both direct and indirect effects to demonstrate that the overall effects are *qualitatively identical* in any M-form optimum in M-imperfect environments as well as in M-perfect environments.

Proposition 1 (Liability contracting, regime choice)**.** *In liability contracting, the A-form is (weakly) more attractive for the shareholders if* $\underline{U}$, b_0 *or* b_1 *increases, and if* $\underline{V}$, c_0 *or* c_1 *decreases.*

To summarize: (i) High CEO's labor market value and low CEO's empire-building concerns motivate the shareholders to provide the CEO with strong financial incentives that closely align the CEO's objective with the company and board. (ii) High board's labor market value and high board's prudence (high board's interest in avoiding project

[17] Suppose not and $R_C^A = 0$; then $S^A > S^M$ and therefore regime choice is absent.

[18] When we proceed to calculation of the effects, we will exploit that the optimal type of precision implies existence or non-existence of particular rents. This is important because for zero rent, the marginal effect on rent is zero, whereas for positive rent, the marginal effect on rent is possibly non-zero. The mapping between type of precision and non/existence of rents allows us to derive type-specific direct effects.

failures) motivate the shareholders to reallocate financial incentives from the CEO to non-executive directors which however generates less perfect alignment of the CEO's and board's objectives. This shows that financial incentives (and consequently also rents) are allocated primarily to one of the agents.

Put differently, there is an *implicit contest between agents over the financial incentives* that takes place in two dimensions at the same time: (i) To win the contest, the agent's nonfinancial incentives must be relatively more valuable to the shareholders (i.e., low empire-building bias in the case of the CEO and high prudence in the case of directors). This is intuitive; the shareholders seek the less costly way to fix of the agency problem of excessive investments. (ii) To win the contest, the agent must be relatively more costly; a high market value implies a low rent. In a word, we cleanly predict that *the relative strength of financial and nonfinancial motives of the executive and non-executive directors* determines the optimal level of alignment of the CEO and company, and also the quality of the project signal.

Our results also imply that the optimal contracts generate either of two decision-making/governance forms/regimes/styles:

- *Executive regime* (A-form contracts) is in line with a standard perspective on the primary motivations of the managers and directors; the CEO's primarily benefits from participation are *financial* whereas the board's primarily benefits from participation are *nonfinancial*. Executive regime occurs when the CEO has a large market value and low empire-building incentives (e.g., low career concerns), and non-executive directors have low market values and are concerned mostly about project success (e.g., high concern of being treated as 'part of a success story').

- *Collegial regime* (M-form contracts) represents a case when the CEO's project selection and signaling is not shaped by financial incentives of the CEO but rather by the incentives of highly motivated non-executive directors.[19] Collegial regime occurs when the CEO has a low market value but high empire-building incentives, and directors are both expensive and naturally prudent (conservative), i.e., primarily concerned about reputation of avoiding project failures.

There are also implications to the labor market with both executive and non-executive directors. We observe that financial incentives (and consequently also rents) are allocated primarily to one of the agents. To be financially incentivized (and thus potentially receive rents), the agent must be relatively valuable on the labor market. This means that the optimally allocated financial incentives *pronounce* pre-existing differences in market values of the agents; relatively less valuable agents receive less rents than relatively more valuable agents. Like in Gregor and Michaeli (2022), we observe forces that lead to an *endogenous segmentation in the labor market with directors*.[20]

4.5 Non-monotonic quality of information

Given existence of two regimes, a change in a parameter affects the equilibrium quality of information in either of three ways: (i) through the effect within the A-form, (ii) through the effect within the M-form and (iii) through the effect associated with a regime switch. The effect within the A-form is zero as the quality is perfect within the A-form. For the other effects, we must distinguish between the type of the M-form optimum. Table 2 summarizes these effects. To interpret the signs correctly, notice that a regime switch to the A-form in M-imperfect environment represents a *step-wise increase* in the equilibrium quality of information; a '+' sign represents a more likely switch from the M-form to the A-form, and '-' sign represents a more likely switch from the A-form to the M-form.

[19] Notice that the CEO normally receive financial incentives also for other tasks that are outside of scope of our analysis such as project implementation.

[20] In a setting where the shareholders contract with the board and the later contracts with the CEO, for certain parameter values, the shareholders may be unable to implement the M-form as the board does not internalize the higher rents paid to the CEO. Otherwise (for all other parameter values) the main results remain the same.

Table 2: **Effect of parameter values on the equilibrium quality of information**

M-form	Within M-form						Regime switch to A-form					
optimum	$\underline{U}$	$\underline{V}$	c_0	c_1	b_0	b_1	$\underline{U}$	$\underline{V}$	c_0	c_1	b_0	b_1
$\tau_M = 1$	0	0	0	0	0	0	+/0	−/0	−/0	−/0	0	+/0
$\tau_M = \tau_B$	0	+	0	0	−	−	+/0	−	−	−	+	+
$\tau_M = \tau_S$	0	0	−	0	+	−	+	−	−	−	+	+
$\tau_M = \tau_C$	−	0	+	+	0	0	+	−	−	−	+	+
$\tau_M = \tau_D$	0	0	0	0	+	−	0	−	−	0	+	+

For eight combinations of the parameter and the M-form optimum, we observe an interesting property: The sign of the effect associated with the regime switch to the A-form (a regime switch effect) is *opposite* to the sign of the effect on the precision within the M-form (a local effect). In these cases, a parametrical change has an opposite effect on the quality of information when it preserves and when it doesn't preserve the (imperfect) M-form. As a consequence, the quality of information is *non-monotonic* at the point of the regime switch. In Table 2, all these non-monotonicities are denoted in red.

In particular, consider $\tau_M = \tau_B$. As we discuss in Appendix A.1, this is likely an optimal precision in an M-imperfect environment or at least is close to the optimum. For this type of the optimum, we either observe a *non-monotonic function with a structural break* at the regime switch (for parameters $\underline{V}, b_0, b_1$) or a *step function at the regime switch* (for parameters $\underline{U}, c_0, c_1$). We *never* observe that a parameter shifts the precision in the same direction both with and without the regime change.

In these situations, we observe the following mechanism: When a parameter *increases* the optimal precision within the M-form (a positive local effect), it also makes the M-form more attractive for the shareholders, and consequently the shareholders are more likely willing to switch from the A-form to the M-form. But a regime switch from the A-form to an imperfect M-form implies a step-wise *decrease* in the precision (a negative regime switch effect). Similarly, when a parameter decreases the optimal precision within the M-form, it makes the M-form less attractive for the shareholders, and consequently the shareholders are more likely willing to switch from the M-form to the A-form. And a regime switch from an imperfect M-form to the perfect A-form implies a step-wise increase in the precision.

The mechanism behind non-monotonicity operates in the following sense: The shareholders primarily maximize precision to maximize total value/surplus/profits, and sacrifice precision under the M-form only when lower precision reduces rents of the agents, i.e., if the bargaining power of the shareholders improves significantly. When a change in the parameter motivates shareholders to improve precision under the M-form, it is because the parameter has increased shareholders' sensitivity to surplus (marginal surplus has increased) and/or decreased shareholders' sensitivity to rents (marginal rents have decreased). Typically, an increase in sensitivity is associated with an increase in the payoff-relevant variable, and a decrease in sensitivity is associated with a decrease in the payoff-relevant variable. When this holds, an increase in precision is associated with a level increase in surplus and/or a level decrease in rents. Both effects increase the shareholders' payoff under the M-form; as long as the payoff under the A-form is constant, the increase in the shareholders' payoff under the M-form makes the M-form increasingly more attractive. This mechanism is however not universal: First, an increase in sensitivity (marginal value) is not always associated with an increase in the payoff-relevant variable (absolute value). Second, a change in the parameter sometimes affects also the shareholders' payoff under the A-form.

5 Project ownership contracting

Like in limited liability contracting, we first derive the *regime-specific* contracts and then consider the shareholders' preference over the regimes (i.e., preferences over the regime-specific contracts). When deriving the regime-specific contracts in regime k with values U^k and V^k, we again use the two-step procedure: We construct the optimal contracts that comply only with incentive constraints and the constraints on the contracting space (here, project ownership constraints). These contracts generate the values $\underline{U}^k$ and $\underline{V}^k$. Then, we modify these contracts such that the participation constraints are met in addition to the other constraints. Again, like in limited liability contracting, we meet the participation constraints by adding ex ante unconditional transfers (i.e., a fixed salary increase). We use that such transfer is feasible and doesn't change incentives of the agents. Again, the values generated by the regime-specific contracts are $U^k = \max\{\underline{U}^k, \underline{U}\}$ and $V^k = \max\{\underline{V}^k, \underline{V}\}$.

5.1 Optimal A-form contracts

Under the A-form, the key incentive constraint is CEO's normality. This is achieved only when the CEO's project ownership reaches a certain threshold.

