ABACUS A Journal of Accounting, Finance and Business Studies

ABACUS, Vol. 49, No. 3, 2013 doi: 10.1111/abac.12012

ALEX DONTOH, JOSHUA RONEN AND BHARAT SARATH

Financial Statements Insurance

The fact that auditors are paid by the companies they audit creates an inherent conflict of interest. We analyze how the provision of financial statements insurance could eliminate this conflict of interest and properly align the incentives of auditors with those of shareholders. We first show that when the benefits to obtaining funding are sufficiently large, the existing legal and regulatory regime governing financial reporting (and auditing) results in low quality financial statements. Consequently, the financial statements of firms are misleading and firms that yield a low rate-of-return (low fundamental value) are over-funded relative to firms characterized by a high rate-of-return (high fundamental value). We present a mechanism whereby companies would purchase financial statements insurance that provides coverage to investors against losses suffered as a result of misrepresentation in financial reports. The insurance premia that companies pay for the coverage would be publicized. The insurers appoint and pay the auditors who attest to the accuracy of the financial statements of the prospective insurance clients. For a given level of coverage firms announcing lower premia would distinguish themselves in the eyes of the investors as companies with higher quality financial statements relative to those with higher premia. Every company would be eager to pay lower premia (for a given level of coverage) resulting in a flight to high audit quality. As a result, when financial statements insurance is available and the insurer hires the auditor, capital is provided to the most efficient firms.

Key words: Agency conflicts; Audit profession; Conflict of interest; Corporate governance; Insurance.

The largest corporate bankruptcy filed in the United States, that of Enron in 2001, was preceded by a string of disclosures about audit failures, and errors in financial

---

Alex Dontoh (adontoh@stern.nyu.edu) is Professor of Accounting at New York University Stern School of Business; Joshua Ronen (jronen@stern.nyu.edu) is Professor of Accounting at New York University Stern School of Business; Bharat Sarath (bsarath@andromeda.rutgers.edu) is Professor of Accounting at Rutgers Business School and Editor-in-Chief of the *Journal of Accounting, Auditing and Finance*.

The authors gratefully acknowledge helpful participant suggestions and comments at the University of Siena and the University of Perugia, Italy, the 2010 Tel-Aviv University Accounting Conference, the University of Sydney, Australia, the Pacioli Society in Sydney, Australia, the University of Otago, New Zealand, the Rotterdam University School of Business in the Netherlands, the University of Salerno, Italy, the 2004 SAAA and IAAER international research conference in Durban, South Africa, the 2003 Third Accounting Research Workshop in Stuttgart, Germany and the 2003 International Accounting Summer Conference 'Reporting Financial Performance' at Georg-August-University Gottingen, Germany.

statements.[1] The presence of such errors highlights the fact that market participants face two inter-related problems when pricing securities based on financial statements. First, they must assess the quality of the information contained in financial statements. Second, they must make projections about future cash flows and fold these projections back into an appropriate value for the security. Even if one assumes that accurate models are available for projecting cash flows and valuing securities, uncertainty about the quality of financial statements can lead to pricing distortions and inefficient market allocations of capital. The objective of this paper is to develop a market-based mechanism that can lead to a timely disclosure of financial statement quality and, thereby, a more efficient allocation of capital. We show that our proposed mechanism improves social welfare.[2]

The cascade of recent audit failures has given rise to a regulatory initiative, the Sarbanes-Oxley Act of 2002 (the Act), and to an ever growing commentary on 'corporate governance'. A major theme of this literature is the role of 'gatekeepers' and, in particular, the failure of auditors to fulfill their role as independent gatekeepers.[3] Indeed, the issue of auditor independence (or its absence) has occupied a major place in the debate over the failure of corporate governance and is the focus of much attention in the Sarbanes-Oxley Act.[4] The Act seeks to address the problem by increased regulation and penalties, empowerment of audit committees, and reduction of the auditor's involvement

[1] As catastrophic as this event may have been, it proved to be only the beginning of a series of stunning revelations of accounting irregularities by major corporations that were the darlings of Wall Street: Worldcom, AOL, Metromedia Fiber Networks, Qwest Communications; the list goes on and on. The number of restatements keeps rising, from 50 a year in the early 1990s to well over 200 a year in 2001.

[2] In a capital-raising context, the critical report is that of the independent expert. However, independent experts do not conduct separate audits and rarely dispute the content of the audited financial statements included in the registration prospectus. For this reason, financial statements insurance plays an important role in the capital raising process. We are grateful to an anonymous referee for bringing this issue to our attention.

[3] For example, Arthur Levitt (2002, p. 116) complains: 'More and more, it became clear that the auditors didn't want to do anything to rock the boat with clients, potentially jeopardizing their chief source of income. Consulting Contracts were turning accounting firms into extensions of management—even cheerleaders at times. Some firms even paid their auditors on how many non-audit services they sold to their clients'.

