Corporate Fraud, Governance and Auditing

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Abstract

We analyze corporate fraud in a model where managers have superior information but, due to private benefits from empire building, are biased against liquidation. This may induce them to misreport information and even bribe auditors when liquidation would be value-increasing. To restrain fraud, shareholders optimally choose auditing quality and the performance sensitivity of managerial pay, taking into account external corporate governance and auditing regulation. For given managerial pay, it is optimal to rely on auditing when external governance is in an intermediate range. When both auditing and managerial incentive pay are used, worse external governance must be balanced by heavier reliance on both of these incentive mechanisms. In designing managerial pay, equity can improve managerial incentives while options worsen them.

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1. Introduction

In many corporate scandals of the past decade, managers have been charged with hiding or distorting key accounting information to pursue corporate expansion plans and keep extracting large benefits of control, in spite of their companies' unsound financial position. For instance, Enron's president Jeffrey Skilling, CEO Ken Lay and CFO David Fastow engaged in fraudulent book-keeping and released false information to securities markets while expanding Enron's empire from natural gas and electricity trading to internet network capacity trading. In the process, they awarded themselves fabulous compensation packages, mainly as options awards. A similar combination of elements is found in the case of Parmalat, whose president Calisto Tanzi concealed large losses and most of the huge debt accumulated while expanding Parmalat's food business and diversifying into non-core sectors such as football, media and travel services. When arrested in September 2003, he admitted diverting to his family € 500 million from the Parmatour subsidiary.

In these corporate scandals, auditing failed to prevent fraud. In Enron's case, in 2002 Arthur Andersen's top managers were convicted of obstruction of justice for shredding documents related to the audit of Enron.[1] Similarly, Parmalat's massive fraud went undetected because in 2003 the auditing firm Grant Thornton accepted a copy of a forged fax sent by Bank of America as valid evidence of a € 3.6 billion credit and € 336 million cash held by Bonlat (a subsidiary of Parmalat), altogether worth 36 percent of Parmalat's debt and accounting for almost all the liquidity of the conglomerate. Prosecutors indicted the Italian division of the accounting firm Deloitte & Touche and of Italaudit, a former branch of Grant Thornton International.

These examples suggest that managers' pursuit of private benefits of control may result in accounting fraud and unfaithful auditing. If so, the incidence of corporate fraud should be greater whenever investors are poorly protected by the law against the extraction of private benefits by managers. But to some extent shareholders may try to restrain fraud by relying on internal governance mechanisms.

We study these issues in a model where managers are better informed than investors, but, due to private benefits from empire building, are biased against liquidation. This may induce them to misreport information and even attempt to bribe auditors when liquidation would be optimal. Poor external corporate governance exacerbates the manager's bias against liquidation, and thereby heightens their incentive to engage in fraudulent accounting and bribe auditors. Shareholders may

[1] Since the Securities and Exchange Commission (SEC) does not allow convicted felons to audit public companies, the firm agreed to surrender its licenses and its right to practice on 31 August 2002.

respond to this problem by increasing the resources spent on auditing and the performance sensitivity of managerial compensation.

Our main contribution lies precisely in the analysis of the optimal response of these internal corporate arrangements to the external institutional setting. The extent to which shareholders will activate internal incentive mechanisms depends on the quality of external corporate governance, as well as on the strictness of the penalties inflicted to corrupt auditors. Both auditing and incentive pay can mitigate the negative effects of poor external governance, but that each has limitations. On one hand, auditing is neutralized by managers' bribes when private benefits are very large, and therefore when the external governance of firms is very poor. On the other, managerial pay must be carefully designed, because increasing its sensitivity to upside risk promotes rather than mitigating incentives to empire building and fraudulent behavior.

We start to analyze the optimal choice of auditing quality for a given managerial incentive pay, so as to focus on the more novel role of auditing quality as internal governance mechanism. Auditing is taken to include not only the verification of accounting data by outside auditing firms, but also the similar activity performed by internal auditors and even by independent directors. The informational basis of corporate policies can be improved by investing in any of these activities.[2] The optimal audit quality turns out to have a non-monotonic relationship with external corporate governance. With poor external governance, auditors are ineffective and therefore hardly worth hiring, since managers would bribe them anyway to avoid liquidation. In an intermediate range of external governance quality, it becomes optimal to hire auditors, as their activity deters managerial fraud. When external governance is very good, auditing become useless again: if managers are very well aligned with shareholders, they can be trusted to do the right thing. Public policy can affect audit quality also via auditing regulation: the stricter are sanctions for disloyal auditors, the wider the region where auditors can be trusted.

Next, we let shareholders choose both audit quality and managerial compensation. Whenever these incentive devices are used together, a deterioration of external governance must be balanced by heavier reliance on both of them: auditing quality must be improved and the equity component of managerial pay increased. Similarly, a less strict auditing regulation (that is, lower sanctions for disloyal auditors) calls for an increase in the equity component of managerial pay. Broadly

[2] Audit quality can be increased by raising the accuracy with which accounting data are verified, for instance by external confirmation of the audited company's credits, by on-site inspections of the company's inventories and via direct interviews with various layers of managers and employees. In general, this greater verification effort by auditors requires more resources in terms of man-hours by qualified personnel and other costs, and therefore translates into steeper auditing costs for the customer company.

speaking, internal corporate governance must substitute for the failings of both external corporate governance and auditing regulation.

While in general it is hard to delimit the parameter region where both audit quality and managerial pay are used as incentive devices, it is possible to do so for one important parameter, namely, the initial assets of the company. As the initial company size increases, the optimal managerial equity stake decreases: intuitively, the more valuable are initial assets relative to the potential gain from continuation, the larger is the dilution that shareholders must accept to discipline management compared to their implied gain in terms of better investment decisions, and therefore the less they should rely on equity in paying managers. In the limit, if the company's initial assets are large enough, it is too costly for shareholders to offer management any equity-based compensation.

This raises the question of whether there are cheaper ways to affect managerial incentives through compensation, and specifically whether call options are preferable to equity. It turns out that within the model this is not true: call options are either ineffective in tempering the manager's bias for continuation, or – if they have a short vesting period – aggravate the tendency towards managerial fraud, in line with the findings of a growing empirical literature. Intuitively, this is because options push managers to take upside risk, while equity-based compensation forces them to take into account also the downside risk generated by unprofitable continuation decisions.

Our paper is related to a recent literature on managerial fraud, among which the closest are Goldman and Slezak (2006) and Povel, Singh and Winton (2008). While the hallmark of our analysis is that shareholders can mitigate managers' incentives to commit fraud both via the design of their compensation and via the choice of auditing quality, the two most related papers concentrate on each of these two levers separately: Goldman and Slezak (2006) focus on equity-based compensation, while Povel, Singh and Winton (2008) on investors' monitoring effort.

These papers differ from ours in other important respects. In Goldman and Slezak (2006), equity-based compensation elicits managerial effort but also induces managers to manipulate earnings to boost stock prices. In contrast, our manager's incentive to misreport derives from an empire-building motive, and equity-based compensation mitigates his fraudulent behavior rather than exacerbating it. The reason is that we assume that compensation can be indexed to the terminal value of stocks, and not to a short-term stock price that managers can manipulate, as assumed by Goldman and Slezak. The analysis by Povel, Singh and Winton (2008) focuses on how investors' monitoring activity varies over the business cycle: they show that in booms investors spend less effort to verify managerial information as their beliefs about companies' investment opportunities are more optimistic than in a slump.[3] In contrast, we focus on how investors' choice of auditing activity (as well as managerial compensation) changes as a result of institutional arrangements, *viz.* external governance rules and auditing regulation.

Our model of auditing is related to the analysis by Dye (1993), where audit quality is unobservable, leading to an agency problem.[4] In contrast, here audit quality is observable, the agency problem arises from the manager's superior information and imperfect alignment with shareholders, and it may extend to auditors if managers bribe them. Our problem is more akin to that analyzed by Kofman and Lawarrée (1993), where an imperfectly informed agent – the auditor – plays a useful role in monitoring a perfectly informed one – the manager – because his incentives can be better aligned with those of the principal. The key differences are that in our setting (i) the audit quality is chosen by shareholders, and that (ii) corporate governance affects the severity of the manager's moral hazard, and thereby the optimal auditing intensity.[5]

Finally, a growing empirical literature has investigated how the incidence of managerial fraud responds to the internal corporate governance of firms and to auditing quality, broadly defined to include the monitoring activity of independent directors. In accordance with our predictions, earning restatements are less frequent in firms whose board or audit committees include an independent director with financial expertise (Agrawal and Chada, 2005) and the incidence of accounting fraud and earnings management is lower in companies with more independent boards (Beasley, 1996; Dechow, Sloan and Sweeney, 1996; Klein, 2002). Another strand of the empirical literature has instead analyzed the relationship between managerial incentive pay and accounting fraud. Bergstresser and Philippon (2006), Burns and Kedia (2006), Kedia and Philippon (2007) and Peng and Röell (2008) have documented that high-powered incentive schemes (especially option-

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[3] This implies that the incidence of corporate fraud should be larger in booms than in slumps, a prediction that Wang, Winton and Yu (2008) show to be consistent with the evidence.

[4] In Dye (1993) the agency problem is disciplined by judicial litigation, to the extent that auditors have wealth that damaged clients can seize. Immordino and Pagano (2007) show how the same agency problem can be tempered by regulations imposing minimum audit standards.

[5] In addition to these, there are two other substantial modeling differences. First, Kofman and Lawarrée (1993) assume that there are two auditors, a corruptible but costless internal auditor and an incorruptible but costly external one, while in our setting there is a single auditor, who is both costly and corruptible. Second, they make different assumptions regarding the state in which the manager has the incentive to bribe the auditor, so that collusion can only occur when the state is favorable to the manager but the auditor makes a mistake. Instead, under our assumptions, the case for collusion is the opposite, that is, it occurs when the state is unfavorable to the manager and the auditor has correctly identified it. A consequence is that in Kofman and Lawarrée (1993) the first-best outcome is achieved if the auditor makes no mistakes, while in our setting this happens only if external corporate governance is sufficiently good.

based ones) are positively correlated with proxies for accounting fraud, such as discretionary accruals, fraud accusations, accounting restatements and security class action litigation.

The contribution of our paper to this line of research is to highlight that the incidence of corporate fraud is not only affected by auditing quality and managerial compensation, but that in turn both of these aspects of the internal governance of firms are endogenous, being optimally chosen by shareholders in response to public policy parameters, namely, to external corporate governance rules and to the stringency of auditing regulation.

The paper is structured as follows. After presenting the model's assumptions in Section 2, Section 3 derives the optimal choice of auditing quality for given managerial compensation, and Section 4 analyzes the joint choice of both incentive schemes. Section 5 concludes.

2. The model

Consider a firm worth V_0, whose continuation requires a cash infusion of size *I*. Absent such refinancing, the company is liquidated at its status-quo value V_0. If shareholders decide to invest the additional resources *I*, the final value of the company changes to $V_1 = V_0 + \tilde{V} - I$, where $\tilde{V}$ is a random variable that equals $V_H > I$ in a good state occurring with probability $p \in (0,1)$ or $V_L < I$ in a bad state occurring with probability $1-p$. Therefore, the investment *I* is profitable in the good state $s = H$ but not in the bad state $s = L$.