Lemma 5 (Project ownership contracting, A-form)**.** *In the optimal A-form contracts in project ownership contracting, the CEO's and board's shares are* $(\alpha^A, \beta^A) = (c_0, 0)$*, and fixed wages are* $(x_\varnothing, y_\varnothing) = (\max\{\underline{U} - \underline{U}^A, 0\}, \underline{V} - \mu b_1)$*, where* $\underline{U}^A = \mu r c_0 + \mu c_1$ *is the CEO's payoff in the optimal CEO's contract that complies only with her incentive and project ownership constraints. The CEO's ex ante expected payoff is* $U^A = \max\{\underline{U}^A, \underline{U}\}$*. The board's ex ante expected payoff is* $V^A = \underline{V}$*.*

Like in limited liability contracting, the board earns zero rent in the optimal A-form contracts. Therefore, it is only the CEO's rent that prevents shareholders from seizing the maximal feasible surplus.[21]

[21] The CEO's rent is different than in liability contracting. To compare the CEO's rents across the two contracting regimes (and thus to get the shareholders' preference over contracting spaces conditional on A-form being implemented), it is interesting to observe that the sign of the project value under prior information determines whether the shareholders, when generating alignment in the A-form, prefer limited liability contracting (LL) to project ownership contracting (PO) or vice versa. A negative prior project value, $\mu < \frac{1}{1+r}$, is equivalent to $\underline{U}^A_{LL} = (1-\mu)c_0 + \mu c_1 > \mu r c_0 + \mu c_1 = \underline{U}^A_{PO}$. This is equivalent to $R^A_{C,LL} \geq R^A_{C,PO}$ and consequently $S^A_{LL} \leq S^A_{PO}$.

5.2 Optimal M-form contracts

Identification of the optimal M-form contracts is significantly more simple under project ownership contracting. Again, we first construct optimal τ-specific M-form contracts. Again, we observe W_τ^M is increasing in τ and $R_{C,\tau}^M$ is (weakly) decreasing in τ. However, with project ownership contracting, board's rent is zero for any implementable precision τ, $R_{B,\tau}^M = 0$. It means that $W_\tau^M - R_{C,\tau}^M - R_{B,\tau}^M$ is increasing in τ, and the optimal M-form contracts are precision/prudence/profits-maximizing contracts.

In M-form, observe that precision is monotonic in board's project ownership:

$$\tau = \frac{\beta - b_0}{\beta(1+r) - b_0 + b_1}$$

Observe that $\frac{\partial \tau}{\partial \alpha_B} \propto b_1 + b_0 r$. Therefore, precision is (i) increasing in β if $b_1 > -rb_0$ (productive shares) and (ii) decreasing in β if $b_1 > -rb_0$ (unproductive shares).

$$\beta^M = \mathbb{1}_{b_1 > -rb_0}.$$

See that the precision under M-form is *imperfect* even with precision-maximizing board ownership, $\tau_M < 1$. Intuitively, even if the board has full ownership of the project, financial incentives generated by ownership (financially-based prudence) cannot fully crowd out board's nonfinancial incentives (nonfinancially-based prudence). Lemma 6 characterizes the optimal M-form contracts in full detail.

Lemma 6 (Project ownership contracting, M-form)**.** *In the optimal M-form contracts in project ownership contracting, the CEO's and board's project shares are* $(\alpha^M, \beta^M) = (0, \mathbb{1}_{b_1 > -rb_0})$*, and fixed wages are* $(x_\varnothing, y_\varnothing) = (\max\{\underline{U} - \underline{U}^M, 0\}, \underline{V})$*, where* $\underline{U}^M = \mu \frac{\beta^M r + b_1}{\beta^M - b_0} c_0 + \mu c_1$ *is the CEO's payoff in the optimal* β^M*-specific CEO's contract that complies only with her incentive and project ownership constraints. The CEO's ex ante expected payoff is* $U^M = \max\{\underline{U}^M, \underline{U}\}$*. The board's ex ante expected payoff is* $V^M = \underline{V}$*.*

5.3 Regime choice

5.3.1 Board's fixed salary contract

Since M-form is imperfect under project ownership contracting, the shareholders face a dilemma in the regime choice only when they have to choose between higher surplus under the A-form ($W^A > W^M$) and lower CEO's rents under the M-form ($R_C^A > R_C^M$ or, equivalently, $\max\{\underline{U}^A, \underline{U}\} > \max\{\underline{U}^M, \underline{U}\}$).

Interestingly, Lemma 7 proves that the CEO's rents are lower under the M-form (and thus the dilemma exists) only if board's nonfinancial incentives are stronger than board's financial incentives. This implies that whenever the M-form is preferred by shareholders, the board's contract involves zero shares. And since the optimal board's contract under the A-form involves zero shares as well, we conclude that the *optimal board's contract under project ownership is a fixed wage contract.*

Lemma 7 (Board's contract under project ownership)**.** *In project ownership contracting, the optimal board's contract is a fixed salary contract, $\beta^* = 0$.*

5.3.2 Effects of parameters

The shareholders' margin from selecting the optimal (and perfect) A-form contracts instead of the optimal (and imperfect) M-form contracts is as follows:

$$S^A - S^M = W^A - W^M - R_C^A + R_C^M = \mu\tfrac{1-\tau_M}{\tau_M}(1 - c_0 - b_0) - R_C^A + R_C^M,$$

where $R_C^A = \max\{\underline{U}^A - \underline{U}, 0\} = \max\{\mu r c_0 + \mu c_1 - \underline{U}, 0\}$, and $R_C^M = \max\{\underline{U}^M - \underline{U}, 0\} = \max\{\mu\tfrac{1-\tau_M}{\tau_M} c_0 + \mu c_1 - \underline{U}, 0\}$. When analyzing how parameters affect the shareholders' margin, we again recognize that τ_M is endogenous to the parameters. Therefore, we again distinguish between a direct and indirect effect of a change in the parameter. A *direct* effect is the derivative of the margin $S^A - S^M$ with respect to the parameter of interest.

An *indirect* effect is the effect through the change in the optimal precision level in the optimal M-form contract, which is $\tau_M = \frac{-b_0}{-b_0+b_1}$ (recall $\beta^M = 0$).

Proposition 2 evaluates both direct and indirect effects to demonstrate that the overall effects of parametrical changes on the regime choice are identical to limited liability contracting. The only minor exception is the effect of board's labor market value; in liability contracting, the effect was negative or neutral, whereas in project ownership contracting, the effect is neutral always. (Still, recall that a change in $\underline{V}$ is relevant for the shareholders as it affects feasibility of the preferred regime.)

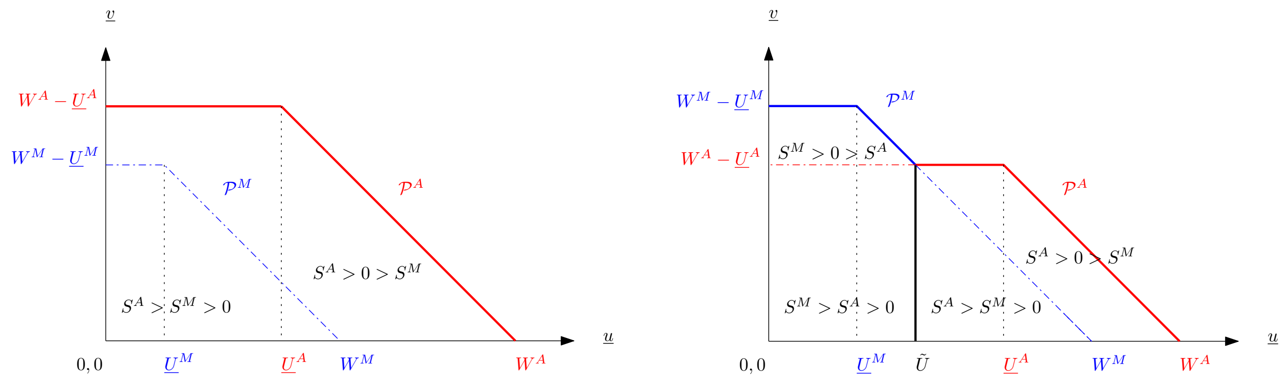
Proposition 2 (Project ownership contracting, regime choice)**.** *In project ownership contracting, the A-form is (weakly) more attractive for the shareholders if $\underline{U}$, b_0 or b_1 increases, and if c_0 or c_1 decreases.*

5.3.3 Illustration: Labor market values

We can easily visualize the regime choice with respect to the labor market values of the agents.[22] To begin with, we introduce regime-specific feasibility sets. A feasibility set $\mathcal{P}^k$ in regime k is the set of pairs of the players' outside options, $(\underline{U}, \underline{V})$, such that the shareholders' payoff is non-negative, $S^k \geq 0$ (i.e., the regime k is feasible to implement). To characterize $\mathcal{P}^k$, we recall that the shareholders' payoff obtained by the regime-specific contracts is $S^k = W^k - R^k_C - \underline{U} - \underline{V} = W^k - \max\{\underline{U}^k, \underline{U}\} - \underline{V} \geq 0$. The first subset of the feasibility set is characterized by $\underline{U} + \underline{V} \leq W^k$ and $\underline{U} > \underline{U}^k$. The second subset of the feasibility set is characterized by $\underline{V} \leq W^k - \underline{U}^k$ and $\underline{U} < \underline{U}^k$. Their union is when $\underline{U} + \underline{V} \leq W^k$ and $\underline{V} \leq W^k - \underline{U}^k$:

$$\mathcal{P}^k = \{\underline{U} + \underline{V} \leq W^k, \underline{V} \leq W^k - \underline{U}^k\}.$$

[22] In liability contracting, this visualization is more complex as a change in the labor market values (i) changes the levels of candidate optima τ_B and τ_C and (ii) consequently also change which of the candidates is optimal. This implies that the contour levels of S^M in the space of labor market values are non-linear.



