Corporate Fraud, Governance and Auditing

Marco Pagano

Università di Napoli Federico II, CSEF, EIEF and CEPR

Giovanni Immordino

Università di Salerno and CSEF

10 November 2008

Abstract

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

JEL classification: G28, K22, M42.

Keywords: accounting fraud, auditing, managerial compensation, corporate governance, regulation.

Authors' addresses: Marco Pagano, CSEF, Facoltà di Economia, Università di Napoli Federico II, Via Cintia, 80126 Napoli, Italy, phone +39-081-5752508, fax +39-081-5752243; e-mail mrpagano@tin.it. Giovanni Immordino, Facoltà di Economia, Università di Salerno, 84084 Fisciano (SA), Italy, phone +39-089-963167, fax +39-089-963165; e-mail: giimmo@tin.it.

1. Introduction

In many recent corporate scandals, managers have been accused of hiding or distorting key accounting information to pursue corporate expansion plans and continue to extract benefits of control, in spite of their companies' unsound financial position. For instance, Enron's top executives 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 Italian case of Parmalat, whose president concealed large losses and most of the huge debt accumulated while expanding Parmalat's food business, diversifying into non-core sectors (such as soccer, media and travel services) and diverting huge sums to his own family. Also the overexpansion of lending that led to the subprime crisis has been accompanied by instances where "executives gave optimistic forecasts to the market while knowing their companies where in trouble", so that "Federal investigators have opened inquiries into at least 25 companies, including Lehman, AIG, Fannie Mae, Freddie Mac and WaMu" (Financial Times, 2008).

In these scandals, auditing failed to prevent fraud. In the Enron case, in 2002 Arthur Andersen's top managers were convicted of obstruction of justice for shredding documents. Similarly, the massive fraud at Parmalat went undetected because in 2003 the auditing firm Grant Thornton took as genuine a copy of a forged fax from Bank of America showing credits and cash held by the Bonlat subsidiary, worth 36 percent of Parmalat's debt, leading to the judicial indictment of the Italian divisions of Deloitte & Touche and Grant Thornton. According to legal experts, also investors damaged by subprime securities losses could pursue auditors and investment bank underwriters, a phenomenon that is "going to be much broader than the accounting crime wave we had at the turn of the century" (Financial Times, 2008).

These examples suggest that managers' pursuit of the private benefits of control may result in accounting fraud and unfaithful auditing, so one should expect the incidence of corporate fraud to 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 internal governance mechanisms.

We study these issues in a model where managers are better informed than investors, but, due to the private benefits of empire building, are biased against liquidation. This may induce them to misreport information and even to bribe auditors when liquidation would be optimal. Poor external

Electronic copy available at: http://ssrn.com/abstract=1337909

rules of corporate governance strengthens their bias against liquidation and their incentive for fraudulent accounting and bribe auditors. Shareholders may respond by allocating more resources to auditing and making managerial compensation more performance-based.

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 severity of sanctions on corrupt auditors. Both auditing and incentive pay can mitigate the effects of poor external governance arrangements, but each has limitations. Auditing is neutralized by managers' bribes when private benefits are very large, hence when the external governance of firms is very poor. And managerial pay has to be designed very carefully, because increasing its sensitivity to upside risk actually increases the incentives for empire building and fraud.

We start by analyzing the optimal choice of auditing quality for a given managerial incentive pay, so as to focus on the role of auditing as an internal governance mechanism. Auditing is taken as including not only checks by outside auditing firms but also verification of the accounts by internal auditors and even by independent directors. The informational basis of corporate policies can be improved by stepping up any of these activities.[1] The optimal audit quality turns out to have a non-monotonic relationship with the external corporate governance framework. With poor external governance, auditors are ineffective and so 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 to deter managerial fraud. Over this range, the better is external governance the less is to be invested in auditing. In the limit, when external governance is very good, auditing is again useless, if managers are very well aligned with shareholders, they can be trusted to do the right thing. Public policy can affect audit quality also by regulation: the stricter the sanctions for unfaithful auditors, the larger the region where auditors can be trusted.

Next, we let shareholders choose both audit quality and managers' compensation. Whenever these incentive devices are used together, a deterioration in external governance must be offset by heavier reliance on both: auditing quality must be improved and the equity component of managerial pay increased. Similarly, a less strict auditing regulations (that is, milder sanctions for

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[1] Audit quality can be improved by increasing the accuracy of verification, as by external confirmation of the company's credits, by on-site inspections of inventories and by direct interviews with managers and employees at various levels. In general, this greater verification effort by auditors involves costs in terms of man-hours by qualified personnel and other costs, and so translates into steeper auditing costs for the customer company.

unfaithful auditors) calls for an increase in the equity component of managerial pay. Broadly speaking, internal corporate governance must substitute for the failings of both the external framework of corporate governance and auditing regulation.

In choosing the equity stake to be given to managers, shareholders balance the gain stemming from better managerial incentives with the implied dilution of their own cash flow rights. This raises the question of whether equity-based compensation is the most efficient way to affect managerial incentives, or whether call options may be preferable. Within the model, this is not the case: call options are either ineffective in tempering the manager's bias for continuation or – if they have a short vesting period – they aggravate the tendency to fraud, as a growing empirical literature has found. Intuitively, this is because options prompt managers to take upside risk, while equity-based compensation forces them to consider the downside risk generated by unprofitable continuation decisions as well.