[4] The empirical literature on the relation between auditor independence and the quality of audits is contradictory and inconclusive. The major shortcoming in the literature is the absence of convincing empirical proxies for either independence or audit quality. Typically, discretionary accounting accruals or restatements are used as proxies for the inverse of quality. However, discretionary accruals need not be a bad thing: they may be used to signal truthfully the private information of managers. In the same vein, restatements can be seen as a corrective mechanism that 'cleanses' the financial statements, and hence associated with higher quality audit as compared with instances in which errors go undetected by the auditor with no consequent restatement. For an extensive review of this literature (see Romano, 2004).

with the client.[5] But the Act does not untie the auditor/management knot: auditors continue to be hired and paid by the firms they audit.

Without joining the debate about the effectiveness of the Act,[6] and as an alternative to, or supplement to, its mandates, this paper introduces a market-based financial statements insurance scheme (herafter, FSI)[7] designed to eliminate conflicts of interest that inhere in the auditor–client relationship and, at the same time, to signal credibly the quality of financial statements. The model developed in this article shows that such a scheme would allow more accurate inferences regarding future cash flows to be drawn from financial statements, and thus permit more efficient resource allocations.

The social value of *ex-ante* self reporting has been recognized in the literature (Kaplow and Shavell, 1994). In essence, the FSI mechanism involves induced truthful 'self reporting' through the auditor's attestation of the quality of the financial statements even when such quality is poor and expected to trigger market sanctions when made public.[8] In contrast, the current structure of incentives driving auditors' behaviour may not elicit unbiased reports. Auditors are paid by the companies they audit; this creates an inherent conflict of interest that is endemic to the relationship between the manager (the principal) and the auditor (the agent). We analyze, first, the financial statement quality equilibrium under the existing legal and regulatory regime governing auditing when managers obtain significant benefits both direct and indirect when they successfully raise capital. Defining quality as the inverse of the probability of overstatement in financial statements, we show that the natural equilibrium is one where lowest quality financial statements are chosen (resulting in a high probability of overstatement in the financial reports). Under these circumstances, firms that potentially yield a low rate-of-return (low fundamental value) cannot be identified easily and are overfunded relative to firms characterized by a high rate-of-return (high fundamental value). We show analytically that the introduction of FSI can lead to a better assessment of financial statement quality resulting in a much more accurate identification of low value firms.

[5] Romano (2004), having reviewed an extensive body of literature, concludes that the Act's mandates were seriously misconceived as they are not likely to improve audit quality or otherwise enhance firm performance and benefit investors as Congress intended.

[6] A strong critique of the Sarbanes Oxley Act may be found in Butler and Ribstein (2006) who observe that '[one of its consequences is] the placing of significant new burdens and risks on auditors, thereby forcing additional inefficient risk-bearing that makes it even harder for smaller and riskier firms to enter the public markets'.

[7] The idea of financial statements insurance was first floated in a short opinion piece for a popular audience in the *New York Times* (8 March 2002) by Joshua Ronen, 'A Market Solution to the Accounting Crisis'. On 10 July 2002, a commentary by Susan Lee, 'A Market Remedy for Our Nasty Accounting Virus', re-exposed the idea in the *Wall Street Journal*.

[8] Lacker and Weinberg (1989) study the characterization of optimal no-falsification contracts from a general perspective. A considerable body of literature argues that injuries associated with purchased products would be more efficiently handled under contracts rather than mandated regulations or torts.

The basic structure of FSI can be described as follows (details may be found in Appendix B, based on Ronen (2002)).[9] Instead of appointing and paying auditors, companies purchase FSI that provides coverage to investors against losses suffered as a result of misrepresentation in financial reports. The premiums paid for that coverage are publicized. The insurance carriers appoint and pay the auditors, who attest to the accuracy of the financial statements of the prospective insurance clients. Those firms announcing lower premiums distinguish themselves in the eyes of the investors as companies with higher quality financial statements. In contrast, those with higher premiums reveal themselves as firms with lower quality financial statements. Every company will be eager to get higher coverage and pay lower premiums lest it be identified as the latter. A sort of Gresham's law would be set in operation, resulting in a flight to quality.

According to sound principles of corporate governance, auditors are supposed to be the agents of the shareholders. However, in practice, although shareholders (and audit committees) vote on management's recommendation of which auditor to hire, it is the management of the company that effectively engages the auditor and ultimately pays for the services. The fact that CEOs and CFOs control the fees paid for auditing and consulting services allows them to elicit actions, including opinions and assurances, that it desires from the auditor. The risk of losing fees from a long-term audit engagement—even in light of the limitations on non-audit services imposed by the Sarbanes-Oxley Act of 2002—may secure auditor compliance with management's objectives. We argue that the imperfect alignment of interests between managers and shareholders and the intractable conflict of interest imposed on auditors can be rectified through an agency relationship between the auditor and an appropriate principal, whose economic interests are aligned with the goal of promoting the quality of the financial statement.[10] Within a free market mechanism, insurers can serve the role of such an intermediary.