(a) When $W^M - \underline{U}^M < W^A - \underline{U}^A$ (b) When $W^M - \underline{U}^M > W^A - \underline{U}^A$

Figure 3: Shareholders' regime choice

Figures 3a and 3b show the feasibility set $\mathcal{P}^A$ (in red color) and the feasibility set $\mathcal{P}^M$ (in blue color) when $\underline{U}^A \geq \underline{U}^M$. (If not, then Condition 1 is clearly not satisfied for any $\underline{u}$ and the A-form is always preferred). It shows two different cases, depending on $W^M - \underline{U}^M \lesseqgtr W^A - \underline{U}^A$: (i) In Figure 3a, $W^M - \underline{U}^M < W^A - \underline{U}^A$, and therefore it is impossible to satisfy inequality $S^A = W^A - \max\{\underline{U}^A, \underline{U}\} > W^M - \max\{\underline{U}^M, \underline{U}\} = S^M$ with any $(\underline{U}, \underline{V})$. Thus the A-form is always preferred. (ii) In Figure 3b, $W^M - \underline{U}^M > W^A - \underline{U}^A$, and therefore the M-form is preferred when the CEO's labor market value $\underline{U}$ is sufficiently low. To illustrate the difference between the two cases, we introduce $\tilde{U} \equiv W^M - \underline{U}^M - W^A + \underline{U}^A$; the former case corresponds to $\tilde{U} < 0$ and the latter case to $\tilde{U} > 0$.

5.3.4 Non-monotonic quality of information

How does a change in the parameters affect the equilibrium quality of information? The answer depends on whether the change induces a regime switch or not. (i) If not and the regime is A-form, the effect is *zero* for any parameter as $\mu_h = 1$. (ii) If not and the regime is M-form, the effect is captured by the effect on signal precision, $\mu_h = \tau_M$. Here we exploit $\beta^M = 0$, and thus $\tau_M = \frac{-b_0}{-b_0 + b_1}$. (iii) If the change in the parameters induces a regime switch, the quality *step-wise* improves if the switch is from M-form to A-form, and step-wise decreases if the switch is from A-form to M-form. These effects are summarized in Proposition 2 (for further details, see also Proof of Proposition 2).

Table 3 summarizes the effects within M-form and the effect due to a regime switch. Like in liability contracting, we observe non-monotonicities. In particular, we observe here that the effects of the board's nonfinancial benefits are *non-monotonic*: Within the optimal M-form, a larger board's nonfinancial (reputation) benefit of approving a successful project and a lower nonfinancial (reputation) cost of approving a failing project (a larger b_0 or a larger b_1) decrease the board's prudence, which reduces the information quality. However, at the same time, the two changes also increase the willingness of the shareholders to implement the A-form, which implies a step-wise increase in the quality of information if the shareholders switch to the A-form.

Table 3: **Effects of parameters on equilibrium quality of information**

M-form	Within M-form						Regime switch to A-form					
optimum	$\underline{U}$	$\underline{V}$	c_0	c_1	b_0	b_1	$\underline{U}$	$\underline{V}$	c_0	c_1	b_0	b_1
$\tau_M < 1$	0	0	0	0	$-$	$-$	$+/0$	0	$-/0$	$-/0$	$+$	$+$

The effects in Table 3 are (with the exception of board's labor market value) identical to the effects of parameters in liability contracting when the M-form optimum is $\tau_M = \tau_B$ (see Table 1).[23] Specifically, it means that we never observe that a parameter shifts the precision in the same direction both with and without the regime change. Therefore, the non-monotonic mechanism described under limited liability contracting fully translates to project ownership contracting.

[23]By discussion in Appendix A.1, this is often an M-form optimum or at least a close lower approximation to the M-form optimum.

5.4 Endogenous boards

In this paper, board directors are given and the shareholders only optimize in the dimension of financial incentives. We now extend to analyze situations when the board's nonfinancial incentives can be modified *incrementally*. This happens, for instance, when terms of the non-executive directors are staggered or when the CEO can partially influence board composition and thus the shareholders thus have only partial control over appointment of the directors.

When a board type can be modified incrementally, is it optimal to increase or decrease board prudence? Gregor and Michaeli (2022) show that, absent of contracting considerations, board's prudence should be increased if the primary concern is the CEO's empire-building bias. They even show that it pays off to increase board's prudence by appointing directors that are willing to make *biased* decisions under certainty. In this paper, the contracting dimension is endogenous, and the shareholders' choice over board type and board contract is a rich multidimensional problem.

At the same, however, when board characteristics can change only marginally, a marginal change almost never affects the optimal regime (unless the shareholders are indifferent over regimes), and therefore the shareholders' preferences over board's nonfinancial incentives are preferences conditional on a given regime. When a regime is given, we can also exploit that the allocated shares are invariant to the directors' nonfinancial characteristics; in the optimal A-form, $(\alpha^A, \beta^A) = (c, 0)$ and in the optimal M-form, $(\alpha^M, \beta^M) = (0, 0)$. Lemma 8 then follows immediately.

Lemma 8 (Preferred boards' characteristics)**.** *In project ownership contracting, when the A-form is optimal, the shareholders prefer to increase b_1 and are indifferent over b_0. When the M-form is optimal, the shareholders prefer to decrease b_1 and b_0.*

By combining the result with Proposition 2, we observe that shareholders optimally *reinforce* those characteristics that are dominant among the directors. (i) If the existing board is highly nonfinancially concerned about approving a profitable project, the shareholders implement the A-form and prefer to further increase the nonfinancial benefit from project success as it makes the directors cheaper for the company; they demand a lower financial compensation. (ii) In contrast, if the board is highly nonfinancially concerned about avoiding a failing project, the shareholders implement the M-form and are better off when the board is even more concerned about project failure. Notice that, unlike mechanism with strategic complementarities in interactions of board directors, this *reinforcement of the dominant nonfinancial characteristic* follows from non-linearities in the shareholders' multidimensional optimization problem.

We thus a observe another force that contributes to segmentation of companies into two distinctly different types: (i) In one group of companies, the shareholders largely financially incentivize the CEO (e.g., large bonuses) and prefer that the non-executive directors are strongly nonfinancially motivated in favor of project success (e.g., entrepreneurs). (ii) In another group of companies, the shareholders do not put emphasis on variable financial incentives of the CEO or directors, and rather appoint conservative directors that are motivated to avoid project failures (e.g., former lawyers). This is another pattern that explains why corporate governance is endogenous (Levit and Malenko, 2016); here, the mutually strengthening governance features are contracting schemes and board characteristics.

6 Empirical predictions

Our model generates several testable empirical predictions on the links between individual characteristics of executive and non-executive directors on one side, and board compensation, executive compensation, the level of investments and investment inefficiency on the other side.

1. First, our model predicts that the parameters (such as board composition and con-

tracting schemes) have opposite effects on the level of investments and the return to investments (and company value). This link manifests that the key friction is the conflict of interests over value-reducing (pet) projects.

2. Second, we predict heterogeneous effects of equity incentives. An important take-away of our analysis is that the effect depends on the structure of nonfinancial benefits and the role of the director (executive vs. non-executive). In the case of executive directors, equity incentives are increasing the return to the investments (quality of information). In the case of non-executive directors which are primarily concerned about entrepreneurial success, equity incentives are also increasing the return to investments. However, in the case of non-executive directors which are more concerned about monitoring, providing equity crowds out nonfinancial motivation and consequently the equity incentives are counterproductive.

3. Third, our model predicts that stocks are for both executive and non-executive directors superior to options in compensation packages because they expose agents to downside risk. This prediction is consistent with Bhagat and Bolton (2019) who find director stock ownership to be strongly and consistently related to future performance. Notice that our predictions cover only incentives in project selection and approval; stocks and options may be also instrumental to elicit effort during project implementation which is not subject of our interest.