Our paper is related to recent literature on managerial fraud. Where the cornerstone of our analysis is that shareholders can undercut managers' incentives for fraud both by compensation arrangements and by choice of auditing quality, the two most closely related papers concentrate on each of these two levers separately: Goldman and Slezak (2006) focus on equity-based compensation; Povel, Singh and Winton (2008) on investors' monitoring effort.

These two papers differ from ours in other important respects as well. In Goldman and Slezak (2006), equity-based compensation elicits managerial effort but also induces managers to manipulate earnings to boost stock prices. In our model, by contrast, manager's incentive to misreport derives from an empire-building motive, and equity-based compensation attenuates fraudulent behavior instead of aggravating it. The reason is that we index compensation to the terminal value of stocks, and not to a short-term stock price that managers can manipulate, as in Goldman and Slezak. Povel, Singh and Winton (2008) focus on how investors' monitoring activity varies over the business cycle. They show that in booms investors exert less effort to verify managerial information, because their beliefs about investment opportunities are more optimistic than in a slump.[2] Instead, we focus on how investors' choice of auditing activity (as well as managerial compensation) changes with institutional arrangements, *viz.* external governance rules and auditing regulations.

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

Our model of auditing is related to the analysis of Dye (1993), where audit quality is unobservable – an agency problem.[3] In our model, however, 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 studied 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 are better aligned with those of the principal. The key differences are that in our setting (i) audit quality is chosen by shareholders and that (ii) corporate governance affects the severity of managerial moral hazard, and thereby optimal auditing intensity.[4]

Finally, a growing empirical literature has investigated how the incidence of managerial fraud responds to the internal governance of firms and to auditing quality, broadly defined to include the monitoring activity of independent directors. In accordance with our predictions, earnings 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 manipulation is lower in companies with more independent boards (Beasley, 1996; Dechow, Sloan and Sweeney, 1996; Klein, 2002). Another strand of the empirical literature has 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) document that high-powered incentive schemes (especially options) 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 show not only that the incidence of corporate fraud is affected by auditing quality and managerial compensation, but that both of these

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[3] In Dye (1993) the problem is resolved by litigation, insofar as auditors have wealth that damaged clients can seize. Immordino and Pagano (2007) show how the agency problem can be tempered by regulations imposing minimum audit standards.

[4] There are two other substantial modeling differences. First, Kofman and Lawarrée 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 this state is favorable to the manager but the auditor makes a mistake. 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 arrangements are sufficiently good.

aspects of the internal governance of firms are endogenous, as they are optimally chosen by shareholders in response to public policy parameters (external corporate governance rules and the stringency of auditing regulations).

The paper is structured as follows. Section 2 sets out the model and its assumptions, 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 an expenditure of size I. Otherwise, the company is liquidated at its status-quo value V_0.[5] If shareholders decide to invest the 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 $1-p$. Thus, the investment I is profitable in the good state $s = H$ but not in the bad state $s = L$.

There are three players: (i) a manager (M), who owns a minority stake γ of the company's shares and runs the company; (ii) 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 disburses an audit fee, so that the required expense 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;[7] under liquidation, for simplicity private benefits are set to zero.[8] The manager has no wealth when shareholders hire him, and his private benefits cannot be

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[5] Alternatively, the choice may be interpreted as one between a *status quo* where the firm retains its existing capital stock and an expansion plan whereby it undertakes a new project costing I.

[6] For the definition of auditing quality q, see below.

[7] The results of the model would not be qualitatively affected by allowing for deadweight costs of managerial diversion. An increase in these deadweight costs is tantamount to a reduction in D within the current setting.

[8] Our results survive even if the manager's private benefits are positive with liquidation, provided they are lower than with continuation.

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 investment I: $\overline{V} - D = pV_H + (1-p)V_L - D > I$. Therefore, managerial diversion is not so large as to prevent the firm from investing, but it can lead to a misallocation of resources, by inducing continuation even in the bad state.[9]

The parameter D is the maximum private benefit that the manager can extract without incurring 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, such as penalties applying for breaching their fiduciary duty towards shareholders.[10]

While external governance D is exogenously given, shareholders have two *internal* governance levers for maximizing the expected continuation value of the firm: managerial compensation and audit 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 scope for shareholders strategy, allowing for more flexible incentive mechanisms that include options. Shareholders can also realign managers' incentives to their own by raising audit quality q, as by allocating more resources to internal auditors or appointing more independent directors: better auditing enables them to check the truthfulness of managers' reports on the profitability of continuation. We aim to characterize the optimal design of internal governance – the choice of γ and q – as a function of the external governance parameter D. The assumption that shareholders can design the company's internal corporate governance presupposes that ownership is not so dispersed as to prevent their ability to pursue their common interest. Otherwise, even decisions such as the choice of auditors would be captured by the manager, thereby making agency problems more severe.

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

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[9] Under the opposite assumption, the unconditional value of the firm under continuation would be negative, so that the inefficiency would be the reverse from our setting: the firm would be liquidated too often, not too seldom. But the basic logic of the model would be similar.

[10] Governments may be constrained in their design of external governance rules either by political economy concerns (e.g. the lobbying of managers) or by the resource costs of enforcing very strict regulations.