The critical features of the FSI scheme underlying this study are: (a) the effect of publicizing the premium charged to different firms; and (b) the shift of control over the auditor's compensation and, hence, incentive structure from management to the insurer. We seek to formalize these two features and to demonstrate that FSI, when linked with appropriate disclosure provisions, leads firms to improve the quality of their disclosures voluntarily. A key economic feature underlying this result is the fact

[9] Cunningham (2004a) provides a comprehensive discussion of the legal and institutional implications and ramifications of the FSI idea presented in this paper. Furthermore, Cunningham (2004b) proposes a model legislative Act of the FSI scheme.

[10] Such a principal (intermediary) should not benefit from the price at which securities are traded. A realignment of interests along these lines would contribute to restoring the 'complete fidelity to the public's trust' that Chief Justice Burger insisted on in a celebrated opinion: 'By certifying the public reports that collectively depict a corporation's financial status, the independent auditor assumes a public responsibility transcending any employment relationship with the client. The independent public accountant performing this special function owes ultimate allegiance to the corporation's creditors and stockholders, as well as to the investing public. This "public watchdog" function demands that the accountant maintain total independence from the client at all times and requires complete fidelity to the public trust' [465 U.S. 805, 818].

that the insurer's primary business is providing coverage and insurers are primarily asessed on whether their polices are generating profits. In contrast, an auditor's primary business is providing the audit service and the allocation of fees across services and coverage can be quite arbitrary. For this reason, the insurer sets the premium at a break-even level at least, whereas the auditor wishes to break even across the joint payments for audit services and indirect litigation coverage.

MODEL

We develop a model in which firms try to attract capital through their financial reports.[11] The firm's management benefits from obtaining capital, but there is a social waste if firms with low rates-of-return are funded.[12] We consider an economy with N firms, where each firm is of type $i, i = 1, \dots, L$ where a type i firm will earn return r_i with $r_1 < r_2 < \dots < r_L$. The type of each firm f is drawn randomly by nature at the start of the period and is independent of other firms. The true type drawn by nature is unobservable at the start of the period but the managers of each firm f obtain a private signal, ω_f, about their firm's type where $\omega_f \in \{\omega_1, \omega_2, \dots, \omega_L\}$ represents the set of L possible signals observable by the firm. We denote by $P(i|\omega_l)$ the probability that the end-of-period rate-of-return will be r_i for a firm f that receives a private signal, ω_l.

The strategic tool for obtaining capital is an audited financial report that is issued to investors. Although this report may not be directly falsified, it can be manipulated indirectly through a reduction in the quality of the statements.[13] Based on his or her private signal, ω_f, the firm's manager chooses accounting policies that determine the internal quality of the reporting system, denoted by q, where we assume $q \in [\underline{q}, \overline{q}] \subseteq \Re$. The overall financial statement quality, x, is determined both by the firm's choice of internal quality, q, and the auditor's effort, e which lies in some real interval $[\underline{e}, \overline{e}]$. The overall quality is determined as the function $x = V(q, e)$ where V is strictly increasing in both q and e. We shall use $\boldsymbol{x}$ to denote the ordered pair $\{q, e\}$

[11] The consideration of a firm in need for raising capital is a modelling choice that facilitates a rigorous analysis of the welfare implications of the FSI mechanism: the raising of capital in the model makes it possible to analyze the impact of the proposed mechanism on resource allocation in the economy. This choice, however, does not affect the generalizability of the model's implications. Specifically, even without initial public offerings or seasoned offerings, the analysis implies that the capital markets become more complete in that prices of the firms' securities will better reflect the underlying profitability of these firms' operations. Higher prices would be paid for the more profitable firms and lower prices for the less profitable, not only when the firms issue securities, but also in secondary trading where investors buy and sell securities to each other on an ongoing basis where securities are continuously traded in the marketplace. Higher prices in turn mean a lower cost of capital (the investment hurdle rate) that encourages the managers of the more profitable firms to invest and expand operations—thus enhancing allocative efficiency.

[12] More generally, it is possible to consider a multi-period consumption–investment model where investing in some of the projects reduces overall welfare calculated across several periods.

[13] A typical example may be the choice of classifying a capital lease as an operating lease by using a higher than warranted discount rate.

and x to denote the value $V(q, e)$. When dealing with ordered pairs we use the natural coordinate order as follows: $\boldsymbol{y} = \{q', e'\} \preceq \boldsymbol{x} = \{q, e\} \Leftrightarrow q' \le q$ and $e' \le e$. In contrast, the statement $y \le x$ is an assertion that $V(q', e') \le V(q, e)$ and does not indicate that each component is lower. Clearly, $\boldsymbol{y} \preceq \boldsymbol{x} \Rightarrow y \le x$ but the converse may not be true. For a given e, $V(q, e)$ is a strictly increasing function of q and therefore, there is only one value of q such that the given value x is the same as $V(q, e)$. For this reason, any function of q and e can also be treated as a function of x and e.