There are three players in the model: (i) a manager (*M*), who owns a minority stake γ of the company's shares and runs the company; (ii) non-controlling shareholders (*S*), who own the remaining stake $1-\gamma$ and decide whether to invest and whether to hire an auditor; and (iii) an auditor, who provides a report of quality q for an audit fee F.[6] We assume risk-neutrality, no discounting and limited liability.

If shareholders decide not only to invest *I*, but also to hire an auditor, the company must also disburse the audit fee, so that the required cash infusion is $I + F$. If the company continues to operate, its manager can divert an amount of corporate resources $D > 0$ and appropriate it as private benefits, decreasing the company's value by the same amount. Under liquidation, private benefits

[6] The definition of auditing quality q is provided later in this section.

are set to zero for simplicity.[7] The manager has no wealth when shareholders hire him, and his private benefits cannot be seized: jointly with the limited liability assumption, this implies that his compensation can never be negative.

The unconditional expectation of the firm's incremental value is assumed to exceed the cash infusion *I*: $\bar{V} - D = pV_H + (1-p)V_L - D > I$. Therefore, managerial diversion is not so large as to prevent the firm from investing, although it can lead to a misallocation of resources, by inducing continuation also in the bad state.[8]

The parameter *D* is the maximum private benefit that the manager can extract without incurring into legal sanctions, so that its magnitude can be regarded as an inverse indicator of the quality of *external* corporate governance: it measures the legal constraints that public regulation and enforcement impose on the opportunistic behavior of managers, for example the penalties applying for breaching their fiduciary duty towards shareholders.

While external governance *D* is exogenously given, shareholders can design the company's *internal* governance to maximize the expected continuation value of the firm, by using two levers: managerial compensation and auditing quality. In the baseline model the incentive effect of managerial compensation is captured by the manager's equity stake γ, but subsequently we enlarge the strategy space of shareholders, allowing for more flexible incentive mechanisms which include the assignment of options. Shareholders can also realign managerial incentives to their own by raising auditing quality *q*, for instance by allocating more resources to internal auditors or appointing more independent directors: more intensive auditing enables them to check the truthfulness of the information reported by managers about the profitability of continuation. The aim of the analysis is to characterize the optimal design of internal governance – the choice of γ and *q* – as a function of the external governance parameter *D*.

In the next subsections we complete the description of the game, by presenting the players' payoffs, the game's structure and the equilibrium concept to be used in its solution.

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[7] Our results survive even if the manager's private benefits are positive in case of liquidation, provided they are lower than in case of continuation.

[8] Under the opposite assumption, the unconditional value of the firm under continuation would be negative, so that the inefficiency would be of the opposite sign: the firm would be liquidated too often, instead of too rarely, as in our setting. But the basic logic of the model would be similar.

2.1 Payoffs

Under continuation the value of the company, net of the required investment and of the audit cost, is

$$V_1^c = \begin{cases} V_0 + \tilde{V} - I - D & \text{under no audit,} \\ V_0 + \tilde{V} - F - I - D & \text{under audit,} \end{cases} \tag{1a}$$

while if the company is liquidated, its final value is

$$V_1^l = \begin{cases} V_0 & \text{under no audit,} \\ V_0 - F & \text{under audit.} \end{cases} \tag{1b}$$

Shareholders' wealth is a fraction $1-\gamma$ of this final value, so that their payoff is:

$$\Pi_S^h = (1-\gamma)V_1^h, \tag{2}$$

where $h = c, l$. Shareholders have no private information about the company's final value. Since $\bar{V} - D > I$, in the absence of any further information they will always go for continuation, even in the bad state where this is inefficient. However, they may improve their decision by taking into account the reports supplied by the manager and/or by the auditor.

In contrast to shareholders, the manager is assumed to have perfect knowledge of the company's final value V_1^c under continuation. Since under continuation he also grabs the private benefit *D*, his final payoff is:[9]

$$\Pi_M^h = \gamma V_1^h + D \cdot 1_c, \tag{3}$$

where $h = c, l$ and 1_c is an indicator function equal to 1 under continuation and 0 otherwise. Expression (3) presupposes that the manager cannot trade his stake γ before the company's final value is publicly known ("long vesting"). Even though the manager knows whether continuation is worthwhile or not, he may not have the incentive to report V_1^c truthfully to shareholders: he may prefer continuation even when it is not value-increasing, if the private benefit *D* that he expects to grab exceeds the loss on his stake γ.

[9] This private benefit is assumed to reduce the monetary benefits accruing to shareholders. However, the results would be qualitatively unchanged if private benefit had been modeled as a non-monetary gain that does not decrease the gain to shareholders.

Auditing may allow shareholders to base their investment decision on reliable information that cannot be obtained from the firm's manager. Auditors have a costly technology that helps to distinguish whether continuation will increase or decrease the company's value, and use it to produce a report $r_A \in \{V_L, V_H\}$.[10] An auditor can perform his job at different quality levels, depending on the procedures that he adopts (e.g., external confirmation of accounting data). We denote audit quality by $q \in [0,1]$, where a higher q corresponds to a more precise signal about the company's final value, but implies a larger cost according to the function $C(q)$, which is continuous, increasing and convex in q, with $C(0) = 0$, $\lim_{q \to 0} C'(q) = 0$ and $\lim_{q \to 1} C'(q) = \infty$.

The auditor's signal is perfectly accurate when the state is H, while it may be inaccurate if the state is L. Formally, the conditional probabilities of the auditor's report being correct are:

$$\begin{aligned} &\Pr(r = L \mid s = L,\ q) = q, \\ &\Pr(r = H \mid s = H,\ q) = 1. \end{aligned} \tag{4}$$

This assumption is quite natural in our context, where the manager observes the true state of nature and wishes the firm to continue: in the good state the manager will convey to the auditor the evidence in his possession to show that continuation is worthwhile, and by the same token he will not caution the auditor against any mistake that he may make when the state is bad. This can be thought as a reduced form of a communication stage between the manager and the auditor.

We assume that audit quality is contractible, so that the auditor's fee $F(q)$ can be conditioned on it.[11] To meet the participation constraint of auditors, their fee must cover their costs, that is, $F(q) \geq C(q)$. We assume that there is competition between auditors.[12]

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[10] The task of auditors is to assess the reliability of the historical and prospective information provided by the company's accountants, and to deliver this "certified" information to investors who use it to evaluate the company. As in Dye (1993), here these two phases (data validation and valuation) are collapsed in a single step, by viewing the auditor's report as an assessment of the company's value.

[11] We assume that the auditor's fee is not conditional on the ex-post accuracy of the report. If optimally designed by shareholders, such a fee would help discourage bribe-taking by the auditor compared to an unconditional fee. However, the analysis under this more sophisticated contract yields no qualitatively new insights and is considerably more complex. Moreover, managers may take advantage of contingent auditing fees to bribe auditors more effectively, rather than to deter them from bribing. This may explain why contingent audit fees are not observed in reality.

[12] The model could easily allow for auditors' rents arising from market power. The only significant change in results would be that the manager's ability to bribe auditors would be correspondingly reduced, since the danger of losing a higher fee would induce auditors to behave better.

If the firm has hired an auditor and the latter has discovered that the firm's incremental value is low ($V = V_L$), the manager may attempt to bribe him into reporting V_H. As such, bribing cannot occur in the good state ($V = V_H$), where the auditor's report would be favorable to continuation anyway.[13] The auditor is assumed to have a reservation bribe: he will not lie unless he receives at least a bribe $\overline{B}$, which may reflect ethical and reputational concerns or fear of a legal sanction. The actual bribe is determined by a take-it-or-leave-it offer:[14] the manager pays to the auditor the reservation bribe $\overline{B}$ and earns the surplus stemming from the more likely continuation. When indifferent, the manager is assumed to prefer not to bribe the auditor. If the auditor does not accept the bribe, he will misreport the state of the world only by mistake, by reporting $r_A = V_H$ in the bad state. This occurs with probability $(1-p)(1-q)$, where $1-p$ is the probability of the bad state and $1-q$ is the probability of an inaccurate report.

For auditing to play a potentially beneficial role in the allocation of investment, its cost to the firm must not be prohibitively high. Therefore, we assume that at least in the good state the company makes a profit even after paying for the cost of auditing, that is $V_0 + V_H - I - D - F > 0$, where *F* is optimally chosen by shareholders. The precise parameter restrictions that are implied by this assumption will be specified below, once the optimal audit contract will be characterized.

2.2. Structure of the game

There are six stages in the game, as illustrated by the time line in Figure 1. At stage 0, shareholders choose the manager's compensation contract, which in the baseline version of the model consists of his equity stake γ. At stage 1, nature (*N*) determines the incremental value of the company under continuation: V_H with probability *p*, or V_L with probability $1-p$. At stage 2, the manager observes the state of nature and reports $r_M \in \{V_L, V_H\}$ to shareholders, either truthfully or not. At stage 3, shareholders decide whether to audit the company or not. If they opt for not auditing the firm, they must decide whether to invest or not on the basis of the manager's report alone. If so, the game ends, and its payoffs are realized. If instead shareholders choose to get a

[13] We rule out the possibility for the auditor to blackmail the manager when the signal is positive, thus obtaining a bribe also in this state of nature.

[14] This assumption is made only for simplicity. Allowing for more general assumptions about the bargaining power of the manager and the auditor would leave the equilibrium qualitatively unaffected.

second opinion from an auditor, the game moves to the next stage. At stage 4, the auditor observes the signal about the state, may accept a bribe from the manager, and files a report $r_A \in \{V_L, V_H\}$ to shareholders. Finally, at stage 5, shareholders choose whether to invest or not based on both the manager's and the auditor's reports, and payoffs are realized.

[Insert Figure 1]

The extensive form of the game is illustrated by the tree in Figure 2, where each node is marked by the initial of the player moving at the node. To save space, we omit payoffs at the final nodes.

[Insert Figure 2]

After the stage-0 choice of the equity stake γ and the stage-1 move by nature (*N*), the manager (*M*) files a report to shareholders: at stage 2 his action is $a_2 \in \{L, NL\}$, where *L* stands for "lying" and *NL* for "no lying". If indifferent, he is assumed to prefer not to lie.[15]

At stage 3, shareholders (*S*) decide whether to audit the company or not, and set the audit quality q by maximizing their expected payoff conditional on the manager's report, $\mathrm{E}(\Pi_S^h \mid r_M)$, where Π_S^h is defined by (2). So they choose action $a_3 \in \{A, NAI, NANI\}$, where *A* stands for "audit", *NAI* for "no audit and investment", and *NANI* for "no audit and no investment". In the figure, shareholders' uncertainty about the value of the company is captured by marking the nodes that they consider as belonging to the same information set either by Γ_i (if the manager reports V_L) or by Λ_i (if the manager reports V_H), for $i = 1, 2$.

If an auditor is appointed, the game moves to stage 4, where nature determines the auditor's draw of a signal about the firm's value: under our assumptions, this signal is always correct if the state is V_H, while it is correct with probability q if the state is V_L. In the latter case, the manager may choose to bribe the auditor to induce him to produce a positive report $r_A = V_H$ anyway.[16]

[15] This tie-breaking condition can be rationalized with the presence of a small psychological cost of lying, or a reputational cost in the presence of a small probability of detection.

[16] Since the accounting information on which the auditor bases his report is provided by the manager, it is natural to assume that the latter knows whether the auditor has received a negative signal about the firm's quality, which is the only case in which bribing him may benefit the manager.