2.1 Payoffs

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

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

while if the company is liquidated, its final value is

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

For simplicity, we assume the company's initial value V_0 to be large enough that its final value is never negative.[11] Shareholders' wealth is a fraction $1 - \gamma$ of this final value, so that their payoff is:

$$\Pi_S^h = (1 - \gamma)V_1^h, \quad (2)$$

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

Unlike shareholders, the manager has perfect knowledge of the company's final value V_1^c under continuation. Since in this case he also gains the private benefit D, his final payoff is:[12]

$$\Pi_M^h = \gamma V_1^h + D \cdot 1_c, \quad (3)$$

where $h = c, l$ and 1_c is an indicator function equal to 1 under continuation and 0 under liquidation.[13] 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

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[11] The model could easily accommodate the case in which the company goes bankrupt when investment is undertaken in the bad state. In this case, due to limited liability shareholders would get a zero payoff from their holdings.

[12] 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.

[13] In principle, shareholders could assign to the manager a fraction of the company's value increment $\gamma(V_1^h - V_0)$ alone. However, this would imply that the manager's monetary payoff would be negative in the bad state, which would conflict with the manager's limited liability.

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 realize exceeds the loss on his stake γ.

Auditing should 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 determine whether continuation will increase or decrease the company's value, and they use it to produce a report $r_A \in \{V_L, V_H\}$.[14] An audit varies in quality, depending on the procedures that adopted (e.g., external confirmation of accounting data). We denote audit quality by $q \in [0,1]$, where higher q corresponds to a more precise signal about the company's final value but implies a higher cost according to a function $C(q)$ that 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 idea that audit quality is a choice variable is consistent with the evidence surveyed by Francis (2004), who documents that clients can raise the quality of auditing by picking auditing firms that are larger or more specialized in their industry.

The auditor's signal is perfectly accurate when the state is H, but 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 of 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.[15] To meet the participation constraint of auditors, their fee must cover their costs, that is, $F(q) \geq C(q)$. We assume competition between auditors.[16]

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

[15] We assume that the fee is not conditional on the ex-post accuracy of the report. If optimally designed by shareholders, such a fee could help deter bribe-taking by the auditor. However, the analysis under this more

If the auditor 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, bribery cannot occur in the good state ($V = V_H$), where the auditor's report would be favorable to continuation anyway.[17] The auditor has a reservation bribe: he will not lie unless he gets at least a bribe $\overline{B}$, which may reflect ethical and reputational concerns or fear of sanction. The actual bribe is determined by a take-it-or-leave-it offer:[18] the manager pays the reservation bribe $\overline{B}$ and gains the surplus stemming from the more likely continuation. When indifferent, the manager is assumed to prefer not to bribe. If the auditor does not accept the bribe, he will misreport the state of the world only by mistake, wrongly 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 beneficial role in the allocation of investment, its cost to the firm must not be prohibitively high, so 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 has been characterized.

2.2. Structure of the game

There are six stages (see the time line in Figure 1). At stage 0, shareholders choose the manager's compensation contract, which in the baseline version of the model is his equity stake γ. At stage 1, nature (N) determines the incremental value of the company under continuation: V_H with probability p and 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

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sophisticated contract yields no qualitatively new insights and is considerably more complex. Moreover, managers could 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 actual practice.

[16] The model could easily allow for auditors' rents arising from market power. The only significant effect of this 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.

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

[18] 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.

decide whether to engage an auditor. If they opt not to audit, they must then decide whether or not to invest solely on the basis of the manager's report. In this case the game is over and its payoffs are realized; if they elect to get an auditor's opinion, the game moves to the next stage. At stage 4, the auditor observes the signal concerning the state, may or may not accept a bribe from the manager, and files a report $r_A \in \{V_L, V_H\}$. Finally, at stage 5, shareholders make their investment choice 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. 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.[19]

At stage 3, shareholders (S) decide whether to audit, and set the audit quality q by maximizing their expected payoff conditional on the manager's report, $E(\Pi_S^h \mid r_M)$, 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 engaged, the game moves to stage 4, where nature determines the auditor's draw of a signal about the firm's value: under our assumptions, if the state is V_H this signal is always correct and if the state is V_L it is correct with probability q. In the latter case, the manager may try to bribe the auditor to make a positive report $r_A = V_H$ anyway.[20] Offering a bribe is denoted as

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[19] 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.

[20] 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, which is the only case in which bribing him may benefit the manager.

action B, 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).[21]

At stage 5, shareholders decide whether to invest (I) or not (NI). They take this decision, denoted by $a_5 \in \{I, NI\}$, by maximizing their expected payoff conditional on the reports $\{r_M, r_A\}$ of the manager and the auditor, $E(\Pi_S^h \mid r_M, r_A)$. 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., at this stage it is sunk), it does not affect the choice between I and NI. Now 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 $\sigma_S = (a_0, a_3(r_M), a_5(r_M, r_A))$: they choose the manager's stake γ and take the investment decision at stage 3 conditional only on the manager's report, or else at stage 5, conditional also on the auditor's report. The manager's strategy is a couple $\sigma_M = (a_2(\tilde{V}), a_4(V_L, a_2))$, where the decision on lying, $a_2(\tilde{V})$, is conditional on the actual value of the company, while that on bribing, $a_4(V_L, a_2)$, 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 their information: 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 triplet $\{\sigma_S, \sigma_M, \beta\}$ that form the pure-strategy perfect Bayesian equilibria (PBE) of the game described so far, showing that the PBE has a unique equilibrium outcome. All proofs are in the Appendix.

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[21] Unlike 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.