After firm f's type, i, and associated rate-of-return r_i, is realized, a financial report $\theta_f \in \{1, \ldots, L\}$ is disseminated to investors. Associated with each report $\theta_f = j$ is the rate-of-return r_j, which we shall refer to as firm f's reported rate-of-return. r_j may, of course, be different from the actual rate-of-return of firm f, r_i. However, investors will not blindly accept r_j; instead, they will use this implied (by the report) rate as well as their perceptions about audit quality to 'infer' an expected rate-of-return for firm f.

To characterize this inference process, let $P(i|j, x)$ denote the probability that the realized rate-of-return is r_i given that the reported rate-of-return is r_j and overall quality x. Investors observe the report $\theta_f = j$ but they cannot observe the choices q and e and hence x. Therefore, investors make conjectures about x and use these *beliefs* to infer a rate-of-return based on a report $\theta_f = j$. Denoting investor beliefs about the overall quality of firm f by ν_f, we write $P(i|j, \nu_f)$ for the posterior probability assigned by investors to the event that the true rate-of-return is r_i given that the reported rate-of-return is r_j and the *conjectures* about the level of x. The inferred rate-of-return associated with this posterior probability distribution, $\hat{r}_j$:

$$\hat{r}_j = E[r|\theta_f = j, \nu_f] = \sum_{i=1}^{L} r_i P(i|j, \nu_f). \tag{1}$$

We assume that there is a minimum threshold rate, r^*, such that funding firms with rates of return less than r^* results in a social loss. r^* is a random variable with a distribution $G(r^*)$ that represents the social cost of capital. r^* is assumed to be independent of firms' rates of return and G is assumed to be convex.To exclude the trivial cases (a) where all firms should be funded (and there is no social loss resulting from misleading statements) and (b) where even the highest-type firm does not merit funding (and capital providers will not enter the market) we assume that r^* is distributed over some interval $[\underline{r}, \overline{r}]$ where $r_1 < \underline{r}$ and $\overline{r} < r_L$. The simplest example of a convex G satisfying these requirements is when r^* is uniformly distributed over the interval $[\underline{r}, \overline{r}]$.

In the first-best scenario, in which the true rate-of-return is perfectly observed, only firms with rates of return higher than r^* will obtain capital. In a second-best scenario, in which investors do not know each firm's type, they analyze the report, $\theta_f = j$, and fund firm f if the inferred rate-of-return, $\hat{r}_j$, is greater than the threshold rate r^*. For simplicity, we assume that whenever $\hat{r}_j \ge r^*$, investors contribute one unit of capital to the firm.[14]

[14] We use the term 'capital inflow' and henceforth also 'funding' in a broad sense to include any purchases of the firm's stock by investors—whether in a public offering or in secondary trading. In the

The managers of a firm typically benefit in both pecuniary and non-pecuniary ways from capital inflows.[15] We represent the (portion) of the value of the firm appropriated by management by B (for benefits). In other words, by ensuring a capital inflow, the firm's management generates both a return which is passed back to shareholders and a benefit B for themselves. In this setting, low quality financial statements that misdirect capital lead to two basic types of losses (viewed from the perspective of investors).

First, when a firm of type i with ($r_i < r^*$) is funded (because the inferred rate-of-return $\hat{r}_j \geq r^*$), the investor suffers a a loss of $1 \times (r^* - r_i)$ (recall that the investment involves one unit of capital). While such losses are straightforward, there is a second type of loss that also results from inferior accounting quality. Because investors are unable to distinguish the high type firms from low type firms, some high type firms may not be funded. So, if a firm k of high type, $r_k > r^*$ is *not* funded, investors lose the amount $1 \times (r_k - r^*)$. The total cost of misinvestment is the sum of these two losses (see example 3.2 for a complete loss calculation). That is, an inflated financial statement not only draws capital towards an inferior firm, it also indirectly starves superior firms (whose 'honest' reports are discounted in the same way as 'dishonest' reports) leading to both an actual loss and an opportunity loss.

Information Structure and Investor Beliefs

In this section, we develop the structure underlying the investor's determination of a posterior inferred rate-of-return for firm f after observing the report $\theta_f = j$ (and other information). This process embeds two economic features:

1. the joint relationship of the true underlying type and the reported type for each level of overall quality x; and
2. the (Bayesian) inference process of investors based on the relationship in (1) above and on their perceptions about the choice of x.