4. Fourth, we provide predictions on excess compensation of non-executive directors. The excessive compensation is calculated in the empirical literature as the difference between the observed compensation levels and expected compensation levels after controlling for firm characteristics (investment opportunities, firm complexity, need for monitoring, and firm performance/risk). The abnormal compensations are then explained by governance variables or other proxies for CEO-director reciprocity

(Dah and Frye, 2017; Chen et al., 2019; Hope et al., 2019). In our setting, excess compensation of non-executive directors arises in the optimal contract as the cost of incentives. This cost exists when it is optimal to allocate incentives primarily to non-executive directors, and therefore excess compensation is associated with low profits and low return to investments.

5. Fifth, we demonstrate a key difference between monitoring and entrepreneurial career concerns of directors. Concerns about reputation of an effective monitor that is rewarded by additional non-executive directorships are different from concerns about being part of an entrepreneurial success story. A proxy for the type of nonfinancial concern is the job type, education and work history. We predict that these concerns have *opposite* effects on the quality of information and on the preference for the executive (vs. collegial) style of decision-making. This has implications especially with respect to the effect of directors' age; the effect of age is conditional on whether concerns are primarily about monitoring or entrepreneurial success.

6. Sixth, we predict that boards with higher monitoring career concerns (e.g., a high number of independent directors, and high media exposure as documented in Jiang, Wan and Zhao 2016) may have a non-monotonic effect on the company value: (i) Higher career concerns make the board more prudent which improves the quality of the CEO's information. Thus reputation incentives improve the accuracy of information or corporate transparency (Sila, Gonzalez and Hagendorf 2017) and the company value typically increases. (ii) However, higher concerns about monitoring also imply that misalignment involves less frictions and is more likely optimal—if there is a switch from the alignment to misalignment, the company value drops. In short, the company value is U-shaped in the monitoring career concerns.

   To provide a more specific example, consider 'professional directors', i.e., independent directors whose only vocation is to serve as directors on one or more corporate boards. Wahid, Welch and Maber (2019) find two opposing effects. On one side, firms with a higher percentage of professional directors exhibit a lower likelihood of accounting restatements. On the other side, controlling for a change in board skills, boards with a higher proportion of professional directors exhibit a lower Tobin's Q and lower efficiency, as measured by sales turnover. They also engage in more acquisitions and experience lower acquisition announcement returns, and market response surrounding professional director appointments is negative. These results are consistent with our prediction on the optimal reallocation of incentives across the CEO and board. The professional directors are more likely to be accounting experts, and thus monitoring concerns of the board increase. Then, it is more likely optimal to reallocate the incentives which results in a drop in performance in the project selection stage.

7. Seventh, we also give predictions regarding executive compensation. We predict that the CEOs receive large variable compensation if their outside opportunities are more attractive and they have only weak empire-building tendency. The prediction on the effect of labor market value is consistent with observations that the proportion of variable compensation in total compensation is increasing in the total compensation.

8. Eighth, we predict that financial and nonfinancial incentives are correlated not only due to the shareholders' allocation of incentives but also due to the shareholders' control over the selection of directors. The two reinforce each other. In particular, we predict a positive correlation between the proportion of variable compensation of the executive directors and entrepreneurial motivation of non-executive directors. Similarly, we predict a negative correlation between the proportion of variable compensation of the executive directors and monitoring motivation of non-executive directors.

7 Concluding remarks

Why do shareholders offer contracts to executive and non-executive directors that motivate directors to generate and follow imperfect decision-relevant information about investment opportunities? In this paper, we attribute the optimally imperfect project signaling quality to *contracting costs* of hard financial incentives, namely to contracting costs associated with financial penalties that are necessary to correct for idiosyncratic nonfinancial preferences of the agents. We show that these contracting costs arise when contingent transfers provided to directors cannot be too low. In a nutshell, in contracting problems that are constrained by low bounds on transfers, it is often impossible to provide incentives to directors without giving them rents. When constructing take-it-or-leave-it offers, the shareholders then follow two different objectives: on one hand, they maximize company profits, and on the other hand, they minimize agency rents. As a result, in some cases, they are willing to decrease the level of the surplus generated by the investment policy in order to appropriate a higher share of the surplus.

To understand the role of contingent transfers in detail, note that the quality of information is maximized either directly or indirectly. A *direct* way is to motivate the CEO to produce precise information. An *indirect* way is to motivate the board to consume only sufficiently precise of the information; this is by increasing board's prudence, and high board's prudence subsequently motivates the CEO to produce a high-quality information (Gregor and Michaeli, 2022). However, both ways may be costly for the shareholders.

First, the CEO's motivation to produce high-quality information requires a financial *penalty for project failure*. But generating the penalty is costly: (i) When transfers are restrained by lower bounds, the penalty is generated only by increasing reward for status quo, and this reward is costly. (ii) When transfers are provided through shares, penalty for project failure is generated only by providing the CEO with a large number of shares, and this is again costly.

Second, board's motivation to be prudent (and consequently to discipline CEO's signal) can be increased by a *penalty for project success* and/or a *penalty for project failure*. But imposing both penalties is costly, and can be limited by the available financial instruments: (i) When transfers are restrained by lower bounds, the penalties are generated only by increasing reward for status quo, and this reward is costly. (ii) When transfers are provided through shares, it is impossible to increase both penalties at the same time. In fact, providing shares increases the penalty for project failure but simultaneously increases the bonus for project success. Moreover, even when the overall effect of shares on board's prudence is positive, the maximal prudence generated by shares is not sufficient to motivate high-quality information, and providing shares is costly.

Our paper also provides insights to the broader literature on directors' labor markets and contracts. Our model can serve as another input for construction of the equilibria in the directors' labor market (i.e., when the outside option is endogenous) as reviewed in Edmans, Gabaix and Jenter (2017). Tolerance to excessive investments (CEO's pet projects) is associated with the CEO's low outside options. This result generates insights into the dynamics on the market with executive directors (a feedback loop). Most importantly, if the outside option is to some extent endogenous to past performance (the market makes an assessment of the director's qualities), then the equilibrium might be that a director with low outside option in the previous job has a record of low company performance (because of the absence of strong hard incentives), and in the future job will therefore again have a low outside option and consequently low performance. Similarly, a director with high outside option in the previous job had a high company performance in the previous job (because of the presence of strong hard incentives), and in the future job will therefore again have a high outside option. In other words, we identify an aspect that could generate segmentation of directors in this specific labor market and associated segmentation of companies.

Appendix

A Miscellaneous

A.1 M-form in limited liability contracting

This section provides additional analysis and graphical illustration of the relevance of τ_B in a broader parametrical space. First, see that $\tau_M \geq \tau_B$. This follows from Table 1: (i) $\tau_M = \max\{\tau_B, \tau_S\}$ when $\tau_C < \tau_S$, (ii) $\tau_M = \max\{\tau_B, \tau_C\}$ when $\tau_C \in [\tau_S, \tau_D]$ and (iii) $\tau_M = \max\{\tau_B, \tau_D\}$ when $\tau_C > \tau_D$. That precision is never below τ_B (at which board's rents emerge) reflects the basic principle that the *shareholders don't sacrifice precision unless lower precision helps to reduce rents* (in this case, specifically board's rents). As a result, whenever τ_B is not exactly optimal, it is underestimating the precision.

Second, we are able to identify specific environments where τ_B is optimal. In particular, suppose boards are highly *success-motivated* and also *sufficiently costly* boards, i.e., suppose *CEO-like directors* with high outside options. When board's nonfinancial benefit from project success is sufficiently large, $\tau_D < 1$; when the board is expensive, then τ_B is sufficiently close to 1 and therefore $1 > \tau_B > \tau_D$. As a result, the upper bound imposes $\tau_M \leq \tau_B$, which implies $\tau_M = \tau_B$.

Figure 4 illustrates how τ_M depends on τ_B (horizontal axis) and τ_C (vertical axis). For each pair (τ_B, τ_C), the illustration takes τ_S and τ_D as fixed. The arrows show how τ_C maps into τ_M, conditional on τ_B: (i) When τ_C is sufficiently high, the optimal precision is lower than at τ_C, just at the higher bound. (ii) When τ_C is sufficiently low, the optimal precision is higher than at τ_C, just at the lower bound. (iii) When τ_C is at an intermediate value, then $\tau_M = \tau_C$. Importantly, the interval of intermediate values given by lower and upper bounds may be a degenerate interval which includes only τ_B.