3. Equilibrium audit quality

Here we solve for the PBE of the game conditional on a given managerial equity stake γ chosen by shareholders at stage 0. We leave the determination of the optimal γ to Section 4. We derive the equilibrium strategies separately for three regions that differ in quality of external corporate governance D. Corporate governance is "good", "intermediate" or "poor" depending on whether the private benefit is small, intermediate or large, as specified below. We will see that the shareholders' incentive to audit differs across these regions (see 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 realize 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

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

For values of D above this threshold, he will lie. At the threshold or below, he will not.[22]

Note that the region of good corporate governance 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

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

parameter changes increase his propensity 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 with shareholders that in equilibrium the latter do not seek 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 engage 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 engaging an auditor, so the expected return to investment is the maximum $p(V_H - I)$. 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 in the manager's strategy. In one the manager never lies, so that shareholders invest according to his report. In the other, he always lies, and shareholders adopt a "contrarian" strategy investing when the report is negative and not when it is positive. Of course, the outcome in the latter equilibrium 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 decide whether to finance the company's continuation – but only if the manager does not bribe the auditor. This requires that the manager's private benefit fall short of another threshold, 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, unless the manager bribes the auditor, the latter's report is negative, shareholders abstain from the investment and the manager gets $\gamma(V_0 - F)$. If instead the manager wishes to bribe the auditor, he must pay his opportunity cost $\bar{B}$. In this case shareholders will invest and the manager's payoff will be $\gamma(V_0 + V_L - I - D - F) + D - \bar{B}$. By bribing, the manager loses monetary benefits (since $V_L - I - D < 0$) and the bribe $\bar{B}$, but gains the private benefit D. Equating these two payoffs, the manager is seen to be indifferent when D equals the threshold

$$D_1 = D_0 + \frac{1}{1-\gamma}\bar{B}. \tag{6}$$

Above this threshold, he will bribe. At the threshold and below it, he will not.[23]

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

Suppose that in this region shareholders engage an auditor who refuses a bribe, and invest according to his report. (Below we will show that in this region this is the unique equilibrium outcome.) In this case, they want to choose q so as to maximize their expected payoff:

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

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; $(1-p)(V_L - I - D)$ 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:

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

Without an auditor, the shareholders would always invest, since the manager would always lie (as $D > D_0$). So their payoff is equal to their share of the company's expected value under continuation, net of the manager's private benefit, i.e. $(1-\gamma)(V_0 + \bar{V} - I - D)$. Subtracting this from (7'), one obtains the benefit that shareholders draw from the auditor, i.e. the "informational value" of auditing, $(1-p)q(I - V_L + D)$, minus its cost F. This value stems 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.

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

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

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

The proof 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 implicitly defining the optimal audit quality:[24]

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

By equation (10), audit quality is chosen so as to equate marginal informational value to marginal cost. Since the latter is increasing in q, optimal quality q^* is increasing in the private benefit D: intuitively, the greater the private benefit in the event of continuation, the greater the shareholders' propensity to raise audit quality in order to present diversion 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, in fact, this is the unique equilibrium outcome:

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

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

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

Note 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 also contributes to the auditors' fee F. Thus when his private benefit is sufficiently small, he may have no incentive to lie in the bad state if an auditor has been engaged, 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 private benefits so great that the manager has the incentive for bribery, 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 accordingly always invest irrespective of the manager's report. As a result, their expected payoff is:

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

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 engage an auditor and continuation always occurs.*

Intuitively, in this case private benefits are so great 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 always get their way.

3.4. The effect of public policy on auditing

In this model public policy can affect private decisions in two ways. As mentioned, it sets the degree of shareholder protection against managerial abuses, and hence private benefits D. This is

what we have termed "external corporate governance". But public policy may also repress abuses by auditors: the penalties for corrupt auditors will affect their reservation bribe, with a higher value of $\overline{B}$ reflecting a more severe penalty and/or greater likelihood of enforcement. In response to the two policy parameters D and $\overline{B}$, shareholders optimally determine their reliance on auditors in investment decisions, i.e. audit quality q.

The analysis set out in the previous sections shows how external corporate governance affects audit quality. As Figure 3 illustrates, 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 positive as D crosses the threshold D_0, keeps rising in the intermediate region, and finally drops back to zero upon crossing the higher threshold D_1. In the good and intermediate regions, that is, better audit quality can compensate for poorer external governance: shareholders have greater recourse to auditors as the managers' ability to grab private benefits increases. But if external governance is too poor, auditing breaks down as an incentive mechanism: in the poor governance region auditors are never engaged. If empirically most countries fall in the intermediate region, the model predicts that reliance on auditors (as measured, for instance, by resources spent on internal auditing) should be decreasing in the quality of external governance. Auditing resources should be negligible only where the quality of external corporate governance is extreme – either poor or excellent .

As noted earlier, the severity of the penalties for auditors' misconduct, i.e. 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: 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 on them, because they are more trustworthy as monitors of management. Empirically, the prediction is that where auditing regulation is stricter, companies are more likely to rely on auditors and pay higher audit fees, even if external corporate governance is weak. This is consistent with evidence reported by Francis and Wang (2008) that "Big 4" auditors impose higher earnings quality and greater accounting conservatism on clients' financial reports in response to stricter auditing regulation, such as greater ability to sue auditors for negligence and regulatory sanctions for auditors' misconduct. Relatedly, Seetharaman, Gul and Lynn (2002) report that audit fees are higher for UK companies that cross-list in US markets, which they interpret as a response by auditors to the increased litigation risk typical of the US system.