For each level of quality x, we have a joint distribution of reports and types denoted by $P(j, i|x)$, $i = 1, \ldots, L$; $j = 1, \ldots, L$. We assume that x has no productive effects, that is, it does not affect the (unconditional) distribution of true types, $P(i)$ or the joint probability $P(i, \omega_f)$; so $P(j, i|x) = P(j|i, x)P(i)$ and $P(j, i|x, \omega_f) = P(j|i, x)P(i|\omega_f)$. We write this joint distribution as an $L \times L$ matrix $\mathcal{P}^x(\omega_f)$, or more simply, as $\mathcal{P}^x$ when ω_f is pre-specified. In other words, given a firm f the private signal of which is ω_f and quality choice is x, the ij^{th} coeffecient of $\mathcal{P}^x = p(j, i|\omega_f, x)$. Recall that for any two levels of overall quality x, y, $y \preceq x$ if, and only if, x entails both higher internal quality and higher audit effort than y. The next assumption develops a systematic ordering relationship between $\mathcal{P}^x_{ij} = P(j, i|\omega_f, x)$ and $\mathcal{P}^y_{ij} = P(j, i|\omega_f, y)$ consistent with $y \preceq x$.

latter case, the purchase of stock exerts an upward pressure on its price thereby decreasing the firm's cost of capital. The firm would be able to finance investment projects that it could not afford without the price increase (price inflation in the case of misrepresentation). For example, it can do so by selling treasury stock at the higher price, obtaining debt financing at lower cost due to a lower debt–equity ratio, etc.; management, as well, benefits through the increased value of stock and options holdings.

[15] Managers may use the capital infusion to either enlarge their own firm or take over other firms. This is widely reported in the financial literature as 'empire-building' or as 'hubris'.

A lower x (in the natural co-ordinate partial order) ought to 'increase' the probability of overstatement; in addition, a higher x should make it easier to separate out true types. To capture these two features, we first assume that all errors in the financial report are overstatements; that is, a firm f of type i only receives reports $\theta_f = j \geq i$.[16] Then we make the following assumption (further details are given in Appendix A):

Assumption 1 (A Formalization of Financial Statement Quality)

(1) For a given overall quality x, firms of higher type are more likely to issue high reports. That is, whenever $i \geq k$, the relative likelihood of being reported as type j, $\frac{P(j|i,x)}{P(j|k,x)}$ increases in j (i.e., for a fixed x, higher signals are 'good news' in the sense of Milgrom (1981)).

(2) For a given type i, the reported type increases (in the sense of First Degree Stochastic Dominance) as overall quality is lowered, that is, for $y \preceq x$, $P(\cdot|i, y)$ FDSD's $P(\cdot|i, x)$.

(3) For any two quality levels $y \preceq x$, there exists a column stochastic matrix Λ^{yx} with $\Lambda^{yx} \circ \mathcal{P}^x = \mathcal{P}^y$.[17]

Assumption 1 sets up a structure for formally analyzing overall quality. The structure is intuitive. The first part of the assumption says that for a fixed overall quality, higher reports imply better rates-of-return, that is, the reported type, though noisy, is positively correlated with the firm's true type (i.e., financial reporting has value). The second part asserts that lower overall quality leads to a greater probability of overstatement in the sense of First-Degree Stochastic Dominance. The third part of the assumption states that lowering quality 'garbles' the relationship between true and reported types that holds at a higher quality. This is a natural definiton of quality in the sense that the relationship between reprted type and true type becomes less precise as overall report quality declines.

As noted in equation (1), the inferred return depends only on the *beliefs* v_f regarding the overall quality chosen by firm f rather than on the firm's actual optimal choice x_f^*. The basic theme underlying our model is that firms can mislead investors by setting $x_f^* < v_f$; however, rational expectations requires that *in equilibrium*, the actual choice of x and market conjectures have to coincide. The equilibrium we derive takes both of these economic requirements into account. We return to this analysis after developing the liability structure that counteracts firms' desire to set low levels of overall quality.

[16] This assumption is realistic because at the time of the report firms know their true rate-of-return and will correct any downside error by providing the auditor with persuasive information about their true type. However, they will allow overstatements to proceed uncorrected.

[17] Parts 2 and 3 can be combined into a single definition by insisting that the garbling matrix be upper-triangular (Robbins and Sarath (1998), Proposition 2).