Offering a bribe is denoted as action *B*, and not doing so as *NB*. The manager chooses $a_4 \in \{B, NB\}$ so as to maximize his payoff Π_M^h, as defined by (3).[17]

At stage 5, shareholders decide whether to invest (*I*) or not (*NI*). They take this action, denoted by $a_5 \in \{I, NI\}$, by maximizing their expected payoff conditional on the two reports $\{r_M, r_A\}$ issued by the manager and the auditor, $\text{E}(\Pi_S^h \mid r_M, r_A)$. In this case Π_S^h is net of the audit cost *F*. But since this cost is paid irrespective of the investment decision (i.e., is sunk at this stage of the game), it does not affect the choice between the actions *I* and *NI*. At this stage of the game, the shareholders' uncertainty about the value of the company is captured by marking the nodes that belong to the same information sets either by Θ_j (if both manager and auditor report V_H) or by Ψ_j (if the manager reports V_L and the auditor report V_H), for $j = 1,2,3$.

2.3. Strategies and equilibrium concept

The shareholders' strategy is a triple $\sigma_S = \left(a_0, a_3(r_M), a_5(r_M, r_A)\right)$: shareholders choose the manager's stake *γ* and take the investment decision at stage 3 conditioning only on the manager's report, or at stage 5 conditioning also on the auditor's report. Instead, the manager's strategy is a couple $\sigma_M = \left(a_2(\tilde{V}), a_4(V_L, a_2)\right)$, where the decision about lying, $a_2(\tilde{V})$, is conditional on the actual value of the company, and the decision about bribing the auditor, $a_4(V_L, a_2)$, also depends on whether the manager himself has previously lied or not.

At stages 3 and 5, shareholders choose their actions based on beliefs about the state of nature, conditional on the information available to them: their belief of being in the good state is denoted by $\beta(r_M) = \Pr(\tilde{V} = V_H \mid r_M)$ at stage 3, and by $\beta(r_M, r_A) = \Pr(\tilde{V} = V_H \mid r_M, r_A)$ at stage 5.

In what follows, we will seek the triples $\{\sigma_S, \sigma_M, \beta\}$ that form the pure-strategy perfect Bayesian equilibria (PBE) of the game described so far. We will show that the PBE of the game features a unique equilibrium outcome. All proofs are in the Appendix.

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[17] Differently from the shareholder, the manager does not maximize an expected payoff but its realized value, because he has perfect knowledge of the true state of nature throughout the game.

3. Equilibrium auditing quality

In this section, we solve for the PBE of the game conditional on a given managerial equity stake γ chosen by shareholders at stage 0, leaving the determination of the optimal γ to Section 4. We derive the equilibrium strategies separately for three regions that differ by the quality of the external corporate governance *D*. Corporate governance is defined to be good, intermediate or poor depending on whether the private benefit is small, intermediate or large, in a sense to be made precise below. We will see that the shareholders' incentives to rely on auditors' services differ across these regions. This is illustrated in Figure 3, which graphs the audit quality optimally chosen by shareholders as a function of *D*, for a given managerial stake *γ*.

[Insert Figure 3]

3.1. Good corporate governance

This region corresponds to values of the manager's private benefit small enough that he wishes to disclose the true value of the firm under continuation. Suppose that the manager knows that shareholders will base their refinancing decision on his report. Then, if the firm's true continuation value is low and the manager files a truthful report, shareholders will not invest and the manager will cash in only his fraction of the firm's liquidation value, γV_0. If instead the manager lies, he induces shareholders to invest and his payoff will be $\gamma(V_0 + V_L - I - D) + D$, that is, a fraction γ of the firm's final value plus his private benefit *D*. By lying, he makes losses on his equity stake (since $V_L - I - D < 0$) but gains the private benefit *D*. He will be indifferent between lying and not lying if *D* takes the threshold value

$$D_0 = \frac{\gamma}{1-\gamma}(I - V_L)\,. \tag{5}$$

For values of *D* above this threshold, he will lie. At the threshold or below it, he will not.[18]

Note that the good corporate governance region is non-empty: D_0 is strictly positive, since by assumption $I - V_L > 0$. The area of this region is increasing in the manager's stake γ and in the loss $I - V_L$ from undue continuation: as both raise the manager's loss from continuation, these

[18] If $D = D_0$, our tie-breaking assumption implies that the manager prefers not to lie.

parameter changes increase his willingness to tell the truth, unless his private benefits increase correspondingly.

In the region where $D \leq D_0$, the manager's interest is so well aligned to that of shareholders that in equilibrium the latter do not elicit a second opinion from an auditor. Thus in Figure 3 the auditing intensity q in this region is zero. More precisely:

Proposition 1. *If $D \leq D_0$, then the unique equilibrium outcome is such that shareholders do not appoint an auditor and the first best is achieved.*

In this case, in equilibrium investment is undertaken only in the good state and no money is wasted on hiring an auditor, so that the expected return to investment is at the highest possible level $p(V_H - I)$. Since the manager diverts an amount D of this surplus, shareholders earn an expected payoff $(1-\gamma)[V_0 + p(V_H - I - D)]$. In this region, we have two equilibria that result in the same investment decision but differ as to the manager's strategy. In one, the manager never lies, so that shareholders invest according to his report. In the other, the manager always lies, and shareholders adopt a "contrarian" strategy: they invest when the manager's report is negative and do not when his report is positive. Of course, in the latter equilibrium the outcome is the same as in the former.

3.2. Intermediate corporate governance

For values of the manager's private benefit above the threshold D_0, the manager will lie, so that a second opinion by an auditor may help shareholders in deciding whether to finance the company's continuation. But an audit is helpful only if the manager does not bribe the auditor. This requires the manager's private benefit to fall short of another threshold, to be denoted by D_1. To determine this new threshold, consider the scenario in which the manager expects shareholders to base their investment decision on the auditor's report, the state of nature is bad and the auditor has correctly evaluated the investment. Then, if the manager does not bribe the auditor, the latter's report will be negative, shareholders will not go ahead with the investment and the manager's payoff will be $\gamma(V_0 - F)$. If instead the manager wishes to bribe the auditor, he must pay his opportunity cost $\overline{B}$. Then, shareholders will invest and the manager's payoff will be $\gamma(V_0 + V_L - I - D - F) + D - \overline{B}$. By bribing the auditor, the manager loses monetary benefits (since $V_L - I - D < 0$) and the bribe $\overline{B}$, but gains the private benefit D. Equating these two payoffs, the manager is seen to be indifferent when D equals the threshold

$$D_1 = D_0 + \frac{1}{1-\gamma}\overline{B}. \qquad (6)$$

Above this threshold, he will bribe the auditor. At the threshold and above it, he will not.[19]

The intermediate corporate governance region $(D_0, D_1]$ is non-empty since $\overline{B} > 0$, and is increasing in $\overline{B}$ and in γ. Intuitively, if auditors are harder to bribe (higher $\overline{B}$), the region where the manager does not bribe them expands. The same logic applies to a larger γ: if the compensation package better aligns the manager's incentives with shareholders' interests, the region where the manager does not wish to bribe the auditor expands.

Suppose that in this region shareholders appoint an auditor who does not accept a bribe, and invest according to the auditor's report. (Below we will show that in this region this is the unique equilibrium outcome.) Then, they will want to choose q so as to maximize their expected payoff:

$$\mathrm{E}(\Pi_S^h) = (1-\gamma)\left\{V_0 + p(V_H - I - D) + (1-q)(1-p)(V_L - I - D) - F\right\}. \qquad (7)$$

In this expression, the term $p(V_H - I - D)$ is the expected after-diversion profit in the good state, when the firm always continues; the term $(1-p)(V_L - I - D)$ is its analogue in the bad state, when the firm invests only if the auditor makes a mistake, which occurs with probability $1-q$; and the last term is the audit cost. The shareholders' expected payoff (7) can be rewritten as:

$$\mathrm{E}(\Pi_S^h) = (1-\gamma)\left\{V_0 + \overline{V} - I - D + q(1-p)(I - V_L + D) - F\right\}. \qquad (7')$$

Without an auditor, the company would invest in all circumstances, since the manager would always lie (as $D > D_0$). So the shareholders' payoff would equal their share of the company's expected value under continuation, net of the manager's private benefit, that is, $(1-\gamma)(V_0 + \overline{V} - I - D)$. Subtracting this expression from (7'), one obtains the benefit that shareholders draw from the auditor: this benefit is the "informational value" of auditing, $(1-p)q(I - V_L + D)$, minus its cost F. The informational value of the auditor arises from the fact that with probability $(1-p)q$ he spares shareholders two losses: the loss $I - V_L$ from mistaken continuation, and the diversion D that goes with it.

[19] If $D = D_1$, our tie-breaking assumption implies that the manager prefers not to bribe the auditor.

To determine the optimal audit quality, shareholders maximize their payoff $E(\Pi_S^h)$, subject to paying auditors at least their cost. Formally, dropping from (7') the terms unaffected by q and F, shareholders solve the following problem:

$$\max_{q,F} \; q(1-p)(I-V_L+D)-F \,, \tag{8}$$

subject to the auditor's participation constraint

$$F \geq C(q) \,. \tag{9}$$

The solution to this problem is characterized in the following:

Lemma 1. *In the equilibrium with auditing, the optimal audit quality* $q^*(D)$ *is increasing in* D *for* $D_0 < D \leq D_1$.

Proving Lemma 1 is immediate. In the interval $D_0 < D \leq D_1$, competition among auditors ensures that the participation constraint is binding, so that $F = C(q)$. Replacing this condition in the maximand (8) and differentiating with respect to q, one obtains the following condition that defines implicitly the optimal audit quality:[20]

$$(1-p)(I-V_L+D) = C'(q^*) \,. \tag{10}$$

By equation (10), the audit quality is chosen so as to equate the marginal informational value of the audit to its marginal cost. Since the marginal cost is increasing in q, the optimal audit quality q^* is increasing in the private benefit D: intuitively, the larger the private benefit in the event of continuation, the more willing shareholders are to raise audit quality as to avoid diversion by the manager when continuation is unwarranted.

The result described so far rests on the assumption that, for $D_0 < D \leq D_1$, there is an equilibrium with auditing. In this region this is indeed the unique equilibrium outcome:

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[20] Under our hypotheses on the limiting behavior of the $C(q)$ function, this optimality condition identifies an interior solution $q^* > 0$.

Proposition 2. *If* $D_0 < D \leq D_1$*, then the unique equilibrium outcome is such that the manager's report is uninformative, shareholders appoint an auditor and continuation occurs if and only if the auditor's report is positive.*

In this region shareholders rely on the auditor in spite of the fact that his information is less precise than that of the manager. The reason is that the manager cannot be trusted, as his incentives are insufficiently aligned with those of shareholders. In contrast, the auditor's imprecise information can be trusted, since in this region he will not be bribed. This result is reminiscent of Kofman and Lawarrée (1993), where an imperfectly informed agent helps monitoring a perfectly informed one because his incentives are better aligned with those of the principal.

It should be noticed that the pure-strategy equilibrium described by Proposition 2 may not always exist. To understand why, consider that, through his equity stake γ, the manager contributes also to the auditors' fee *F*. Therefore, when his private benefit is sufficiently low, he may have no incentive to lie in the bad state if an auditor has been hired, in which case the auditor is no longer necessary. But if no auditor were hired, the manager's profit in the bad state would increase and he would have an incentive to lie.