B Proofs

Proof of Lemma 1: Part 1 (*CEO's contract*). The CEO's rent, $R_C = \max\{0, U - \underline{U}\}$, is minimized when the CEO's (ex ante expected) payoff U is minimized subject to her incentive constraint (normality) and her participation constraint ($U \geq \underline{U}$). As stated in Section 3.3, we proceed in two steps. First, we derive a contract that minimizes the CEO's payoff and satisfies her incentive constraint (but not necessarily her participation constraint):

$$(x_0, x_\varnothing, x_1) = (0, c_0, 0)\,.$$

This illustrates that the CEO must be financially incentivized to not support value-destroying projects. The corresponding CEO's total (financial and nonfinancial) payoff is $\underline{U}^A \equiv (1-\mu)c_0 + \mu c_1$. Next, we add the participation constraint. (i) If $\underline{U}^A > \underline{U}$, then the optimal contract doesn't change and also the payoff doesn't change, $\underline{U}^A = \underline{U}$. The CEO receives a positive rent $U^A - \underline{U} = \underline{U}^A - \underline{U}$. (ii) If $\underline{U}^A \leq \underline{U}$, then the shareholders need to increase the CEO's payoff by $\underline{U} - \underline{U}^A$ to meet her participation constraint. There are

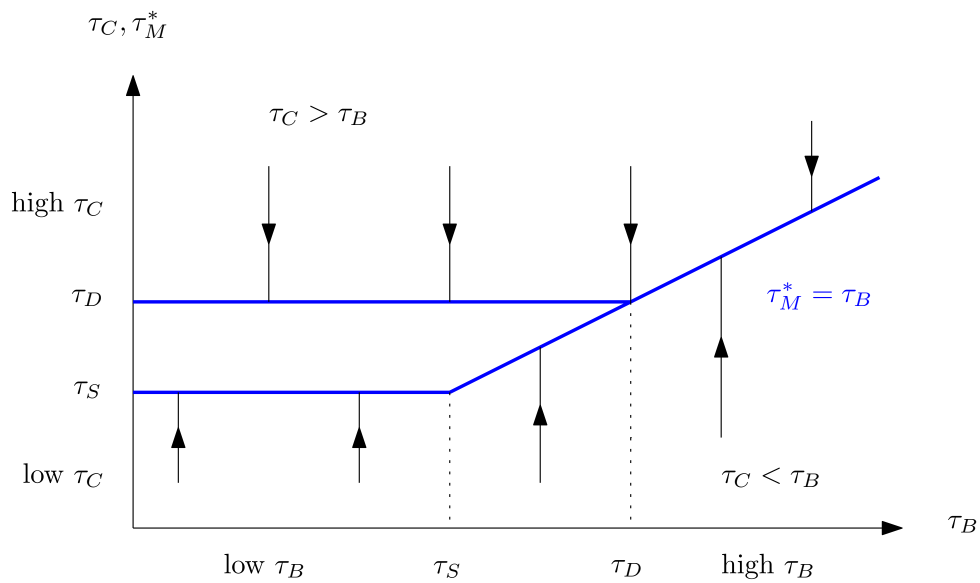


Figure 4: Illustration of how τ_M^* depends on τ_B and τ_C (with τ_S and τ_D fixed)

many ways how to accommodate the transfer in the contract without distorting incentive constraints; for instance, like in the case of unconstrained contracting, one can increase the bonus for project success by the amount $\frac{1}{\mu}(\underline{U} - \underline{U}^A)$. To generalize cases (i) and (ii), an optimal A-form CEO's contract is

$$(x_0^A, x_\varnothing^A, x_1^A) = \left(0, c_0, \tfrac{1}{\mu}\max\{\underline{U} - (1-\mu)c_0 - \mu c_1, 0\}\right).$$

and the CEO's ex ante expected payoff is $U^A = \max\{\underline{U}, \underline{U}^A\}$.

Part 2 (*Board's contract*). Analogically, the board's rent, $R_B = \max\{0, V - \underline{V}\}$, is minimized when the board's (ex ante expected) payoff V is minimized subject to board's incentive constraint (normality) and board's participation constraint ($V \geq \underline{V}$). Again, we first derive a contract that minimizes board's payoff and satisfies her incentive constraint (but not necessarily her participation constraint). This contract offers zero payoffs:

$$(y_0, y_\varnothing, y_1) = (0, 0, 0).$$

The corresponding board's payoff is $\underline{V}^A \equiv \mu b_1$. Since $\underline{V} \geq \mu b_1$ by assumption, the shareholders always need to increase board's payoff by $\underline{V} - \underline{V}^A \geq 0$ to meet the participation constraint. There are many ways how to provide the transfer without distorting incentive constraints; for instance, like in the case of unrestricted contracting, one can provide the transfer both when the project is rejected and when the project is successful. An optimal A-form board's contract is then

$$(y_0^A, y_\varnothing^A, y_1^A) = (0, \underline{V} - \mu b_1, \underline{V} - \mu b_1),$$

and the board's ex ante expected payoff is $V^A = \max\{\underline{V}, \underline{V}^A\} = \underline{V}$.

Proof of Lemma 2: Part 1 (*Board's contract*). Deriving τ-specific board's contract is straightforward: In the equilibrium of the persuasion game, board's prudence is defined as a belief τ at which the board is *indifferent* between approval and rejection, $y_\varnothing = (1-\tau)(y_0+b_0)+\tau(y_1+b_1)$.[24] Given this indifference, the board's ex ante expected payoff is simply the board's payoff under rejection,

$$V_\tau = \left(1-\tfrac{\mu}{\tau}\right) y_\varnothing + \tfrac{\mu}{\tau}\left[(1-\tau)(y_0+b_0)+\tau(y_1+b_1)\right] = \left(1-\tfrac{\mu}{\tau}\right) y_\varnothing + \tfrac{\mu}{\tau} y_\varnothing = y_\varnothing.$$

We begin with the incentive constraints only. When the shareholders minimize board's expected variable payoff conditional on τ, their objective is actually to *minimize* $y_\varnothing$ subject to (i) board's normality constraints, $y_0+b_0 \leq y_\varnothing \leq y_1+b_1$, (ii) board's indifference at τ, $y_\varnothing = (1-\tau)(y_0+b_0)+\tau(y_1+b_1)$, and also (iii) limited liability constraints, $(y_0, y_\varnothing, y_1) \in \mathbb{R}^3_+$. To construct the board's payoff-minimizing contract, the key is whether $b_\varnothing = 0 \lesseqgtr (1-\tau)b_0+\tau b_1$.

- For a sufficiently *small* τ, we have $(1-\tau)b_0+\tau b_1 < 0$. The shareholders need to increase either y_0 or y_1 to make board indifferent at τ. It is irrelevant which of the two payoffs or their combination is increased because for any combination, we have $\underline{V}^M_\tau = y_\varnothing = 0$, and thus the ex ante financial transfer to the board is identical. For example, suppose an identical bonus $-[(1-\tau)b_0+\tau b_1]$ is provided for project approval irrespective of the project success, i.e., $y_0 = y_1$:

$$(y_0, y_\varnothing, y_1) = (-(1-\tau)b_0 - \tau b_1, 0, -(1-\tau)b_0 - \tau b_1).$$

  Intuitively, for a small τ, nonfinancially based portion of the prudence $\tau_N = \frac{-b_0}{-b_0+b_1}$ is larger than required, $\tau_N > \tau$. Since the shareholders aim at implementing a lower prudence (worse signal precision), they must introduce financial rewards that make the board less prudent. Importantly, notice that a change in τ for a small τ does *not change* board's payoff, $\underline{V}^M_\tau = y_\varnothing = 0$. Thus, achieving board's indifference condition is at no cost to the shareholders.

- For a sufficiently *large* τ, we have $0 < (1-\tau)b_0+\tau b_1$. The shareholders need to increase $y_\varnothing$ by $(1-\tau)b_0+\tau b_1$ to make board indifferent at τ.[25] Precisely:

$$(y_0, y_\varnothing, y_1) = (0, (1-\tau)b_0+\tau b_1, 0).$$

  Intuitively, for a large τ, nonfinancially based prudence τ_N is too low, $\tau_N < \tau$, and shareholders have to make the board more prudent by rewarding project rejection. This *increases* board's expected payoff, $\underline{V}^M_\tau = y_\varnothing = (1-\tau)b_0+\tau b_1$. Here, achieving board's indifference condition is costly for the shareholders.

To sum up, $\underline{V}^M_\tau$ is quasi-linear in τ; it is initially flat at zero and then increases linearly. We can write it as $\underline{V}^M_\tau = \max\{(1-\tau)b_0+\tau b_1, 0\}$.

[24]When $y_0+b_0 < y_1+b_1$, the belief is unique. We will proceed with this case and thus disregard the knife-edge case where a normal board is indifferent over project approval for any belief.

[25]See that a required increase in $y_\varnothing$ will not violate board's normality.

We proceed to the second step. To satisfy the board's participation constraint, it is then sufficient to add a transfer $\max\{\underline{V}-\underline{V}_\tau^M, 0\}$ to each of the three outcomes; this fixed transfer will not affect either board's normality or prudence. Consequently, the board's ex ante expected payoff is $V_\tau^M = \max\{\underline{V}, \underline{V}_\tau^M\}$.