Liability Structure

Both firms and auditors face penalties under provisions of the 1933 and 1934 Securities Acts and other statutory and case law when they issue financial reports that *ex-post* are found to be misleading. Additionally, financial statements with low overall quality may impose additional penalties on the auditor in the form of reputation loss. Our goal is to show that the allocative efficiency of capital increases with the provision of FSI. To make this point clearly, we fix the total recoveries obtainable through the legal system while varying the mechanism by which these recoveries are collected by investors. The firm's expected liability is denoted by $\mathcal{L}_f(x)$. We denote the auditor's expected liability by $\mathcal{L}_a(x,e)$ to emphasize the fact that the auditor is separately responsible for any deficiencies in the audit process caused by a low level of effort, e. The structure that we impose on the expected liability is: $\mathcal{L}_f(x)$ and $\mathcal{L}_a(x,e)$ are both decreasing in x (under the usual partial order on x) and e. Notice that $\mathcal{L}_a(x,e)=\mathcal{L}_a(V(q,e),e)$; where it causes no confusion, we shall also write $\mathcal{L}_a(x,e)=\mathcal{L}_a(V(q,e),e)$ as $\mathcal{L}_a(q,e)$ where $\mathcal{L}_a(q,e)$ is decreasing in both q and e.[18]

Funding and Managerial Benefits

Managers choose the overall quality of financial statements to maximize their own benefits. These benefits derive from a successful ability to raise capital. The manager's ultimate payoff depends both on firm value and success in raising new capital. Firm value depends on the return on investment less any potential damages that may have to be paid (to pre-existing shareholders) for inflated financial reports. In addition, managers derive a direct benefit, B, whenever they are successful in raising capital.[19] We assume, for simplicity, that all firms have an investment, I, absent any new capital, or the amount $I + 1$ if new capital is raised. Managers may appropriate a portion B of the new capital as direct benefits.[20] In this setting, denoting the probability of funding firm f by FP_f, the expected firm value when a private signal ω_f is observed, x is implemented, and audit fee $F(x, e)$ (defined in the next section) is paid may be written as:

$$(1+E(r|\omega_f))(I+FP_f(x|\omega_f,\vec{v})(1-B))-\mathcal{L}_f(x)-F(x,e) \quad (2)$$

[18] We are realistically mindful of the fact that liability for erroneous disclosures exists even when the firm does not attract additional capital. Indeed, as long as the firm's securities are publicly traded, it faces potential liability under the 1934 Securities Act.

[19] Baker, Jensen and Murphy (1988) note that '[there is an] . . . observed relationship between compensation and company size'. In other words, what starts out as a simple empirical correlation between size of firm and size of remuneration for top level managers is turned into a causal mechanism that rewards managers for increasing the size of the firms they lead even though they may destroy value in doing so.

[20] An implicit assumption is that a firm of higher type *ex-ante* will also earn higher returns *ex-post* even after management-appropriated benefits, B are deducted. In other words, the perquisites appropriated, B, are 'small' relative to firm returns.

Assuming that the managers own α of the firm, and given that they expropriate B, the managers payoff function is:

$$\alpha[(1+E(r|\omega_f))(I+FP_f(x|\omega_f,\vec{v})(1-B))-\mathcal{L}_f(x)-F(x,e)]+B\times FP_f(x|\omega_f,\vec{v}) \quad (3)$$

We shall assume that the manager benefits more from direct consumption than he or she loses in firm value as a result of his or her consumption. That is,

$$B\times FP_f(x|\omega_f,\vec{v})-\alpha B(1+E(r|\omega_f))FP_f(x|\omega_f,\vec{v})>0 \Leftrightarrow 1>\alpha(1+E(r|\omega_f)) \quad (4)$$

If insurance is available with an associated premium π_f, then the managers' payoff may be written as:[21]

$$\alpha[(1+E(r|\omega_f))(I+FP_f(x|\omega_f,\vec{v})(1-B))-(\pi_f+F(\hat{x},e))]+B\times FP_f(x|\omega_f,\vec{v}) \quad (5)$$

where $\hat{x}$ is the overall quality reported by the auditor to the insurer (see the next section). After receiving a private signal ω_f, the managers choose x so as to maximize the payoff in equation (3) or (5) depending on whether insurance is available.

The last part of our model development concerns the role of the auditor.

Auditor Incentives and Decisions

The auditor is the principal informational intermediary in the trading of securities. In our model, we take as a given that the auditor must supply information to investors but that the quality of this information depends on the incentives provided by the auditor's employer (either the firm or the insurer). Our goal is to study firm–investor interactions and not audit contracts or auditor behavior. To this end, we focus solely on whether the auditor's incentives lead to the true overall quality, x, being revealed to investors rather than on whether auditors will 'shirk'.

The auditor is assumed to be risk-neutral and to face a cost of effort denoted by $C(e)$. Let $F(x, e)$ denote the fee that ensures that the auditor breaks even, that is,

$$F(x,e)=C(e)+\mathcal{L}_a(q,e) \quad (6)$$

We assume that the fee $F(x, e)$ will induce the auditor to exert the effort level e required by the auditor's employer. The ability to impose *ex-post* penalties, such as adjustment of fees or refusal to renew the auditor's contract will force the auditor to implement the level of effort e desired by the firm (or insurer) as long as $F(x, e)$ is

[21] A minor difference between the insurance and non-insurance situation should be noted. If managers 'pump and dump', they will be able to sell before the legal penalty $\mathcal{L}_f(x)$ is imposed whereas the insurance premium π_f is unavoidable as it is paid *ex-ante*. However, in the interest of keeping the comparison across the different settings as 'clean' as possible, we assume that the managers will have to face the reduction in share value associated with low quality choices either as higher premia or as a higher litigation payout.

large enough to cover both direct, $C(e)$ and indirect costs, $\mathcal{L}_a(q,e)$.[22] For a given level of overall quality, x, $q^*(x)$ and $e^*(x)$ denote the choices of q and e that minimize the total cost of $\mathcal{L}_f(x)+F(x,e)$.