3.3. Poor corporate governance

This region corresponds to values of the private benefit that are so large that the manager has the incentive to bribe the auditor, so that shareholders prefer to forgo the auditor's services. In this region, they also expect the manager to lie when the firm's value is low, and therefore they will always invest irrespective of the manager's report. As a result, their expected payoff is:

$$\mathrm{E}(\Pi_S^c) = (1-\gamma)(V_0 + \overline{V} - I - D)\,. \tag{11}$$

More specifically:

Proposition 3. *If* $D > D_1$*, then the unique equilibrium outcome is such that the manager's report is uninformative, shareholders do not appoint an auditor and continuation always occurs.*

Intuitively, in this case private benefits are so large that they induce the manager both to lie and to bribe the auditor. External corporate governance is so poor that auditing is unable to counteract it, and managers get it their way.

3.4. Effect of public policy on auditing

In this model, public policy can affect private decisions in two ways. As already mentioned, it sets the degree of shareholder protection against managers' abuses, and thereby private benefits D. This is what we have labeled as external corporate governance. But public policy may also repress abuses by auditors: the penalties upon corrupt auditors will affect their reservation bribe, with a higher value of $\overline{B}$ reflecting a larger penalty and/or likelihood of enforcement. In response to the two policy parameters D and $\overline{B}$, shareholders determine optimally their reliance on auditors in investment decisions, i.e. the audit quality q.

The analysis in the previous sections indicates how external corporate governance affects audit quality. As shown in Figure 3, the response of the optimal audit quality to a worsening of external governance (an increase in D) is non-monotonic: q^* jumps from zero to a positive level as D crosses the threshold D_0, then it keeps rising in the intermediate region, and finally drops back to zero upon crossing the higher threshold D_1. Therefore, in the good and intermediate regions, better audit quality tends to compensate for worse external governance: shareholders rely more on auditors as the managers' ability to grab private benefits increases. But if external governance is too weak, auditing breaks down as an incentive mechanism: no auditors are employed in the poor governance region. If empirically most countries fall in the intermediate region, the model predicts that companies' reliance on auditors (as measured, for instance, by resources spent on internal auditing) should be decreasing in the quality of external governance, while being negligible only where the quality of external corporate governance is extreme – either poor or excellent .

As mentioned above, the severity of the penalties inflicted to auditors, that is, the level of $\overline{B}$, can be regarded as an additional policy instrument. From equation (6), it is immediate that an increase in $\overline{B}$ translates into a proportional increase in the threshold D_1, so that the intermediate governance region expands at the expense of the poor governance region: this is illustrated in Figure 4, where the dashed line shows the new optimal audit quality. Intuitively, if the law punishes corrupt auditors more severely, shareholders will rely more heavily on auditors, as these are more trustworthy monitors of management. Empirically, the prediction is that where auditing regulation is stricter, companies are more likely to rely on auditors even if external corporate governance is rather weak.

[Insert Figure 4]

So far, the analysis has been conducted for a given managerial stake γ. However, to control managers' incentives shareholders can also fine-tune the managerial compensation scheme, besides the resources devoted to auditing: they can increase the managerial stake γ instead of raising the auditing quality q. The extent to which they will rely on each of these two control variables depends on their relative costs and effectiveness. To analyze this point, we turn to stage 0 of the game, where shareholders choose the managerial compensation scheme.

4. Managerial compensation

In designing managerial compensation, shareholders must trade off managerial incentives with their cost. To induce good behavior by the manager, they must compensate him via an equity stake γ, possibly in addition to a fixed salary. By doing so, they forgo a fraction γ of the final value of the company V_1, as defined by (1a) and (1b).[21] For simplicity, we set the manager's reservation utility equal to zero.

In the previous section, we have shown that, depending on the model's parameters, the firm's continuation decision may be based on (i) the manager's report r_M alone, (ii) the auditor's report r_A alone, or (iii) neither of them. In each of these instances, the manager must be given a different initial stake: (i) for r_M to be reliable, the size of the manager's stake must ensure his sincerity; (ii) for r_A to be reliable, the size of his stake must deter him from bribing the auditor; (iii) if neither report is trusted, it is not worth giving the manager any equity. Let us denote the maximal value of the shareholders' payoff by $\Pi(r_M)$ in case (i), by $\Pi(r_A)$ in case (ii) and by $\Pi(\varnothing)$ in case (iii). In the appendix (see the proof of Proposition 4), we show that these maximal payoffs are respectively:

$$\Pi(r_M) = \frac{I - V_L}{I - V_L + D} \cdot \left[V_0 + p(V_H - I - D) \right],$$

$$\Pi(r_A) = \min\left\{1, \frac{I - V_L + \overline{B}}{I - V_L + D}\right\} \cdot \left[V_0 + \overline{V} - I - D + q^*(1-p)(I - V_L + D) - C(q^*) \right], \qquad (12)$$

$$\Pi(\varnothing) = V_0 + \overline{V} - I - D,$$

[21] Recall that the manager cannot be asked to pay for the stake, since he is assumed to have no initial wealth.

where q^* is defined by equation (10). Shareholders will choose the managerial stake γ and auditing intensity that correspond to the case where their expected payoff is largest. This choice is described by the following proposition:[22]

Proposition 4. *The optimal managerial stake and audit quality are:*

(i) $\gamma = \frac{D}{I - V_L + D}$, $q = 0$ *if* $\Pi(r_M) > \max\{\Pi(r_A), \Pi(\varnothing)\}$,

(ii) $\gamma = \max\left\{0, \frac{D - \overline{B}}{I - V_L + D}\right\}$, $q = q^*$ *if* $\Pi(r_A) > \max\{\Pi(r_M), \Pi(\varnothing)\}$,

(iii) $\gamma = 0$, $q = 0$ *if* $\Pi(\varnothing) > \max\{\Pi(r_M), \Pi(r_A)\}$.

This proposition shows that the managerial stake is largest when the firm's continuation decision is based on the manager's report r_M (case (i)); it is intermediate when this decision is based on the auditor's report r_A (case (ii)); and it is smallest where neither report is trusted (case (iii)). This reflects decreasing demands on the manager's loyalty across these three cases.

In case (ii), where shareholders use both the auditing quality q and the managerial stake γ to discipline management, a change in external corporate governance pushes both q and γ in the same direction: as external governance improves (*D* falls), shareholders can afford to decrease both the auditing quality q and the managerial stake γ, that is, need to use less intensively both of the incentive devices under their control.

Stricter regulation of auditing has a similar effect on the managerial equity stake. A stiffer expected penalty on fraudulent auditors, which is captured by a higher reservation bribe $\overline{B}$, is associated with a smaller optimal managerial stake γ. Intuitively, if public policy makes the auditor harder to bribe, shareholders can afford to provide less incentives to the manager, and can even reduce his stake down to zero if $\overline{B}$ becomes so large as to exceed private benefits ($\overline{B} > D$).[23]

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[22] On top of the incentive compensation arising from the equity stake, the manager receives no fixed wage, which is due to the simplifying assumption that the manager's reservation utility is zero: if this assumption is removed, the wage will be determined by the manager's participation constraint, and therefore will be inversely related to his equity stake.

[23] Moreover, a higher $\overline{B}$ increases the payoff $\Pi(r_A)$ that shareholders obtain in case (ii), and therefore expands the parameter region where they rely on the auditor.

In conclusion, in the region where an auditor is employed, an improvement in public regulation (a lower D or a higher $\overline{B}$) allows companies to relax their standards in designing internal corporate governance: broadly speaking, the public and private dimensions of governance appear to be substitutes.

Which of the three regimes described in Proposition 4 do shareholders prefer? The ranking is determined in a complex way by the numerous parameters of the model.[24] The value of the initial company's assets, V_0, is the only parameter that affects the ranking between the three regimes in a way that is both unambiguous and economically relevant: as V_0 increases, its effect on profits is smallest in case (i), intermediate on those in case (ii) and largest in case (iii). As a result, case (i) will be relevant for a firm with little assets in place, case (ii) for an intermediate firm, and case (iii) for a firm with very large initial assets. The implied prediction is that as V_0 increases, the optimal managerial equity stake γ decreases: intuitively, the larger the initial value of the company's assets, the costlier it is to discipline management in terms of forgone wealth, and therefore the lower the reliance on equity in managerial compensation. This prediction is consistent with the evidence in Murphy (1999), who documents that pay-for-performance sensitivity is lower in larger companies.

This could lead to the conjecture that using options – or some mix of options and equity – may improve the efficiency of the managerial compensation package. It has been argued that call options can be cheaper than equity as a managerial incentive scheme (Hall and Murphy, 2000). However, in our model this conjecture is incorrect:

Proposition 5. *Equity dominates call options in managerial incentive compensation.*

To prove this statement, we need to distinguish between call options with a long vesting period and those with a short one, depending on whether they can be exercised after the state of the world is publicly known or already at the time of the investment decision (stage 5 of the model). In the first case, it is easy to show that options have no effect on managerial incentives. In the second case, where early exercise is possible, options actually worsen the manager's incentive to inefficient continuation, compared to equity.

[24] For some parameters, the complexity stems from the fact that they affect both the shareholders' stake $1-\gamma$ and the equilibrium value of the company. Intuitively, as one moves from regime 1 to regime 3, shareholders retain an increasingly larger slice of a smaller pie, since by sharpening the manager's incentives the firm's expected profitability increases. Several of the model's parameters affect both of these magnitudes.

Consider first the case where options can be exercised only after the state of nature is public knowledge. Here options do not change the manager's incentive to lie or bribe, as they go in the money only in the good state, in which the manager already wishes to tell the truth so as to grab the private benefit from continuation. Vesting the manager with such options simply imposes a cost on shareholders without improving the manager's incentives, and therefore is dominated by equity-based compensation, which instead penalizes the manager for inefficient continuation.

Consider next the scenario where options have a short vesting period and their exercise price is such that they go in the money if the good state is believed to have occurred. Then, a manager who in the bad state were to lie or bribe the auditor and thereby induce shareholders to invest, would not only earn the private benefit *D* but also be able to exercise his options. This would clearly worsen the manager's alignment with shareholders, being tantamount to boosting his private benefits from continuation, thus exacerbating his tendency to file fraudulent reports to shareholders and/or bribe auditors. This accords with recent empirical literature showing that the importance of options in managerial compensation correlates positively with proxies for accounting fraud, such as discretionary current accruals, fraud accusations, accounting restatements and security class action litigation (see for instance Bergstresser and Philippon, 2006, Burns and Kedia, 2006, Kedia and Philippon, 2007, and Peng and Röell, 2008).