- Specifically, for any small τ, a fixed transfer $\underline{V}$ is provided (i.e., board's rent is zero) and the τ-specific M-form board's contract is

$$(y_{\tau,0}^M, y_{\tau,\varnothing}^M, y_{\tau,1}^M) = (\underline{V} - (1-\tau)b_0 - \tau b_1, \underline{V}, \underline{V} - (1-\tau)b_0 - \tau b_1).$$

- For a large τ, we introduce τ_B as the precision level at which $\underline{V}_\tau^M = \underline{V}$. (Its exact value is provided later in Lemma 3.) There are two cases:

  – If $\tau < \tau_B$ and the precision is large (which is a non-empty interval), adding the transfer $\max\{\underline{V} - \underline{V}_\tau^M, 0\}$ makes the optimal τ-specific M-form board's contract identical like when τ is small (see above). The board's rent is zero, $R_{B,\tau}^M = \max\{0, \underline{V}_\tau^M - \underline{V}\} = 0$.

  – If $\tau \geq \tau_B$ (which implies that the precision is large), a transfer is not provided and the τ-specific M-form board's contract is

$$(y_{\tau,0}^M, y_{\tau,\varnothing}^M, y_{\tau,1}^M) = (0, (1-\tau)b_0 + \tau b_1, 0).$$

  The board's rent is positive, $R_{B,\tau}^M = \max\{0, \underline{V}_\tau^M - \underline{V}\} = \underline{V}_\tau^M - \underline{V} > 0$.

Part 2 (*CEO's contract*). Providing zero payoffs preserves CEO's empire-building type, and thus satisfies the M-form. Thus, the minimized CEO's payoff that complies with the CEO's incentive compatibility constraints (without necessarily satisfying CEO's participation constraints) is $\underline{U}_\tau^M = p_h[(1-\tau)c_0 + \tau c_1] = \mu\frac{1-\tau}{\tau}c_0 + \mu c_1 \geq \mu c_1$.

To satisfy also the CEO's participation constraint, it is then sufficient to add a transfer $\max\{\underline{U} - \underline{U}_\tau^M, 0\}$ to each of the three outcomes; this fixed transfer will not affect CEO's type. The τ-specific M-form CEO's contract is

$$x_{\tau,0}^M = x_{\tau,\varnothing}^M = x_{\tau,1}^M = \max\{\underline{U} - \mu\tfrac{1-\tau}{\tau}c_0 - \mu c_1, 0\}.$$

Consequently, the CEO's ex ante expected payoff is $U_\tau^M = \max\{\underline{U}, \underline{U}_\tau^M\}$ and the CEO's rent is $R_{C,\tau}^M = \max\{0, \underline{U}_\tau^M - \underline{U}\}$.

Proof of Lemma 3: We evaluate the marginal effects of an increase in τ:

- Project surplus: The surplus from the project is $W_\tau^M = \mu(1+r+b_1-b_0+c_1-c_0) - \frac{\mu}{\tau}(1-c_0-b_0)$. The marginal effect is $\frac{\mu}{\tau^2}(1-c_0-b_0) > 0$. As τ approaches one, the marginal effect decreases to $\mu(1-c_0-b_0) > 0$.

- CEO's rent (non-negative effect): The CEO's minimized payoff consistent with the CEO's incentive constraints only is $\underline{U}_\tau^M = \frac{\mu}{\tau}c_0 + \mu(c_1-c_0) = \mu\frac{1-\tau}{\tau}c_0 + \mu c_1 \geq \mu c_1$

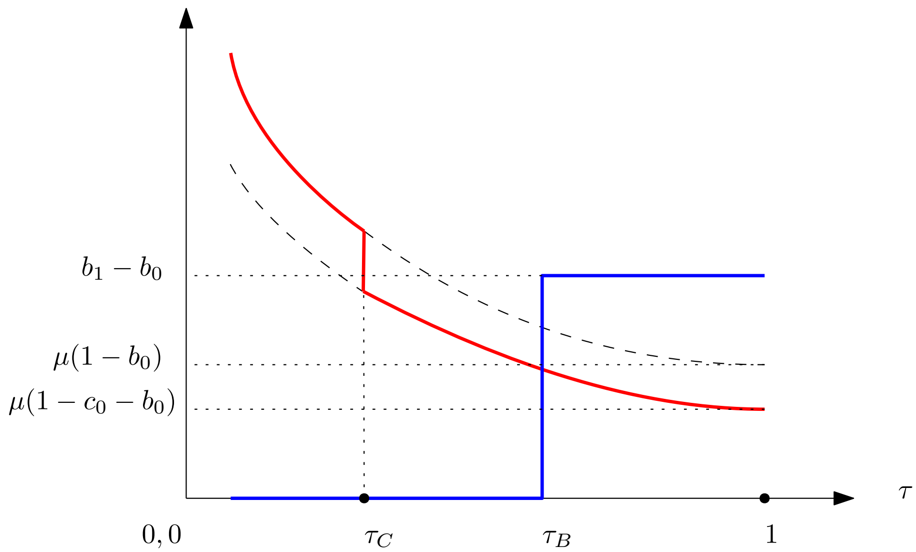


Figure 5: Improvements (red line) and deteriorations (blue line) of the shareholders' value S^M_τ when board's prudence τ increases and τ-optimal M-form contracts are proposed

and the CEO's rent is consequently $R^M_{C,\tau} = \max\{\underline{U}^M_\tau - \underline{U}, 0\}$. The marginal effect on $-R^M_C$ is positive, $\frac{\mu}{\tau^2}c_0 > 0$, when $\tau < \tau_C$; at $\tau = \tau_C$, it step-wise drops to zero, where $\tau_C \equiv \frac{\mu c_0}{\underline{U} - \mu(c_1 - c_0)}$. Notice that the flat part exists always as $\tau_C \leq 1$ follows from $\underline{U} \geq \mu c_1$.

- Board's rent (non-positive effect): The board's minimized payoff consistent with the board's incentive constraints only is $\underline{V}^M_\tau = (1-\tau)b_0 + \tau b_1$ and the board's rent is $R^M_{B,\tau} = \max\{\underline{V}^M_\tau - \underline{V}, 0\}$. The marginal effect on $-R^M_B$ is zero when $\tau < \tau_B$; at $\tau = \tau_B$, it step-wise drops to the negative effect, $b_0 - b_1 < 0$, where $\tau_B \equiv \frac{\underline{V} - b_0}{b_1 - b_0}$. Notice that for $\underline{V} > b_1$, we have $\tau_B > 1$, and then board rent doesn't exist for any feasible precision level $\tau \in [\mu, 1]$.

Figure 5 illustrates the first two effects (red line) and compares it with the absolute value of the third effect (blue line). It effectively decomposes the overall effects into non-negative effects (marginal benefits in red) and non-positive effects (marginal costs in blue). In the specific case illustrated in Fig. 5, the optimum is at $\tau_M = \tau_B$.

As the sum of the first two effects (visualized by the red line) is *decreasing* and the third effect (visualized by the blue line) is *non-decreasing*, the optimal value of prudence/precision is unique. On the figure, if an intersection doesn't exist, then $\tau_M = 1$. If the intersection exists at a step (either τ_B or τ_C), we speak of a *corner* optimum. If it is not at a step, we speak of an *interior* optimum. The interior optimum is either of two values:

- Single rent: If only board rent exists, the interior optimum balances a positive marginal effect on surplus with a negative marginal effect on board's rent, $\frac{\mu}{\tau^2}(1 - c_0 - b_0) = b_1 - b_0$. The optimum is at $\tau_S \equiv \sqrt{\mu \frac{1-c_0-b_0}{b_1-b_0}}$.

- Double rent: If both the CEO's rent and board's rents exist, then two positive marginal effects are in the interior optimum balanced with a single negative marginal effect, $\frac{\mu}{\tau^2}(1-b_0) = b_1 - b_0$, and the optimum is larger, $\tau_D \equiv \sqrt{\mu \frac{1-b_0}{b_1-b_0}} > \tau_S$.

Finally, the statement on the necessary and sufficient conditions for positive rents follow from the definition of kinks τ_B and τ_C. That is, $R^B_{\tau,M}$ is positive when $\tau > \tau_B$ and zero otherwise, and $R^C_{\tau,M}$ is positive when $\tau < \tau_C$, and zero otherwise.

Proof of Lemma 4: First, we begin with characterization of M-perfect environment ($\tau_M = 1$). The condition $\tau_S \geq 1$ means that the positive marginal effects of prudence dominate (weakly) negative marginal effects of prudence for any feasible $\tau \leq 1$, and consequently $\tau_M = 1$. The condition $\tau_B \geq 1$ means that the (weakly) negative marginal effects of prudence are in fact zero for any feasible $\tau \leq 1$ (the board's rent is zero for any τ), and consequently $\tau_M = 1$.

To prove the inverse: If $\tau_S < 1$ and $\tau_B < 1$, the positive marginal effects of prudence are dominated by negative marginal effects of prudence for $\tau = 1$, and consequently, using S^M_τ is decreasing and continuous in τ on a left neighborhood of 1, $\tau_M < 1$.