So far, in our analysis we have taken managerial stake γ as given. But to control managers' incentives shareholders can fine-tune not only the resources devoted to auditing but also the managerial compensation scheme. They can increase the managerial stake γ instead of raising auditing quality q. The extent to which they rely on each of these two control variables depends on relative costs and effectiveness. To analyze this point, we turn to stage 0, the choice of managerial compensation scheme.

4. Managers' compensation

In designing managerial compensation, shareholders trade incentives off against their cost. To induce good conduct, they must compensate the manager with an equity stake γ, possibly in addition to a fixed salary. Thus they forgo a fraction γ of the final value of the company V_1, as defined by (1a) and (1b).[25] For simplicity, we set the manager's reservation utility equal to zero.

In the previous section, we showed that, depending on the model's parameters, the 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 the two. Each of these instances, corresponds to a different initial stake for the manager: (i) for r_M to be reliable, it must be large enough to ensure sincerity; (ii) for r_A to be reliable, it must deter bribery of the auditor; (iii) if neither report is trusted, then 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:

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

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

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

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[25] 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 in which their expected payoff is greatest, so that:

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

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

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

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

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 the decision is based on the auditor's report r_A (case (ii)); and smallest where neither report is trusted (case (iii)). This reflects the progressively decreasing demand on the manager's loyalty.[26]

In case (ii), where shareholders use both 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 auditing quality q and the managerial stake γ. That is, both of the incentive devices under their control can be used less intensively.

Stricter regulation of auditing has a similar effect on the managerial equity stake. Stiffer expected penalties for fraudulent auditors, captured by a higher reservation bribe $\bar{B}$, are associated with a smaller optimal managerial stake γ. Intuitively, if public policy makes bribery harder, shareholders can afford to diminish the manager's incentives or even, if $\bar{B}$ becomes so large as to exceed private benefits ($\bar{B} > D$) cut his stake to zero.

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

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[26] On top of the compensation arising from equity, the manager receives no fixed wage, owing to the simplifying assumption that the manager's reservation utility is zero. Removing this assumption, the wage is determined by the manager's participation constraint, and is thus inversely related to his equity stake.

Which of the three regimes described in Proposition 4 will shareholders prefer? The ranking is determined in a complex way by the model's parameters.[27] Two parameters that unambiguously affect this ranking are the auditors' reservation bribe $\overline{B}$ and the company's initial value V_0. An increase in $\overline{B}$, resulting for instance from harsher punishment of auditors for misconduct, raises profits in case (ii), while leaving them unaffected in cases (i) and (iii), and therefore expands the parameter region where shareholders rely on auditing, consistently with the evidence by Francis and Wang (2008) discussed above. In particular, if $\overline{B}$ were to exceed D, regime (ii) always dominates regime (iii), since managers will never bribe an auditor. Instead, an increase in the firm's initial value V_0 increases the shareholders' payoff in all three cases, but the effect is largest in case (iii), intermediate in case (ii) and smallest in case (i). 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 hence the lesser the reliance on equity-based schemes. 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 options – or a mix of options and equity – could improve the efficiency of the managerial compensation package. It has been argued that call options can be cheaper than equity (Hall and Murphy, 2000). In our model, however, this conjecture does not hold.

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

To prove this proposition, we need to distinguish between call options with long and short vesting periods, i.e. those that can only be exercised after the state of the world is publicly known and those that can be exercised already at the time of the investment decision (stage 5 of the model). For the former, it is easy to show that options have no effect on managerial incentives. For the latter (early exercise), they actually aggravate the manager's incentive for inefficient continuation, compared with equity.

Consider first the case of options that can be exercised only once the state of nature is public knowledge. Here they do not alter the manager's incentive to lie or bribe, as they will be in the money only in the good state, in which the manager already wants to tell the truth so as to pocket

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[27] 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.

the private benefit from continuation. Vesting the manager with such options simply imposes a cost on shareholders without improving the manager's incentives, so this strategy is dominated by equity-based compensation, which penalizes the manager for inefficient continuation.

Consider next the short vesting period when the exercise price is such that the options are in the money if the good state is believed to have occurred. Then, a manager who in the bad state lied or bribed the auditor and thereby induced shareholders to invest, would not only earn the private benefit D but would also be able to exercise his options. This clearly worsens the alignment with shareholders; it is tantamount to boosting the private benefits from continuation, thus exacerbating the tendency to file fraudulent reports and/or bribe auditors. This accords with recent empirical literature showing that the importance of options in managerial compensation is correlated with various 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, in our model not even equity is the optimal compensation scheme. Instead, 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 and the same amount, as private benefit, if he lies: being indifferent, by our tie-breaking rule he reports truthfully. In the good state, he gets the private benefit D if he tells the truth and zero if he lies, so again truth-telling is assured.[28] This compensation scheme can be also achieved by making it contingent on the final price of the company: the manager gets 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), and D when the value is unchanged (V_0, upon no continuation in the bad state). This compensation scheme may also be implemented with options, by vesting the manager with a short straddle portfolio, which is profitable when the underlying security changes little in price before the exercise date.[29]

This optimal compensation scheme may appear strange in the context of the theoretical literature on executive compensation, where call options are seen as enhancing the incentive to exert effort

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[28] Notice that shareholders have no choice but to leave 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 his participation constraint. If his reservation utility exceeds D, then the optimal compensation scheme would also have to include a fixed salary.