Suppose FSI is available, a further consideration enters the picture—the report to the insurer about the choice of x. We denote this report by $\hat{x}$ and write $F(\hat{x},x,e)$ for the fees when the auditor is incentivized to report $\hat{x}$ while the implemented overall quality of the firm is x. We distinguish between two cases: (a) auditor hired by the firm and (b) auditor hired by the insurer. We assume the auditor's report to the insurer is private and does not increase the auditor's exposure to litigation. We assume that the insurer can demand an *ex-post* adjustment if $\hat{x} \neq x$ through increased future premia when the firm hires the auditor or through a transfer from the auditor when the insurer hires the auditor. We denote this adjustment by $\sigma_a(\hat{x},x)$. The auditor is paid a fee commensurate with the $\hat{x}$ reported to the insurer. In addition, when the auditor is hired by the insurer, the auditor's initial fee will be paid by the insurer, but reimbursed by the firm and the fee will not be affected by the overall quality level x. Gathering all these points together, the audit fee paid by the firm, $F(\hat{x},x,e)$, has the following structure:

(auditor hired by the firm and the fee paid directly by the firm):

$$F(\hat{x},x,e)=F(x,e)=C(e)+\mathcal{L}_a(x,e)$$

(FSI: auditor hired by insurer and the fee paid by the insurer but reimbursed by the firm):

$$F(\hat{x},x,e)=F(\hat{x},e)=C(e)+\mathcal{L}_a(\hat{x},e) \tag{7}$$

We note, however, that under FSI (where the insurer hires the auditor), the total payoff of the auditor $F(\hat{x},e)-\sigma(\hat{x},x)$, is net of the *ex-post* adjustment and thus depends on all three variables, $\hat{x}$, x and e. To minimize $\sigma_a(\hat{x},x)$, the auditor is thus induced to report $\hat{x}=x$ resulting in $\sigma_a(\hat{x},x)=0$. In this way, the strategy whereby the auditor reveals x truthfully to the insurer in equilibrium is implemented. To sum up, when the firm hires the auditor, the auditor can be costlessly induced to report the overall quality level favoured by the firm (see also Proposition 3) whereas when the insurer hires the auditor, *ex-post* transfers induce the auditor to report quality truthfully to the insurer.[23]

[22] Note that in our setting the firm hiring the auditor observes the latter's effort and so it is able to enforce a 'first best' effort consistent with the hiring entity's objective. Thus, in the case of the auditee hiring the auditor, the former's objective and the corresponding desired 'first best' effort may not be necessarily beneficial from the standpoint of shareholders or society as a whole. For example, the hiring entity may design a hiring contract that induces a low-quality financial statements which may be beneficial to the hiring entity but injurious to shareholders or to society as a whole. The hazard of the auditor misrepresenting the quality of the disclosure is present when the auditor is hired by the auditee and not by the insurer. Other than complicating the analysis, introducing moral hazard with respect to the auditor's effort would not qualitatively change the results.

[23] The design of the mechanism does not transfer the moral hazard currently faced by auditors to the insurance companies in equilibrium. Note that the insurance industry, in reality as well as in the model, is competitive. Hence, the sum of the premium and the audit fees paid by the insured to the insurance company cannot exceed in competitive equilibrium what the most efficient insurer would demand

Formalization

We now state the formal programs for the strategic choice of overall financial statement quality for a firm *f* receiving a private signal ω_f under several different economic regimes. There are two basic aspects of FSI that we need to examine:

(1) the effects of the public disclosure of FSI premia;
(2) the economic rationale for allowing the insurer to control the auditor's contract.