But in general even equity is not the optimal compensation scheme in this model. Indeed, the optimal contingent payment scheme requires a compensation *D* when the manager reports the bad state and zero otherwise. Under this scheme, in the bad state he receives compensation *D* if he tells the truth or the same amount as private benefit if he lies: being indifferent, by our tie-breaking rule he will report truthfully. In the good state, he receives the private benefit *D* if he tells the truth and zero is he lies, so again truth-telling is assured.[25] This compensation scheme can be achieved also by making it contingent on final price of the company: the manager will receive zero when the company's value is high ($V_0 + V_H - I - D$, upon continuation in the good state) or low ($V_0 + V_L - I - D$, upon continuation in the bad state), while he receives *D* when company's value is unchanged (V_0, upon no continuation in the bad state). This compensation scheme may also be

[25] Notice that shareholders have no choice but leaving private benefit *D* to the manager in the good state, since by assumption it cannot be seized. In a setting where the manager has a positive reservation utility, this private benefit would help satisfy the manager's participation constraint. If his reservation utility exceeds *D*, then the optimal compensation scheme would also have to include a fixed salary.

implemented with options, by vesting the manager with a short straddle portfolio, which profits when the underlying security changes little in price before the expiration of the straddle.[26]

This optimal compensation scheme would may appear strange in the context of the theoretical literature on executive compensation, where giving call options to managers is seen as enhancing their incentives to exert effort and take risk (see for instance Smith and Stulz, 1985, Hall and Murphy, 2000, and Dittman and Maug, 2007). The reason is that the agency problem present in our model does not arise from the manager's effort or risk aversion, but from his bias for continuation. This illustrates that depending on the agency problem that executive compensation is supposed to mitigate, the efficient set of financial contracts can be dramatically different. It is natural to conjecture that in a more general model where both types of agency problems are present, both call and put options might be employed, depending on the model parameters.

6. Conclusions

This paper presents a model of managerial fraud where managers possess superior information about the prospects of their company but, due to the private benefits from empire building, have a bias against firm's liquidation. This bias may induce them to misreport their information and even attempt to bribe auditors when liquidation would be optimal. We use this model to study how shareholders should optimally design the firm's internal corporate governance so as to control for managerial fraud, along two dimensions: the quality of auditing, and the performance sensitivity of managerial compensation.

Our main contribution is to characterize how both of these aspects of the internal governance of firms should optimally respond to changes in public policy parameters, namely, the quality of external corporate governance and the stringency of auditing regulation. We find that, for given managerial pay, it is optimal to rely on auditing when external governance is in an intermediate range. When both auditing and managerial incentive pay are used, worse external governance must be balanced by heavier reliance on both of these incentive mechanisms. We also show that equity dominates options in the design of managerial compensation.

The model offers potentially useful lessons for empirical research seeking to identify the company-level arrangements that can control the incidence of corporate fraud. First, both the

[26] A short straddle is a portfolio of options that involves simultaneously selling a put and a call of the same underlying security, strike price and expiration date.

resources devoted to auditing and a suitably designed managerial incentive should be included in empirical studies as potential company-level determinants of the incidence of corporate fraud. Second, both of these arrangements are predicted to optimally respond to regulation, and therefore should be instrumented with measures of external corporate governance and auditing regulation.

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Appendix

We start by presenting three lemmas containing results that will subsequently facilitate the derivation of equilibria. Lemma A1 identifies preferred choices and beliefs in cases where these do not depend on the managerial stake *γ*. These choices and beliefs will be part of any equilibrium and therefore are marked by asterisks.

Lemma A1. (i) $a_5^*(V_H,V_L)=a_5^*(V_L,V_L)=NI$. (ii) $\beta^*(V_H,V_L)=\beta^*(V_L,V_L)=0$.

(iii) $\beta^*(V_L,V_H)=\beta^*(V_H,V_H)=p$ when $a_4^*(V_L,L)$=$a_4^*(V_L,NL)=B$.

(iv) $\beta^*(V_L,V_H)=\beta^*(V_H,V_H)=p/[p+(1-p)(1-q)]$ when $a_4^*(V_L,L)$=$a_4^*(V_L,NL)=NB$.

(v) $a_5^*(V_L,V_H)=a_5^*(V_H,V_H)=I$.

Proof of Lemma A1. (i) From Figure 2, it is evident that the couple of reports (V_H,V_L) received by shareholders corresponds to a singleton, so that they are aware that $V=V_L$ and therefore prefer no investment. The same applies when the couple of reports is (V_L,V_L).

(ii) As already explained under (i), the couple of reports (V_H,V_L) corresponds to a singleton, so that the belief that $V=V_H$ is zero: $\beta(V_H,V_L)=0$. The same applies when the reports is (V_L,V_L).

(iii) When the reports received by *S* are (V_L,V_H), the information set is $\Psi=\{\Psi_1,\Psi_2,\Psi_3\}$. The assumption that *B* is chosen by *M* when $V=V_L$ (whether *M* previously lied or not) implies that the play may have reached node Ψ_1 or Ψ_2 with probability $1-p$, and Ψ_3 with probability *p*. Hence by Bayes' rule, the belief that $V=V_H$ is *p*: $\beta(V_L,V_H)=p$. When the reports received by *S* are (V_H,V_H), the information set is $\Theta=\{\Theta_1,\Theta_2,\Theta_3\}$. Using the same argument as before, the play may have reached node Θ_1 or Θ_2 with probability $1-p$, and Θ_3 with probability *p*. Hence by Bayes' rule, the belief that $V=V_H$ is *p*: $\beta(V_H,V_H)=p$.

(iv) The argument is similar to that used under point (iii), with the only difference that now *NB* is assumed to be chosen by *M* when $V=V_L$ (whether he previously lied or not). Then, when the reports received by *S* are (V_L,V_H), the play may have reached only node Ψ_2 or Ψ_3, with probabilities $(1-p)(1-q)$ and *p* respectively. Hence by Bayes' rule, the belief that $V=V_H$ is *p*:

$\beta(V_L,V_H) = p/\left[p+(1-p)(1-q)\right]$. When instead the reports received by S are (V_H,V_H), the play may have reached only node Θ_2 or Θ_3, with probabilities $(1-p)(1-q)$ and p respectively, so that the belief that $V = V_H$ is p: $\beta(V_H,V_H) = p/\left[p+(1-p)(1-q)\right]$.

(v) When the reports received by S are (V_L,V_H), from points (iii) and (iv) S holds the belief $\beta(V_L,V_H) = p$ if M chooses B, or $\beta(V_L,V_H) = p/\left[p+(1-p)(1-q)\right]$ if M chooses NB. If M chooses B, S's expected payoff from investing is the unconditional expectation $(1-\gamma)(V_0+\bar{V}-I-D-F)$, which is to be compared with a payoff $(1-\gamma)(V_0-F)$ in case of no investment. The difference between these two expected payoffs is $(1-\gamma)(\bar{V}-I-D)$, which is positive by assumption. Therefore, S will invest. If instead M were to choose NB, then S's payoff would be the conditional expectation $(1-\gamma)\left[V_0+E(V|V_L,V_H)-I-D-F\right]$, which is to be compared with a payoff $(1-\gamma)(V_0-F)$. The difference $(1-\gamma)\left[E(V|V_L,V_H)-I-D\right]$ is larger than its unconditional analogue, and therefore it is also positive, so that S would invest. Therefore, when S receive the reports (V_L,V_H), they will always invest. Using the same reasoning it is easy to show that when S receive the reports (V_H,V_H), they will always invest. ■

The following lemma shows that in the regions where corporate governance is intermediate or good, the manager does not bribe the auditor:

Lemma A2. $a_4^*(V_L,L) = a_4^*(V_L,NL) = NB$ if and only if $D \leq D_1$.

Proof of Lemma A2. Suppose that $V = V_L$, the manager lied (L) and the auditor correctly identified the state, which happens with probability q. Then, M must decide whether bribing the auditor or not. If he chooses B, then S will receive reports (V_H,V_H), and by point (v) of Lemma A1 investment will follow. In this case, M's payoff, net of the bribe $\bar{B}$, equals $\gamma(V_0+V_L-I-D-F)+D-\bar{B}$. If instead M chooses NB, then the reports will be (V_H,V_L) and no investment will occur (by point (i) of Lemma A1). In this case, M's payoff equals $\gamma(V_0-F)$. Hence, M's surplus from choosing B over NB is $\gamma(V_L-I-D)+D-\bar{B}$, which is positive if $D > D_1$, zero if $D = D_1$ and negative if $D < D_1$. Recalling our tie-breaking assumption, M opts for NB if and only if $D \leq D_1$. The same argument shows that this result holds also if initially M did not lie (NL). ■

The next lemma derives the best response of shareholders for the case where the manager always reports the truth or never does:

Lemma A3. If $a_2^*(V_L)$=$a_2^*(V_H) = NL$, then $a_3^*(V_H) = NAI$ and $a_3^*(V_L) = NANI$. If $a_2^*(V_L)$=$a_2^*(V_H) = L$, then $a_3^*(V_H) = NANI$ and $a_3^*(V_L) = NAI$.

Proof of Lemma A3. For brevity, we provide a heuristic proof. When *M*'s preferred choice is $a_2^*(V_L)$=$a_2^*(V_H) = NL$, the expected payoff to *S* attains its highest possible value if they chose not to audit and invest if and only if $r_M = V_H$. Indeed, this policy leads them to invest only in the good state and to save auditing costs. A symmetric argument holds when *M*'s preferred choice is $a_2^*(V_L)$=$a_2^*(V_H) = L$, in this case, as *M* lies in a systematic fashion, a "contrarian" investment rule couple with no auditing achieves the highest possible payoff for *S*. ■

Taken together, Lemmas A1 and A2 identify the best responses of shareholders at stage 5 and the best responses of the manager at stage 4. Lemma A3 identifies the best responses of shareholders at stage 3 for some of the possible strategies of managers at stage 2.

Using these results, we can restrict the set of candidate equilibrium strategies to 20 cases, which are presented in Table 1 below for $D \le D_1$, where D_1 is defined by equation (6). Each row describes a strategy of shareholders (columns 2 to 7) and a strategy of the manager (columns 9 to 14).

We could produce a similar table for $D > D_1$, which would differ from Table 1 only in its two last columns, where *B* would simply replace *NB* throughout. We omit this second table for brevity.

A rapid check of Table 1 leaves us with the 8 candidate equilibrium strategies described in the following:

Lemma A4. In Table A1, the strategies subscripted by $\{3,5,6,7,8,11,12,13,16,18,19,20\}$ cannot be part of a PBE.