Table 1 follows from the comparison of marginal effects conducted in Proof of Lemma 3.

Proof of Proposition 1: Part 1 (*M-perfect environment*). By undertaking comparative statics on the shareholders' margin $S^A - S^M = \max\{b_1 - \underline{V}, 0\} - \max\{(1-\mu)c_0 + \mu c_1 - \underline{U}, 0\}$, we obtain the following effects:

Table 4: Regime choice (in favor of A-form) in M-perfect environment

Effect	M-form optimum	$\underline{U}$	$\underline{V}$	c_0	c_1	b_0	b_1
direct	$\tau_M = 1$	$+/0$	$-/0$	$-/0$	$-/0$	0	$+/0$

The results in Table 4 can be interpreted in the following way: When the effect is positive ('+' sign), any increase in the parameter makes the A-form more attractive for the shareholders. When the effect is negative ('-' sign), any increase in the parameter makes the perfect M-form more attractive for the shareholders. When the effect is neutral ('0' sign), a change in the parameter has no effect; this is associated either with a rent equal zero or a positive rent that is however invariant in the parameter.

Part 2 (*M-imperfect environment*). We will derive the overall effect of a parametrical change by observing the direct and indirect effects. Formally, we have either an *interior* optimum (τ_S or τ_D) or a corner optimum (τ_B or τ_C). (i) An interior optimum is characterized by $\frac{\partial S^M}{\partial \tau_M} = 0$ (an intersection of continuous marginal benefit and cost functions), and therefore, by envelope theorem, the indirect effect is zero. (ii) In contrast, a corner optimum is characterized by steps in the marginal benefit or cost functions. Denoting $s(\tau)$ the difference between marginal benefit and marginal cost of precision in M-form (see also Fig. 5), we have $S^M = \int_0^{\tau_M} s(\tau) d\tau$. The step-wise drop in $s(\tau)$ at τ_M implies $\lim_{\tau \to \tau_M^+} s(\tau) > 0$. Therefore, an increase in the corner τ_M implies an increase in S^M,

$\frac{\partial S^M}{\partial \tau_M} > 0$. This means that the indirect effect is *opposite to the local effect* of parametrical change on the optimal precision in M-form. For example, when the parameter is b_1, we write $\frac{\partial S^A - S^M}{\partial \tau_M} \frac{\partial \tau_M}{\partial b_1} = -\frac{\partial \tau_M}{\partial b_1}$.

Table 5 lists direct, indirect and the overall effect of each parametrical change. When analyzing the direct effect, we exploit the following properties: (i) $\tau_M = \tau_B \Rightarrow R_B^M = 0$; (ii) $\tau_M = \tau_S \Rightarrow R_B^M > 0 \wedge R_C^M = 0$; (iii) $\tau_M = \tau_C \Rightarrow R_B^M > 0 \wedge R_C^M = 0$; and (iv) $\tau_M = \tau_D \Rightarrow R_B^M > 0 \wedge R_C^M > 0$. The only ambiguity is with respect to b_0 when $\tau_M = \tau_B$. By inserting $\tau_M = \tau_B$ into the margin, we observe that the positive indirect effect is dominating over the negative direct effect if $\underline{V}$ is sufficiently small, $\underline{V} < 1 - c_0$.

Table 5: Regime choice (in favor of A-form) in M-imperfect environment

Effect	M-form optimum	$\underline{U}$	$\underline{V}$	c_0	c_1	b_0	b_1
direct	$\tau_M = \tau_B$	+/0	0	−	−/0	−	0
	$\tau_M = \tau_S$	+	−	−	−	+	+
	$\tau_M = \tau_C$	+	−	−	−	+	+
	$\tau_M = \tau_D$	0	−	−	0	+	+
indirect	$\tau_M = \tau_B$	0	−	0	0	+	+
	$\tau_M = \tau_S$	0	0	0	0	0	0
	$\tau_M = \tau_C$	+	0	−	−	0	0
	$\tau_M = \tau_D$	0	0	0	0	0	0
overall	$\tau_M = \tau_B$	+/0	−	−	−	+	+
	$\tau_M = \tau_S$	+	−	−	−	+	+
	$\tau_M = \tau_C$	+	−	−	−	+	+
	$\tau_M = \tau_D$	0	−	−	0	+	+
overall, robust	$\tau_M < 1$	+/0	−	−	−/0	+	+

Tables 4 and 5 show that the signs are never opposite and thus the comparatives statics predictions are qualitatively similar in M-perfect and M-imperfect environments.

Proof of Lemma 5: Part 1 (*CEO's contract*). The CEO's incentive constraint (normality) requires $x_0 + c_0 = x_\varnothing - \alpha + c_0 \leq x_\varnothing$, or equivalently $\alpha \geq c_0$. Since $c_0 \leq 1$, it can be satisfied without violating project ownership constraint, $\alpha \in [0, 1]$. The CEO's payoff-minimizing contract that satisfies the two constraints is $\alpha = c_0$, and the corresponding CEO's total payoff is $\underline{U}^A = \mu(c_1 + \alpha r) = \mu c_1 + \mu r c_0$. To guarantee participation of the CEO, her fixed wage is $x_\varnothing = \max\{\underline{U} - \underline{U}^A, 0\}$. Notice $\underline{U}^A > \mu c_1$, so the CEO's rent is positive whenever CEO's labor market value is sufficiently low.

Part 2 (*Board's contract*). The board remains normal even with zero shares. The corresponding board's payoff is $\underline{V}^A = \mu b_1$. To guarantee board's participation, her fixed wage is $y_\varnothing = \max\{\underline{V} - \underline{V}^A, 0\} = \underline{V} - \mu b_1$. Since $\underline{V} \geq \mu b_1 = \underline{V}^A$, the board earns zero rent.

Proof of Lemma 6: Part 1 (*CEO's τ-specific contract*). In M-form, the CEO is an empire-builder in the absence of shares and therefore $\alpha_\tau^M = 0$. In the payoff-minimizing contract, she receives zero wage. Given precision τ, she thus faces an ex ante lottery over the total payoffs $(c_0, 0, c_1)$ with probabilities $((1-\mu_h)p_h, p_l, \mu_h p_h) = \left(\mu\frac{1-\tau}{\tau}, 1-\frac{\mu}{\tau}, \mu\right)$. Therefore, $\underline{U}_\tau^M = \mu\frac{1-\tau}{\tau}c_0 + \mu c_1 \geq \mu c_1$. This is decreasing in τ and therefore also the CEO's rent $R_{C,\tau}^M = \max\{\underline{U}_\tau^M - \underline{U}, 0\}$ is (weakly) decreasing in τ.

Part 2 (*Board's τ-specific contract*). The key observation is that the empire-building CEO's optimal signal submitted to a normal board makes the board indifferent over project acceptance and rejection as $\mu_h = \tau$. The indifference means that the board's interim project value is equal to the interim value of rejection, which is zero. Therefore, the board's ex ante payoff in a board's contract that only complies with her normality and project ownership constraints is zero, $\underline{V}_\tau^M = 0 < \mu b_1$. Therefore, the board's rent is zero, $R_{B,\tau}^M = \max\{\underline{V}_\tau^M - \underline{V}, 0\} = 0$. (For completeness, see that board's incentive constraint in τ-specific M-form contract is that her board ownership β must deliver required precision τ, which precisely means $\beta_\tau^M = \frac{\tau b_1 + (1-\tau)(-b_0)}{\tau(1+r)(1-\tau)(-1)}$. It means that not every level of τ is feasible.)

Part 3 (*Shareholders' payoff S^M*). We use that W_τ^M is increasing in τ (recall Proof of Lemma 3), $R_{C,\tau}^M$ is (weakly) decreasing in τ, and $R_{B,\tau}^M$ is constant in τ to observe that $S^M = W_\tau^M - R_{C,\tau}^M - R_{B,\tau}^M - \underline{U} - \underline{V}$ is increasing in τ. Recall also that τ is monotonic in β. Therefore, the M-form optimal board's ownership is either $\beta^M = 0$ and $\beta^M = 1$. In the text, we observe that the maximizer is $\beta^M = \mathbb{1}_{b_1 > -rb_0}$. Using $\tau = \frac{\beta^M - b_0}{\beta^M(1+r) - b_0 + b_1}$ and $\frac{1-\tau}{\tau} = \frac{\beta^M r + b_1}{\beta^M - b_0}$, we derive $\underline{U}^M = \mu\frac{\beta^M r + b_1}{\beta^M - b_0}c_0 + \mu c_1 \geq \mu c_1$. Since $\underline{V}_\tau^M = 0$ for any feasible τ, we also know $\underline{V}^M = 0$.