[29] A short straddle means simultaneously selling a put and a call of the same underlying security, strike price and expiration date.

and take risk (see for instance Smith and Stulz, 1985, Hall and Murphy, 2000, and Dittmann and Maug, 2007). The reason is that in our model the agency problem does not arise from the manager's aversion to effort or risk 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 may 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 the company but, owing to the private benefits from empire building, have a bias against the liquidation of the firm. This may prompt them to misreport their information or even to bribe auditors when liquidation would be optimal. We use the model to study how shareholders should design internal corporate governance so as to curb managerial fraud, along two dimensions: the quality of auditing, and the performance sensitivity of managerial compensation.

Our main contribution is to characterize how both these aspects of the internal governance of firms should optimally respond to changes in public policy parameters, namely, the quality of the external framework of 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 of intermediate quality. When both auditing and managerial incentive pay are used, worse external governance must be balanced by greater reliance on both mechanisms. We also show that in the design of managerial compensation equity dominates options.

The model offers potentially useful lessons for empirical research into the company-level arrangements that can control corporate fraud. First, both the resources allocated to auditing and a suitably designed managerial incentive should be included in empirical studies as potential company-level determinants of the incidence of fraud. Second, both of these arrangements are predicted to respond optimally to regulation, and so 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 $(1-\gamma)(V_0+\overline{V}-I-D-F)$, 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 $(1-\gamma)(\overline{V}-I-D)$, 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 $\overline{B}$, equals $\gamma(V_0+V_L-I-D-F)+D-\overline{B}$. 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 $\gamma(V_L-I-D)+D-\overline{B}$, 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 $D \leq D_1$, 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 $D \le D_1$

S	Report by M (r_M)		Reports by M and A (r_M, r_A)				M	True value (V)		True value and stage-2 action by M (V, a_2)	
	V_H	V_L	V_H,V_H	V_H,V_L	V_L,V_H	V_L,V_L		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 $(1-\gamma)[V_0 + p(V_H - I - D)]$. 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 $(1-\gamma)(V_0 + \bar{V} - I - D)$. If instead they deviate to auditing, the investment decision would lead to a total expected profit $V_0 + p(V_H - I) + (1-p)(1-q)(V_L - I) - F = V_0 + \bar{V} - I + (1-p)q(I - V_L) - F$. 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 $(1-\gamma)\{V_0 + \bar{V} - I - D + (1-p)q(I - V_L + D) - F\}$. This deviation payoff can be shown to be larger than the unconditional profit $(1-\gamma)(V_0 + \bar{V} - I - D)$. 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) $\left\{ \sigma_{S4}^*, \sigma_{M4}^*, \beta_4^* \right\}$, 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 $D_0 < D \le D_1$, 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 $\gamma[V_0 + (1-q)(V_L - I - D) - F] + (1-q)D$ 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 $D \ge \hat{D}$, 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 $(1-\gamma)[V_0 + (1-q)(V_L - I - D) - F]$. Hence $\{\sigma_{S4}^*, \sigma_{M4}^*, \beta_4^*\}$ is a PBE.

(ii) $\{\sigma_{S15}^*, \sigma_{M15}^*, \beta_{15}^*\}$, 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 $D \ge \hat{D}$ 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:

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

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 $D > D_1$.

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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 $\left\{ \sigma_{S10}^*, \sigma_{M10}^*, \beta_{10}^* \right\}$ is a PBE.

(ii) $\left\{ \sigma_{S17}^*, \sigma_{M17}^*, \beta_{17}^* \right\}$, 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:

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

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:

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

subject to:

$$PC_M : w + \gamma V_0 + p\gamma (V_H - I - D) + pD \geq 0,$$

$$IC_L : w + \gamma V_0 \geq w + \gamma V_0 + \gamma (V_L - I - D) + D,$$

$$IC_H : w + \gamma (V_0 + V_H - I - D) + D \geq w + \gamma V_0,$$

$$LL : w \geq 0,$$

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:

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

subject to:

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

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

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

$$LL : w \geq 0.$$

Again, LL and IC_L are binding. The latter implies a stake $\gamma = \max \left\{ 0, (D - \overline{B})/(I - V_L + D) \right\}$. 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:

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

subject to:

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

$$LL : w \geq 0.$$

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. ∎
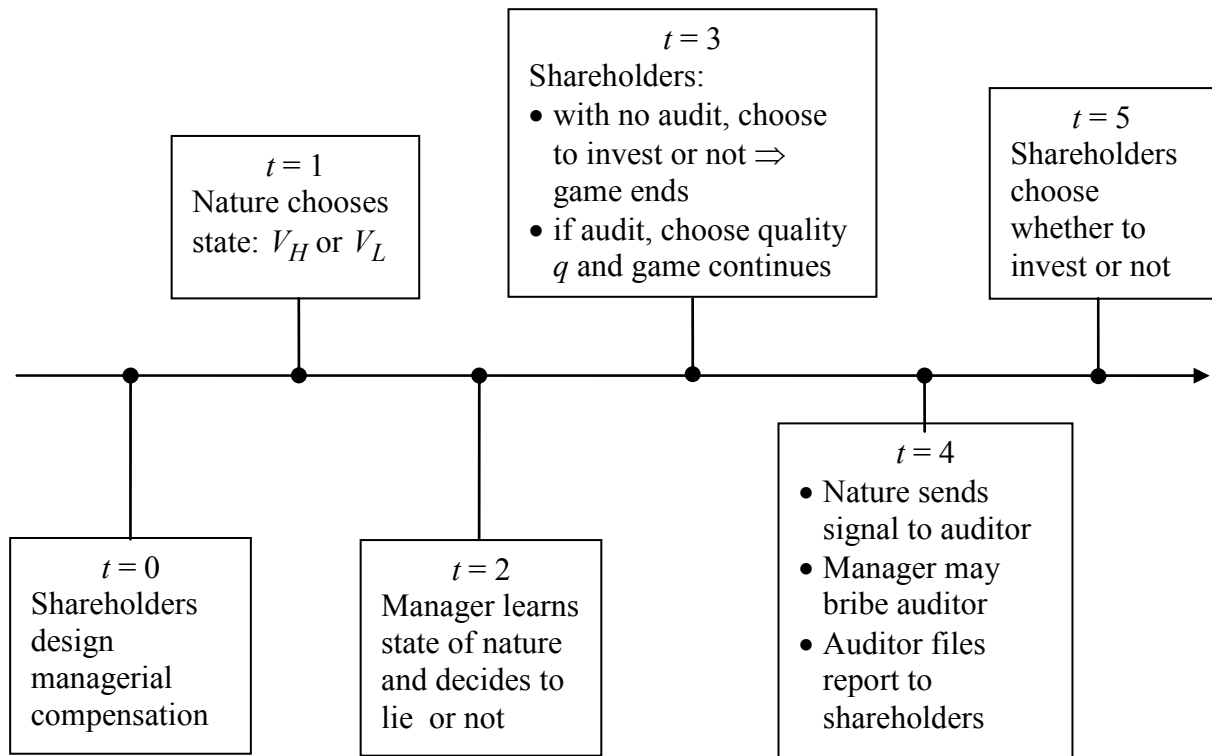
Figure 1. Time line

Figure 2. Game tree

Information sets:

$\Lambda_i : r_M = V_H$

$\Gamma_i : r_M = V_L$

$\Theta_j : \{r_M, r_A\} = \{V_H, V_H\}$

$\Psi_j : \{r_M, r_A\} = \{V_L, V_H\}$

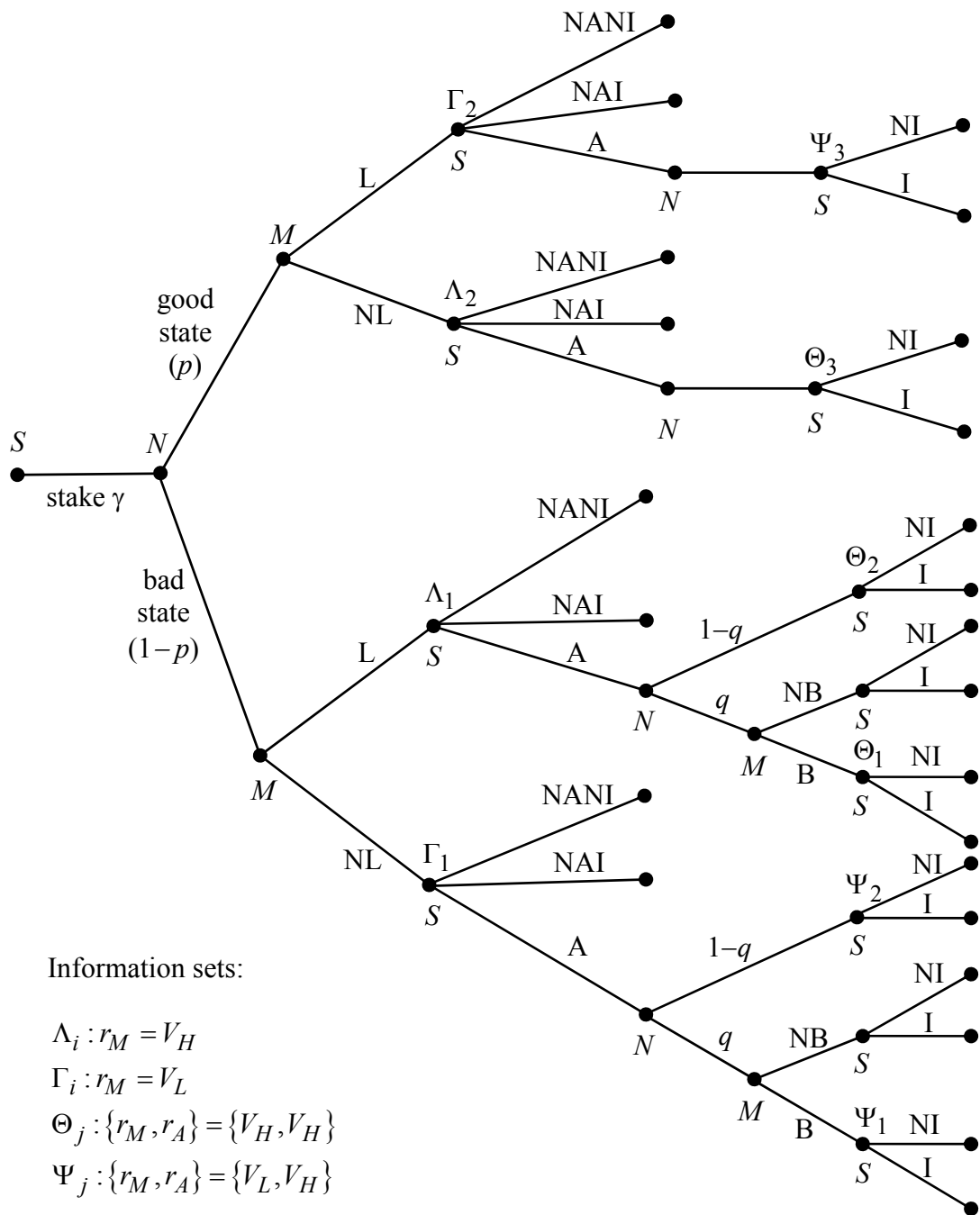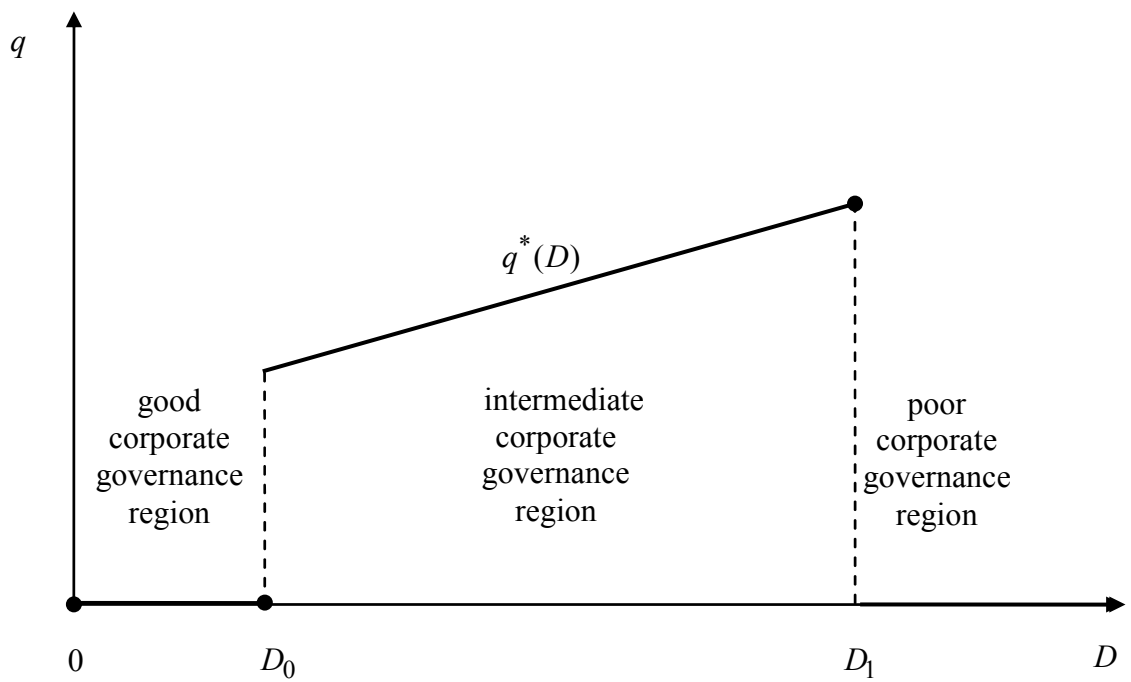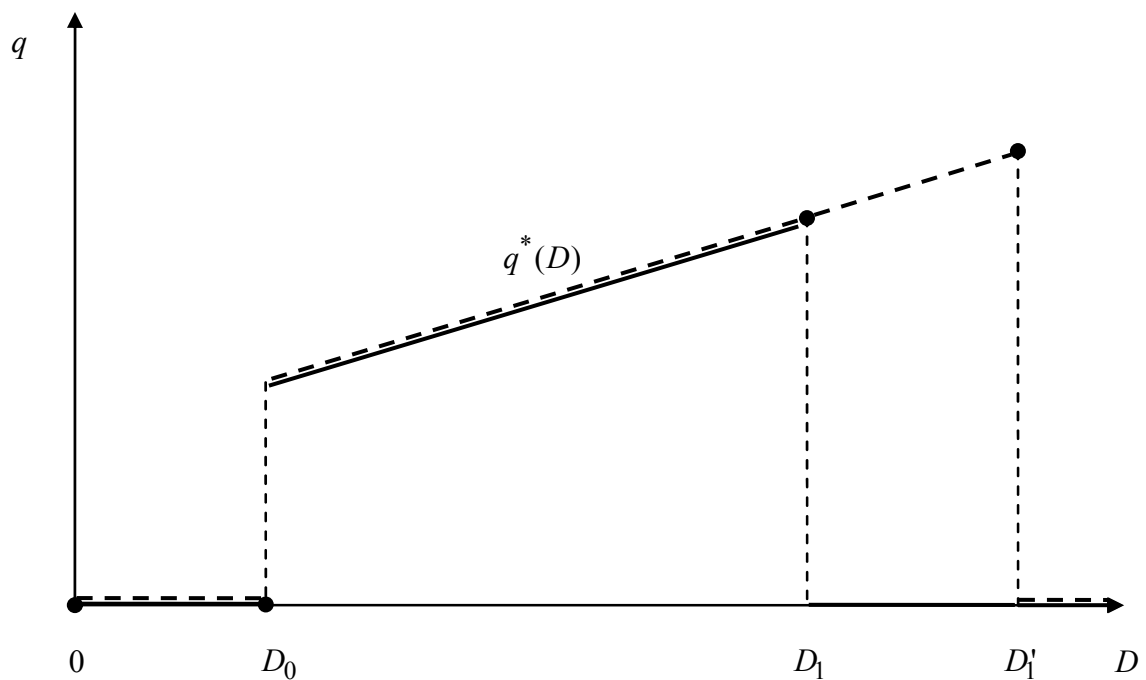**Figure 3. Optimal audit quality q and external corporate governance D**

Figure 4. Effect of a public penalty for corrupt auditors