Table A1. Candidate equilibrium strategies for $D \leq D_1$

	Report by M (r_M)		Reports by M and A (r_M, r_A)					True value (V)		True value and stage-2 action by M (V, a_2)	
S	V_H	V_L	V_H, V_H	V_H, V_L	V_L, V_H	V_L, V_L	M	V_H	V_L	V_L, L	V_L, NL
σ_{S1}	*NAI*	*NANI*	*I*	*NI*	*I*	*NI*	σ_{M1}	*NL*	*NL*	*NB*	*NB*
σ_{S2}	*NANI*	*NAI*	*I*	*NI*	*I*	*NI*	σ_{M2}	*L*	*L*	*NB*	*NB*
σ_{S3}	*A*	*A*	*I*	*NI*	*I*	*NI*	σ_{M3}	*NL*	*L*	*NB*	*NB*
σ_{S4}	*A*	*NANI*	*I*	*NI*	*I*	*NI*	σ_{M4}	*NL*	*L*	*NB*	*NB*
σ_{S5}	*A*	*NAI*	*I*	*NI*	*I*	*NI*	σ_{M5}	*NL*	*L*	*NB*	*NB*
σ_{S6}	*NANI*	*A*	*I*	*NI*	*I*	*NI*	σ_{M6}	*NL*	*L*	*NB*	*NB*
σ_{S7}	*NANI*	*NANI*	*I*	*NI*	*I*	*NI*	σ_{M7}	*NL*	*L*	*NB*	*NB*
σ_{S8}	*NANI*	*NAI*	*I*	*NI*	*I*	*NI*	σ_{M8}	*NL*	*L*	*NB*	*NB*
σ_{S9}	*NAI*	*A*	*I*	*NI*	*I*	*NI*	σ_{M9}	*NL*	*L*	*NB*	*NB*
σ_{S10}	*NAI*	*NANI*	*I*	*NI*	*I*	*NI*	σ_{M10}	*NL*	*L*	*NB*	*NB*
σ_{S11}	*NAI*	*NAI*	*I*	*NI*	*I*	*NI*	σ_{M11}	*NL*	*L*	*NB*	*NB*
σ_{S12}	*A*	*A*	*I*	*NI*	*I*	*NI*	σ_{M12}	*L*	*NL*	*NB*	*NB*
σ_{S13}	*A*	*NANI*	*I*	*NI*	*I*	*NI*	σ_{M13}	*L*	*NL*	*NB*	*NB*
σ_{S14}	*A*	*NAI*	*I*	*NI*	*I*	*NI*	σ_{M14}	*L*	*NL*	*NB*	*NB*
σ_{S15}	*NANI*	*A*	*I*	*NI*	*I*	*NI*	σ_{M15}	*L*	*NL*	*NB*	*NB*
σ_{S16}	*NANI*	*NANI*	*I*	*NI*	*I*	*NI*	σ_{M16}	*L*	*NL*	*NB*	*NB*
σ_{S17}	*NANI*	*NAI*	*I*	*NI*	*I*	*NI*	σ_{M17}	*L*	*NL*	*NB*	*NB*
σ_{S18}	*NAI*	*A*	*I*	*NI*	*I*	*NI*	σ_{M18}	*L*	*NL*	*NB*	*NB*
σ_{S19}	*NAI*	*NANI*	*I*	*NI*	*I*	*NI*	σ_{M19}	*L*	*NL*	*NB*	*NB*
σ_{S20}	*NAI*	*NAI*	*I*	*NI*	*I*	*NI*	σ_{M20}	*L*	*NL*	*NB*	*NB*

Proof of Lemma A4.

(i) Strategies subscripted by 3, 7 and 11: the manager has the incentive to deviating to *NL* when the company is worth V_L, as he would get the same payoff without lying, which he prefers under our assumptions. Strategies 12, 16 and 20: by the same argument, the manager has the incentive to deviating to *NL* when the company is worth V_H.

(ii) Strategy 5: the manager has the incentive to deviate to *L* when the company is worth V_H, as he would induce the investment with no auditing, hence saving his fraction of the auditing costs. Strategy 18: by the same argument, the manager has the incentive to deviate to *NL* when the company is worth V_H.

(iii) Strategy 6: the manager has the incentive to deviate to *L* when the company is worth V_H. To see this, consider that by this deviation he would induce the investment with auditing and earn the continuation profit $\Pi_M^c = \gamma(V_0 + V_H - F - I - D) + D$, which is positive by assumption. Strategy 13: by the same argument, the manager has the incentive to deviate to *NL* when the company is worth V_H.

(iv) Strategy 8: the manager has the incentive to deviate to *L* when the company is worth V_H, as he would induce investment rather than no investment, and thereby earn the continuation profit $\Pi_M^c = \gamma(V_0 + V_H - I - D) + D > 0$. Strategy 19: by the same argument, the manager has the incentive to deviate to *NL* when the company is worth V_H. ■

Proof of Proposition 1. Based on Lemma A4, the remaining 8 set of candidate equilibrium strategies are subscripted by $\{1,2,4,9,10,14,15,17\}$. We will show that, of these, only those subscripted by 1 and 2 are part of a PBE for $D \le D_0$, whereas the other six are not.

(i) $\left\{\sigma_{S1}^*, \sigma_{M1}^*, \beta_1^*\right\}$, where σ_{S1}^* and σ_{M1}^* are given by Table A1, and β_1^* is the following belief:

$$\beta_1^* = \left\{\beta(V_L) = \beta(V_L, V_L) = \beta(V_H, V_L) = 0, \beta(V_H) = 1, \beta(V_H, V_H) = \beta(V_L, V_H) = \frac{p}{p + (1-p)(1-q)}\right\}.$$

In this candidate equilibrium, *M* does not lie and *S* invest according to *M*'s report. Hence the investment decision leads to the first-best expected profit $E(\Pi^*) = p(V_H - I)$, of which *M* diverts an amount *D*. Thus, *S* earn their maximal expected payoff $(1-\gamma)\left[V_0 + p(V_H - I - D)\right]$. They have eight possible deviations from σ_{S1}^*, which correspond to the strategies subscripted by 2 to 7, 9 and 11 in Table A1. In the deviations subscripted by 2, 7 and 11, their expected payoff is lower because they rely on a suboptimal investment decision rule. In all the other deviations, their payoff is decreased by the auditor's fee and in some cases also by reliance on a suboptimal investment rule. As a result, all possible deviations yield a lower expected payoff to *S* than that of the candidate equilibrium.

Now consider the possible deviations by *M* from the strategy σ_{M1}^*. In the candidate equilibrium, *M* earns the highest possible payoff $\gamma(V_0 + V_H - I - D) + D$ in the good state and γV_0 in the bad state. Therefore, *M* will never deviate to lying in the good state, since this would produce no investment and he would earn γV_0. If he deviates to lying in the bad state, *S* would invest in this state, so that *M*'s payoff would be $\gamma(V_0 + V_L - I - D) + D < \gamma V_0$ for $D \leq D_0$. Hence, both possible deviations yield a lower payoff to *M* than that of the candidate equilibrium.

The belief β_1^* is consistent with Lemma A1 insofar as $\beta(V_L,V_L)$, $\beta(V_H,V_L)$, $\beta(V_H,V_H)$ and $\beta(V_L,V_H)$ are concerned. Also $\beta(V_L)=0$ and $\beta(V_H)=1$ are consistent with Bayes' rule, given *M*'s strategy σ_{M1}^*. Hence $\left\{\sigma_{S1}^*, \sigma_{M1}^*, \beta_1^*\right\}$ is a PBE.

(ii) $\left\{\sigma_{S2}^*, \sigma_{M2}^*, \beta_2^*\right\}$, where σ_{S2}^* and σ_{M2}^* are given by Table A1, and β_2^* is the following belief:

$$\beta_2^* = \left\{\beta(V_H) = \beta(V_L,V_L) = \beta(V_H,V_L) = 0, \beta(V_L) = 1, \beta(V_H,V_H) = \beta(V_L,V_H) = \frac{p}{p+(1-p)(1-q)}\right\}.$$

In this candidate equilibrium, *M* always lies and *S* invests when *M* reports V_L and does not when *M* reports V_H, consistently with their new beliefs $\beta(V_L)=1$ and $\beta(V_H)=0$. Again, the investment decision leads to the first-best expected profit, and, following the same steps as under point (i), it is easy to show that there are no profitable deviations and that beliefs are consistent with Bayes' rule.

(iii) σ_{S4} and σ_{M4} cannot be part of an equilibrium: these strategies imply a smaller expected payoff for *M* than a deviation to *NL* in the bad state, which would give him γV_0. To see this, note that under σ_{S4} and σ_{M4} in the bad state *M* would lie, and *S* would hire an auditor and invest with probability $1-q$. As a result, *M*'s expected payoff would be $\gamma\left[V_0 + (1-q)(V_L - I - D) - F\right] + (1-q)D$, which is increasing in *D*. Hence, in the region under consideration this payoff achieves its maximum for $D = D_0$. From (5), this maximum payoff is

$\gamma(V_0 - F)$. If instead *M* deviates to *NL* in the bad state, there is no investment and a payoff of γV_0 for *M*.

(iv) σ_{S9} and σ_{M9} cannot be part of an equilibrium. Under these strategies, *S* do not hire an auditor and always invest, so that they earn the unconditional payoff $(1-\gamma)(V_0 + \overline{V} - I - D)$. If instead they deviate to auditing, the investment decision would lead to a total expected profit $V_0 + p(V_H - I) + (1-p)(1-q)(V_L - I) - F = V_0 + \overline{V} - I + (1-p)q(I - V_L) - F$. Then, *M* would divert an amount *D* whenever the investment is made, which happens with probability $p + (1-p)(1-q)$. As a result, *S* would earn a fraction $1-\gamma$ of the total expected profit minus the expected diversion $[p + (1-p)(1-q)]D$. Thus, after rearranging it, their payoff can be written as $(1-\gamma)\{V_0 + \overline{V} - I - D + (1-p)q(I - V_L + D) - F\}$. This deviation payoff can be shown to be larger than the unconditional profit $(1-\gamma)(V_0 + \overline{V} - I - D)$. To see this, consider that if *S* hire an auditor, they would choose the profit-maximizing audit quality q^*, defined by condition (10): $C'(q^*) = (1-p)(I - V_L + D)$. The difference between *S*'s deviation payoff and their payoff in the candidate equilibrium is $(1-\gamma)\left[q^*(1-p)(I - V_L + D) - C(q^*)\right] = (1-\gamma)\left[q^* C'(q^*) - C(q^*)\right] > 0$ by the convexity of $C(q)$. Hence, this deviation by *S* is profitable.

(v) σ_{S15} and σ_{M15} cannot be part of an equilibrium, since the argument under point (iii) above can be used to show that these strategies imply a smaller payoff for *M*, than a deviation to *L*.

(vi) Using the argument under (iv), one can rule out that the remaining three couples of strategies $(\sigma_{S10}, \sigma_{M10})$, $(\sigma_{S14}, \sigma_{M14})$ $(\sigma_{S17}, \sigma_{M17})$ are part of an equilibrium. ■

Proof of Proposition 2. As in the proof of Proposition 1, based on Lemma A4 we focus only on the 8 candidate equilibrium strategies subscripted by $\{1, 2, 4, 9, 10, 14, 15, 17\}$. We will show that, of these, only those subscripted by 4 and 15 may be part of a PBE for $D_0 < D \le D_1$, whereas the other six are not.

(i) $\{\sigma^*_{S4}, \sigma^*_{M4}, \beta^*_4\}$, where σ^*_{S4} and σ^*_{M4} are given by Table 1, and the belief β^*_4 is:

$$\beta_4^* = \left\{ \beta(V_L) = \beta(V_L, V_L) = \beta(V_H, V_L) = 0, \beta(V_H) = p, \beta(V_H, V_H) = \beta(V_L, V_H) = \frac{p}{p + (1-p)(1-q)} \right\}.$$

In this candidate equilibrium, *M* always reports V_H (and therefore lies in the bad state), *S* hires an auditor under the contract specified in Lemma 1, and invest according to *A*'s report. Thus, *S*'s payoff is given by equation (7). Recall that in point (iv) of the proof of Proposition 1 we have shown that, for $D_0 < D \leq D_1$, the payoff to *S* from hiring an auditor exceeds that obtainable from any strategy involving *NA*. In the present context, this implies that *S* will not deviate to such strategies.

Now consider the possible deviations by *M* from the strategy σ_{M4}^*. In the candidate equilibrium, *M* earns the highest possible payoff $\gamma(V_0 + V_H - I - D) + D$ in the good state and $\gamma\left[V_0 + (1-q)(V_L - I - D) - F\right] + (1-q)D$ in the bad state. Therefore, *M* will never deviate to lying in the good state, since this would produce no investment and he would earn γV_0. If he deviates to not lying in the bad state, *S* would not invest, so that *M*'s payoff would be γV_0. This deviation is not profitable if $D \geq \hat{D}$, where $\hat{D} = \left[(I - V_L) + \frac{C(q)}{1-q}\right]\frac{\gamma}{1-\gamma}$. For $D < \hat{D}$, the deviation is profitable, so that this equilibrium will not exist.