Proof of Lemma 7: If $S^A \geq S^M$, then, by Lemma 5, the optimal board's contract is $\beta^* = \beta^A = 0$. If $S^A < S^M$, then, by Lemma 6, the optimal board's contract is $\beta^* = \beta^M = \mathbb{1}_{b_1 > -rb_0}$. We prove that $b_1 > -rb_0$ contradicts $S^A < S^M$: See that $b_1 > -rb_0$ implies $\underline{U}^M = \mu\frac{r+b_1}{1-b_0}c_0 + \mu c_1 > \mu r c_0 + \mu c_1 = \underline{U}^A$. Therefore, $R_C^M \geq R_C^A$. Given $R_B^M = R_B^A = 0$ and $W^M < W^A$ (as $\tau^M < 1$), we have $S^M < S^A$. This contradicts $S^A < S^M$.

Proof of Proposition 2:

Table 6 lists direct, indirect and the overall effect of each parametrical change. Like in limited liability contracting, the indirect effect is *opposite to the local effect* of parametrical change on the optimal precision in M-form. For example, when the parameter is b_1, we write $\frac{\partial S^A - S^M}{\partial \tau_M}\frac{\partial \tau_M}{\partial b_1} = -\frac{\partial \tau_M}{\partial b_1}$. Recall also that we are interested in the parametrical environments in which $\underline{U}^A \geq \underline{U}^M$; if $\underline{U}^A < \underline{U}^M$, then the A-form is clearly optimal as the A-form involves higher surplus and (weakly) lower rents.

Table 6: Regime choice (in favor of A-form) in project ownership contracting

Effect	$\underline{U}$	$\underline{V}$	c_0	c_1	b_0	b_1
direct	$+/0$	0	$-/0$	$-/0$	$-$	0
indirect	0	0	0	0	$+$	$+$

Table 6: Regime choice (in favor of A-form) in project ownership contracting

overall	+/0	0	−/0	−/0	+	+

Proof of Lemma 8: Under the A-form, the shareholders' payoff is $S^A = W^A - \max\{\underline{U}^A, \underline{U}\} - \underline{V}$. Since $\underline{U}^A$ is invariant in the board's characteristics, it is sufficient to see that $W^A = \overline{W} = \mu(r + b_1 + c_1)$ is increasing in b_1 and is constant in b_0.

Under the M-form, the shareholders' payoff is $S^M = W^M - \max\{\underline{U}^M, \underline{U}\} - \underline{V} = \overline{W} - \mu\frac{b_1}{-b_0}(1 - c_0 - b_0) - \max\{\underline{U}^M, \underline{U}\} - \underline{V} = \mu(r + b_1 + c_1) - \mu\frac{b_1}{-b_0}(1 - c_0 - b_0) - \max\{\mu\frac{b_1}{-b_0}c_0 + \mu c_1, \underline{U}\} - \underline{V}$. It is decreasing in b_1 and also in b_0.

References

[1] Adams, R., Akyol, A., Verwijmeren, P. (2018). Director skill sets. *Journal of Financial Economics*, 130(3), 641–662.

[2] Adams, R., Ferreira, D. (2007). A theory of friendly boards. *Journal of Finance*, 62(1), 217–250.

[3] Baldenius, T., Melumad, N., Meng, X. (2014). Board composition and CEO power. *Journal of Financial Economics*, 112(1), 53–68.

[4] Baldenius, T., Meng, X., Qiu, L. (2019). Biased boards. *The Accounting Review*, 94(2), 1–27.

[5] Bhagat, S., Bolton, B. (2019). Corporate governance and firm performance: The sequel. *Journal of Corporate Finance*, 58, 142–168.

[6] Caplin, A., Dean, M., Leahy, J. (2019). Rational inattention, optimal consideration sets, and stochastic choice. *Review of Economic Studies*, 86(3), 1061—1094.

[7] Coles, J., Daniel, N., Naveen, L. (2014). Co-opted boards. *Review of Financial Studies*, 27(6), 1751–1796.

[8] Chen, J., Goergen, M., Leung, W., Song, W. (2019). CEO and director compensation, CEO turnover and institutional investors: Is there cronyism in the UK?. *Journal of Banking & Finance*, 103, 18–35.

[9] Chen, K., Guay, W., Lambert, R. (2022). Multidimensional Corporate Governance: The Joint Design of Board Structure and Executive Compensation. Available at SSRN: https://ssrn.com/abstract=3584848.

[10] Dah, M. A., Frye, M. B. (2017). Is board compensation excessive?. *Journal of Corporate Finance*, 45, 566–585.

[11] Décaire, P., Sosyura, D. (2021). CEO Pet Projects. Available at SSRN: https://ssrn.com/abstract=3747263.

[12] Dominguez-Martinez, S., Swank, O. H., Visser, B. (2008). In defense of boards. *Journal of Economics and Management Strategy*, 17(3), 667–82.

[13] Edmans, A., Gabaix, X., Jenter, D. (2017) Executive compensation: A survey of theory and evidence. In B E Hermalin and M S Weisbach (eds.), *Handbook of the Economics of Corporate Governance*, Amsterdam: North-Holland, 383–539.

[14] Edmans, A., Gosling, T., Jenter, D. (2021). CEO compensation: Evidence from the field. CEPR Discussion Paper 16315.

[15] Erel, I., Stern, L., Tan, C., Weisbach, M. (2021). Selecting directors using machine learning. *Review of Financial Studies*, 34(7), 3226–3264.

[16] Fama, E., Jensen, M. (1983). Separation of ownership and control. *Journal of Law and Economics*, 26(2), 301–325.

[17] Fedaseyeu, V., Linck, J., Wagner, H. (2018). Do qualifications matter? New evidence on board functions and director compensation. *Journal of Corporate Finance*, 48, 816–839.

[18] Field, L., Mkrtchyan, A. (2017). The effect of director experience on acquisition performance. *Journal of Financial Economics*, 123(3), 488–511.

[19] Friedman, H., Hughes, J., Michaeli, B., (2020). Optimal signaling when additional information might arrive. *Journal of Accounting and Economics*, 69(2–3), 101276.

[20] Friedman, H., Hughes, J., Michaeli, B., (2022). A rationale for imperfect signaling standards. *Management Science*, 68(3).

[21] Göx, R., Hemmer, T. (2020). On the relation between managerial power and CEO pay. *Journal of Accounting and Economics*, 69(2–3), 101300.

[22] Göx, R., Michaeli, B. (2019). Optimal Information Design and Incentive Contracts with Performance Measure Manipulation. Available at https:// ssrn.com/ abstract=3484199.

[23] Gregor, M., Michaeli, B. (2022). Board bias, information, and investment efficiency. Available at SSRN: https://ssrn.com/abstract=3965147.

[24] Harris, M., Raviv, A. (2008). A theory of board control and size. *Review of Financial Studies*, 21(4), 1797–1832.

[25] Hope, O. K., Lu, H., Saiy, S. (2019). Director compensation and related player transactions. *Review of Accounting Studies*, 24(4), 1392–1426.

[26] Kamenica, E., Gentzkow, M. (2011). Bayesian persuasion. *American Economic Review*, 101(6), 2590–2615.

[27] Jiang, W., Wan, H., Zhao, S. (2016). reputational concerns of independent directors: Evidence from individual director voting. *Review of Financial Studies*, 29(3), 655–696.

[28] Kim, H., Kwak, B., Lee, J., Suk, I. (2019). CEO and outside director equity compensation: substitutes or complements for management earnings forecasts?. *European Accounting Review*, 28(2), 371–393.

[29] Levit, D., Malenko, N. (2016). The labor market for directors and externalities in corporate governance. *Journal of Finance*, 71(2), 775–808.

[30] Laux, V. (2014). Pay convexity, earnings manipulation, and project continuation. *The Accounting Review*, 89(6), 2233–2259.

[31] Linck, J., Netter, J., Yang, T. (2009). The effects and unintended consequences of the Sarbanes-Oxley Act on the supply and demand for directors. *Review of Financial Studies*, 22(8), 3287–3328.

[32] Liu, C., Masulis, R., Stanfield, J. (2021). Why CEO option compensation can be a bad option for shareholders: Evidence from major customer relationships. *Journal of Financial Economics*, 142(1), 453–481.

[33] Masulis, R., Mobbs, S. (2014). Independent director incentives: Where do talented directors spend their limited time and energy?. *Journal of Financial Economics*, 111(2), 406–429.

[34] Shue, K., Townsend, R. (2017). How do quasi-random option grants affect CEO risk-taking?. *Journal of Finance*, 72(6), 2551–2588.

[35] Sila, V., Gonzalez, A., Hagendorff, J. (2017). Independent director reputation incentives and stock price informativeness. *Journal of Corporate Finance*, 47, 219–235.

[36] Wahid, A. S., Welch, K., Maber, D. A. (2019). Professional directors and governance quality. *Contemporary Accounting Research*, 36(4), 2238–2282.

[37] Yermack, D. (2004). Remuneration, retention, and reputation incentives for outside directors. *Journal of Finance*, 59(5), 2281–2308.