The belief β_4^* is consistent with Lemma A1 insofar as $\beta(V_L, V_L)$, $\beta(V_H, V_L)$, $\beta(V_H, V_H)$ and $\beta(V_L, V_H)$ are concerned. Also $\beta(V_H) = p$ are consistent with Bayes' rule, given *M*'s strategy σ_{M4}^*. Finally, $\beta(V_L) = 0$ is such that *NANI* upon a negative report by *M* is sequentially rational, since under this belief the expected payoff to *S* from σ_{S4}^* is $(1-\gamma)V_0$, while by deviating to *NAI* they would obtain $(1-\gamma)(V_0 + V_L - I - D)$, and by deviating to *A* they would obtain $(1-\gamma)\left[V_0 + (1-q)(V_L - I - D) - F\right]$. Hence $\left\{\sigma_{S4}^*, \sigma_{M4}^*, \beta_4^*\right\}$ is a PBE.

(ii) $\left\{\sigma_{S15}^*, \sigma_{M15}^*, \beta_{15}^*\right\}$, where σ_{S15}^* and σ_{M15}^* are given by Table A1, and the belief β_{15}^* is:

$$\beta_{15}^* = \left\{ \beta(V_H) = \beta(V_L, V_L) = \beta(V_H, V_L) = 0, \beta(V_L) = p, \beta(V_H, V_H) = \beta(V_L, V_H) = \frac{p}{p + (1-p)(1-q)} \right\}.$$

In this candidate equilibrium, *M* always reports V_L (and therefore lies in the good state), *S* hires an auditor under the contract specified in Lemma 1, and invest according to *A*'s report. The proof that this is a PBE for $D \geq \hat{D}$ proceeds as under point (i).

(iii) σ_{S1} and σ_{M1} cannot be part of an equilibrium, because *M* has the incentive to deviate to *L* when the company is worth V_L.

(iv) σ_{S2} and σ_{M2} cannot be part of an equilibrium, because *M* has the incentive to deviate to *NL* when the company is worth V_L.

(v) σ_{S9} and σ_{M9} cannot be part of an equilibrium, because under this strategy the firm would always invest and *S* would earn its unconditional payoff, while if it hires an auditor by Proposition 1 point (iv) they would increase their payoff.

(vi) $(\sigma_{S10}, \sigma_{M10})$, $(\sigma_{S14}, \sigma_{M14})$ and $(\sigma_{S17}, \sigma_{M17})$ cannot be part of an equilibrium, by the same argument as under (v). ■

Proof of Proposition 3. As in the proof of Propositions 1 and 2, based on Lemma A4 we focus only on the 8 candidate equilibrium strategies subscripted by $\{1,2,4,9,10,14,15,17\}$. We will show that, of these, only those subscripted by 10 and 17 are part of a PBE for $D > D_1$, whereas the other six are not.

(i) $\left\{\sigma^*_{S10}, \sigma^*_{M10}, \beta^*_{10}\right\}$, where σ^*_{S10} is given by Table A1, σ^*_{M10} is obtained by replacing *NB* to *B* in the corresponding strategy in Table A1, and the belief β^*_{10} is:

$$\beta^*_{10} = \{\beta(V_L) = \beta(V_L, V_L) = \beta(V_H, V_L) = 0, \beta(V_H) = p, \beta(V_H, V_H) = \beta(V_L, V_H) = p\}.$$

In this candidate equilibrium, *M* always reports V_H (and therefore lies in the bad state), *S* do not hire an auditor and the firm always invests. Thus, *S*'s payoff is given by equation (11). To show that S will not want to deviate from σ^*_{S10}, note that the payoff to *S* exceeds that from any strategy involving *A* upon a positive report by *M*, since due to bribing an audit report would be uninformative (would lead to investment anyway) but still costly. The payoff in equation (11) also exceeds the payoff from a strategy involving *NANI* upon a positive report by *M*, which is $(1-\gamma)V_0$.

Now consider the possible deviations by *M* from the strategy σ^*_{M10}. In the candidate equilibrium, *M* earns the highest possible payoff $\gamma(V_0 + V_H - I - D) + D$ in the good state and $\gamma(V_0 + V_L - I - D) + D > \gamma V_0$ in the bad state, where the latter inequality is guaranteed by $D > D_1$.

Therefore, M will never deviate in the good state. If he deviates to not lying in the bad state, S would not invest, so that M's payoff would be γV_0.

The belief β^*_{10} is consistent with Lemma A1 insofar as $\beta(V_L,V_L)$, $\beta(V_H,V_L)$, $\beta(V_H,V_H)$ and $\beta(V_L,V_H)$ are concerned. Also $\beta(V_H)=p$ are consistent with Bayes' rule, given M's strategy. Finally, $\beta(V_L)=0$ is such that *NANI* upon a negative report by M is sequentially rational, since under this belief the expected payoff to S from σ^*_{S10} is $(1-\gamma)V_0$, while by deviating to *NAI* or to A they would obtain $(1-\gamma)(V_0+V_L-I-D)$ or $(1-\gamma)(V_0+V_L-I-D-F)$ respectively. Hence $\{\sigma^*_{S10},\sigma^*_{M10},\beta^*_{10}\}$ is a PBE.

(ii) $\{\sigma^*_{S17},\sigma^*_{M17},\beta^*_{17}\}$, where σ^*_{S17} is given by Table A1, σ^*_{M17} is obtained by replacing *NB* to *B* in the corresponding strategy in Table A1, and the belief β^*_{17} is:

$$\beta^*_{17}=\{\beta(V_H)=\beta(V_L,V_L)=\beta(V_H,V_L)=0,\beta(V_L)=p,\beta(V_H,V_H)=\beta(V_L,V_H)=p\}.$$

In this candidate equilibrium, M always reports V_L (and therefore lies in the good state), S does not hire an auditor and the firm always invests. The proof that this is a PBE for $D>D_1$ proceeds as under point (i).

(iii) σ_{S1} and σ_{M1} cannot be part of an equilibrium, because M has the incentive to deviate to L when the company is worth V_L.

(iv) σ_{S2} and σ_{M2} cannot be part of an equilibrium, because M has the incentive to deviate to *NL* when the company is worth V_L.

(v) σ_{S9} and σ_{M9} cannot be part of an equilibrium. For these strategies to be part of an equilibrium, one would need a belief $\beta(V_L)$ such that, upon a negative report by *M*, *A* is sequentially rational. However, *A* is not rational for any possible belief $\beta(V_L)$, as it would imply that the firm always invests and *S* earns its unconditional payoff net of the audit cost, while under *NAI* shareholders would save the audit cost.

(vi) σ_{S14} and σ_{M14} cannot be part of an equilibrium. For these strategies to be part of an equilibrium, one would need a belief $\beta(V_H)$ such that, upon a positive report by *M*, *A* is sequentially rational. However, A is not rational for any possible belief $\beta(V_H)$, as it would imply that the firm always invests and S earns its unconditional payoff net of the audit cost, while under NAI shareholders would save the audit cost.

(vii) $(\sigma_{S4}, \sigma_{M4})$ and $(\sigma_{S15}, \sigma_{M15})$ cannot be part of an equilibrium, because for $D > D_1$ M would bribe the auditor, so that the audit report is uninformative but still costly, and therefore S would deviate to NAI. ■

Proof of Proposition 4. In Propositions 1 through 3 we have shown that, depending on the model's parameters, the firm's continuation decision will be based on (1) the manager's report, (2) the auditor's report or (3) neither of them. We now show that shareholders will assign to the manager a different initial stake γ, depending on the equilibrium path that they want to induce from $t = 1$ onward. We also allow for a fixed wage $w \geq 0$.

(1) To induce the first kind of equilibrium, shareholders must choose a stake γ and a fixed wage w such that the manager always reports truthfully and accepts the contract. Hence, they solve:

$$\Pi(r_M) = \max_{\gamma, w} (1-\gamma) p \left(V_H - I - D\right) - w,$$

subject to:

$$\begin{aligned}
&PC_M : w + \gamma V_0 + p\gamma\left(V_H - I - D\right) + pD \geq 0, \\
&IC_L : w + \gamma V_0 \geq w + \gamma V_0 + \gamma\left(V_L - I - D\right) + D, \\
&IC_H : w + \gamma(V_0 + V_H - I - D) + D \geq w + \gamma V_0, \\
&LL : w \geq 0,
\end{aligned}$$

where PC_M is the manager's participation constraint, IC_L and IC_H are his incentive compatibility constraint in the bad and good states respectively, and LL is his limited liability constraint. It is immediate to see that IC_L and LL are both binding, which implies a stake $\gamma = D/(I - V_L + D)$. As the fixed wage plays no incentive role, shareholders choose $w = 0$.

(2) To induce the second type of equilibrium, shareholders solve:

$$\Pi(r_A) = \max_{\gamma, w, q, F} (1-\gamma)\left[V_0 + \bar{V} - I - D + q(1-p)\left(I - V_L - D\right) - F\right] - w$$

subject to:

$$PC_M : w + \gamma\left[V_0 + \bar{V} - I - D + q(1-p)\left(I - V_L - D\right) - F\right] + \left[p + (1-p)(1-q)\right]D \geq 0,$$

$$IC_L : w + \gamma\left(V_0 - F\right) \geq w + \gamma V_0 + \gamma\left(V_L - I - D - F\right) + D - \bar{B},$$

$$PC_A : F \geq C(q),$$

$$LL : w \geq 0.$$

Again, LL and IC_L are binding. The latter implies a stake $\gamma = \max\left\{0, (D - \bar{B})/(I - V_L + D)\right\}$. Competition ensures that the auditor's participation constraint PC_A is also binding. In this regime the optimal audit quality q^* is implicitly defined in equation (10). As in the previous case, shareholders choose $w = 0$.

(3) Finally, to induce the third type of equilibrium, shareholders solve:

$$\Pi(\varnothing) = \max_{\gamma, w}(1-\gamma)\left(V_0 + \bar{V} - I - D\right) - w$$

subject to:

$$PC_M : w + \gamma\left(V_0 + \bar{V} - I - D\right) + pD \geq 0,$$

$$LL : w \geq 0.$$

Since in this equilibrium neither the fixed wage nor the equity stake play any incentive role, they are both optimally set to zero, that is, $w = 0$ and $\gamma = 0$.

Substituting the optimal choice of wage, stakes and audit quality in the three objective functions above, one finds that the maximal value of the shareholders' payoff in the three corresponding equilibria is given by (12). Hence, shareholders will choose the managerial stake γ that correspond to the equilibrium with the largest expected payoff, which proves Proposition 4. ■

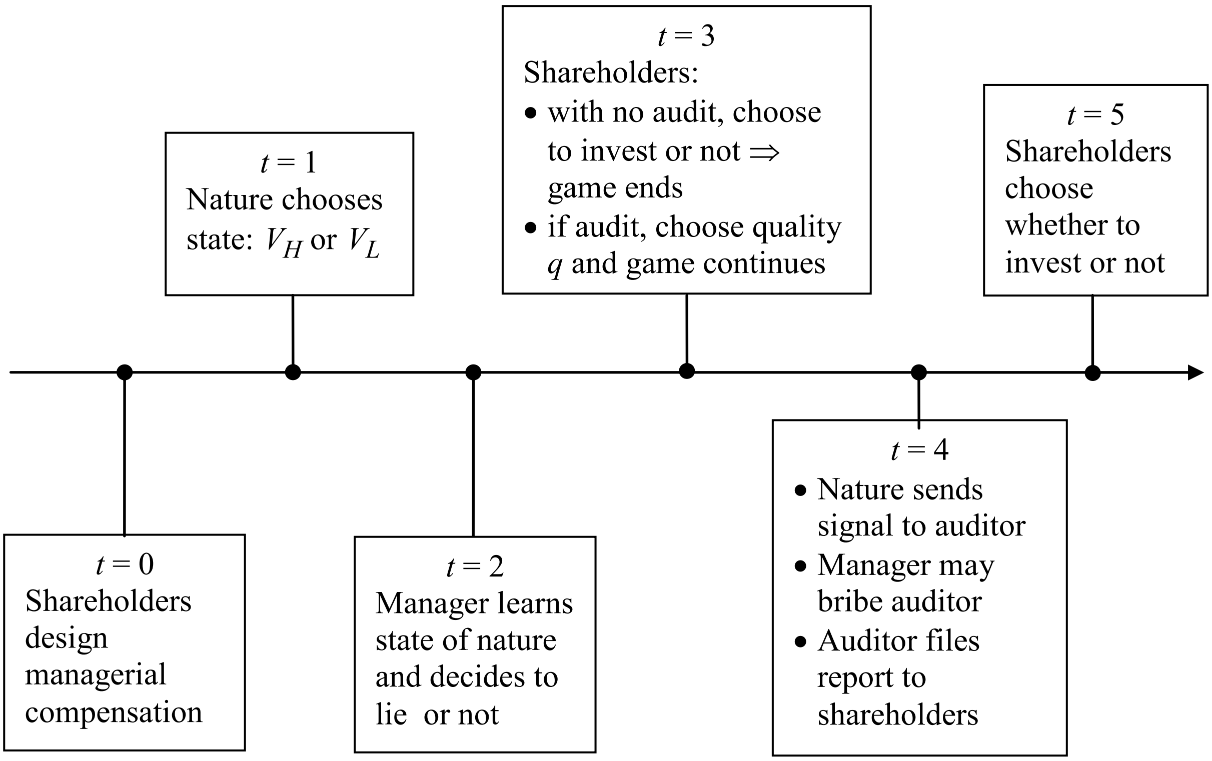

Figure 1. Time line

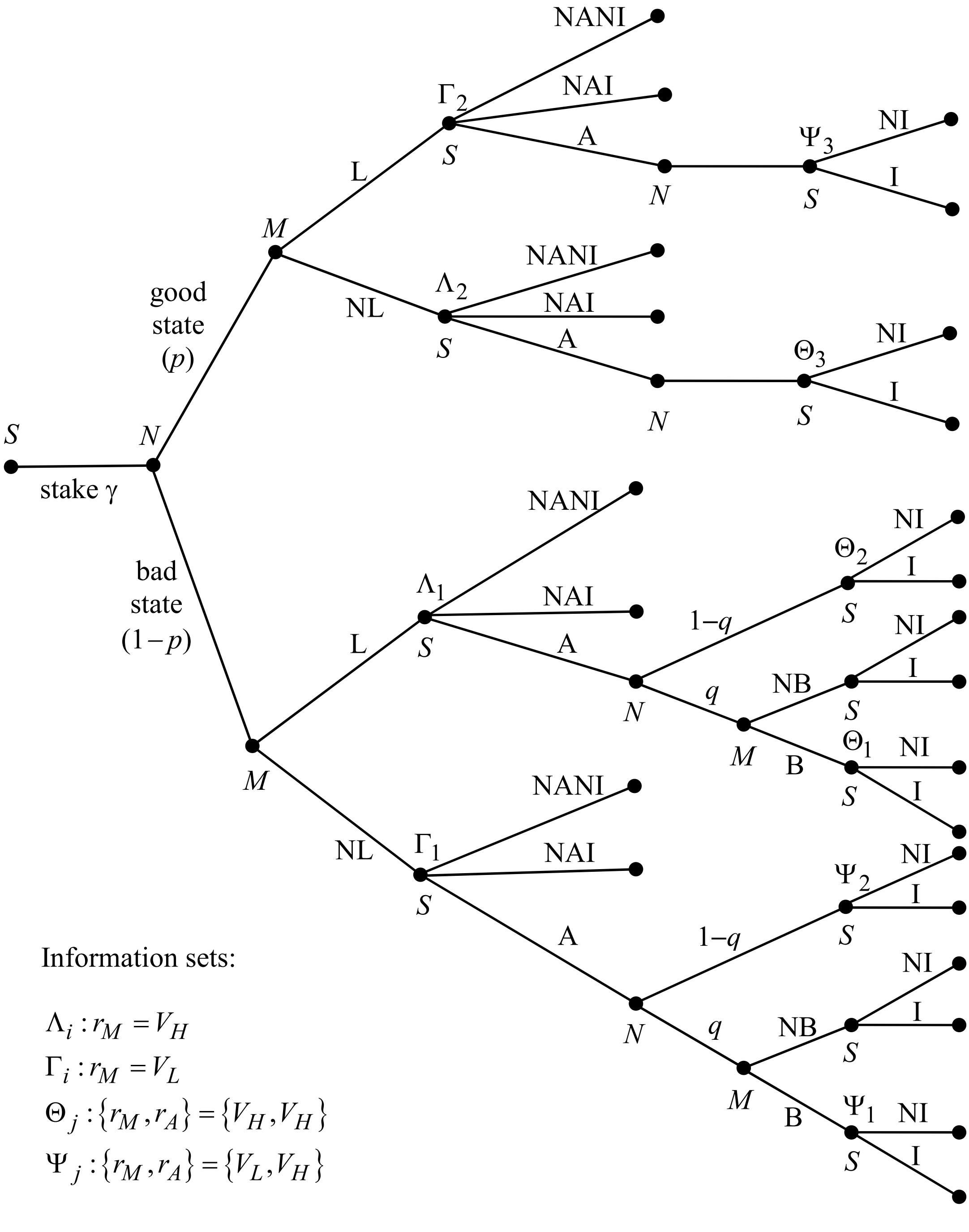

Figure 2. Game tree

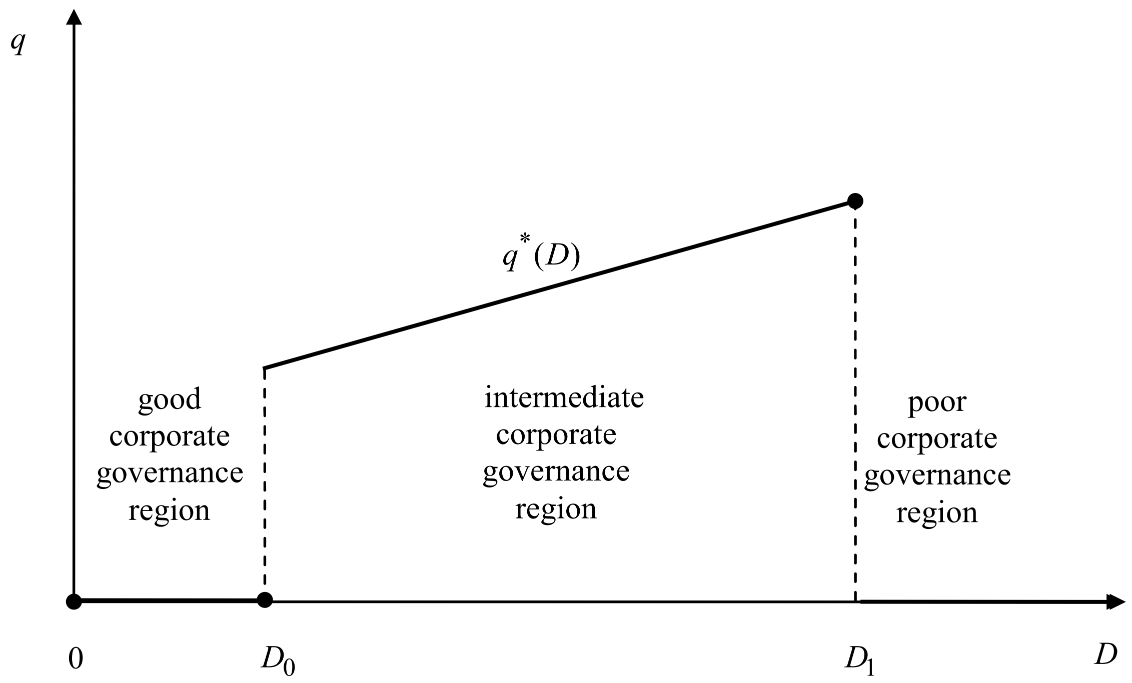

Figure 3. Optimal audit quality *q* and external corporate governance *D*

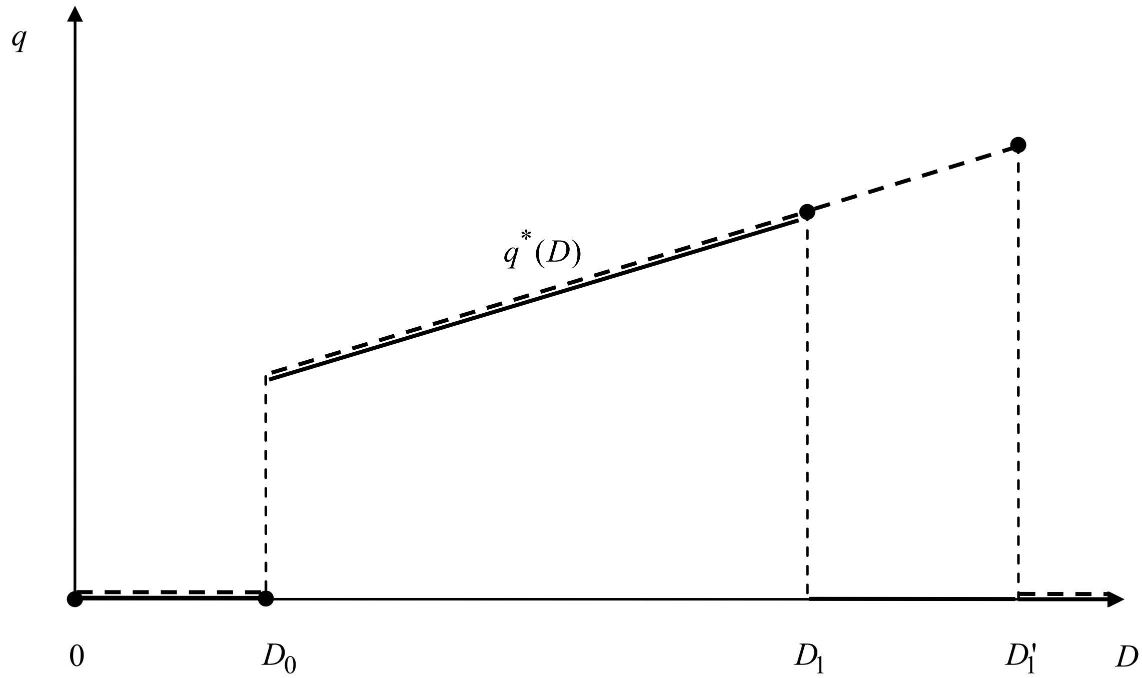

Figure 4. Effect of a public penalty for corrupt auditors