While both these features are part of FSI, they are driven by different incentive problems. The first incentive problem relates to the fact that the client-firm increases its likelihood of acquiring capital by implementing low x. The second relates to the fact that the client-firm would prefer, irrespective of the actual choice of x, that the auditor reports a high x implementation. While both incentive problems arise from the desire of the client-firm to acquire funding, the mechanisms required to mitigate the two problems are distinct. To clarify this point, we analyze four distinct programs (the time line for each of these programs is shown in Figure 1):

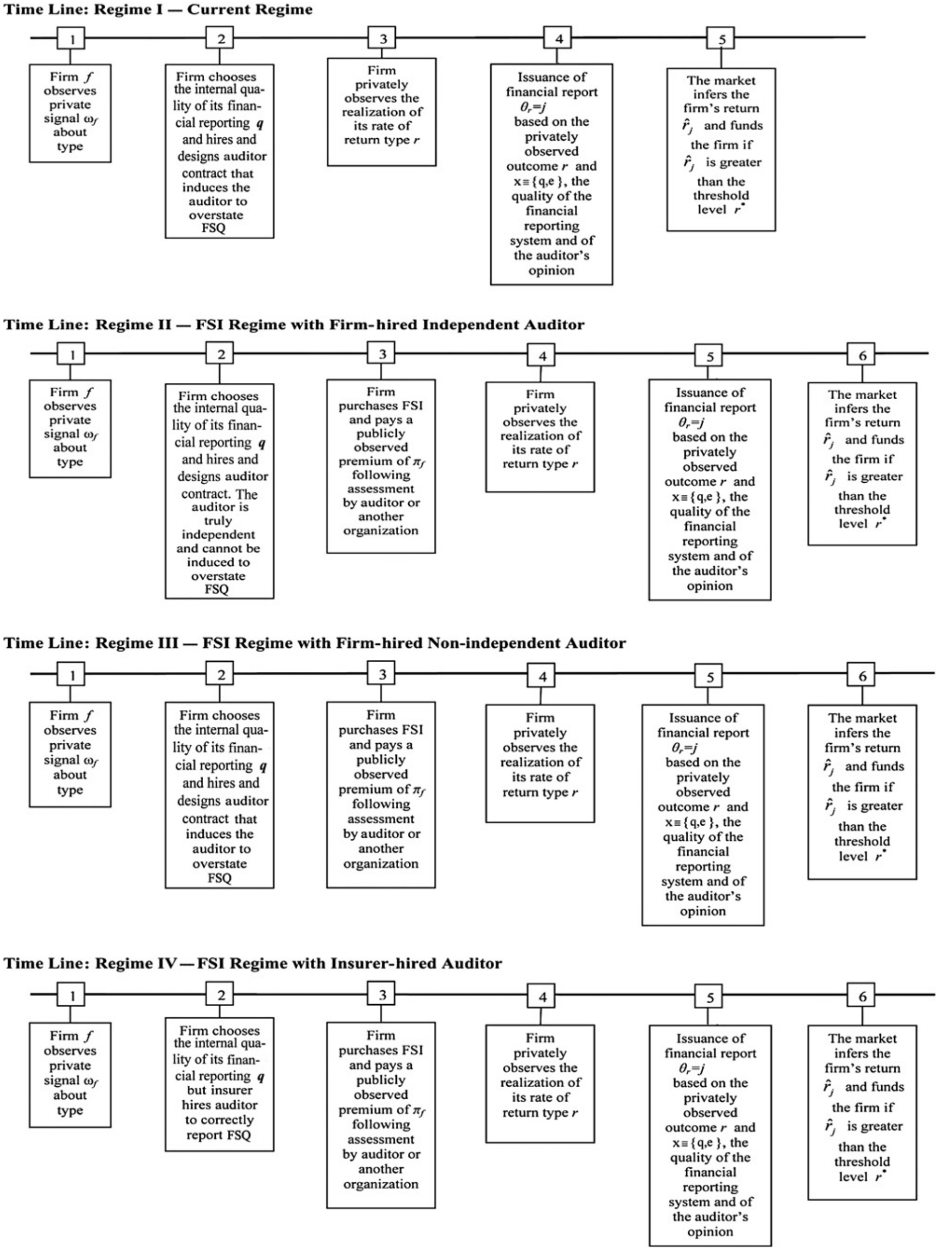
(I) The current regime where information about x is unavailable prior to the funding decision and investors base their decisions on (*ex-ante*) beliefs. The auditor is hired and paid by the client-firm and may not be truly independent.
(II) Insurance is available; the auditor is hired by the client-firm and is truly independent. That is, the auditor cannot be induced to overstate x (although he or she can be induced to lower audit effort). Investors update their beliefs about x after observing the insurance premium.
(III) Insurance is available and the auditor is hired by the client-firm and can be induced by the client-firm to overstate x. Investors update their beliefs about x after observing the insurance premium.
(IV) FSI is available, premia are disclosed and the auditor is hired by the insurer. Investors update their beliefs about x after observing the premium.[24]

barring collusion (which is ruled out by effective competition). Thus the sum of the premium and the audit fee would be commensurate with the least costly, and effective insurance provider. Given this constrained total, would the insurer have an incentive to drive down the audit fee and drive up the insurance premium? This will not happen in equilibrium because the insured would bear the cost of an increased cost of capital triggered by the capital markets interpreting a higher premium as a signal of a poorer financial statements quality, and thus would defect to another competitive insurer that would not impose this cost on the insured. Besides, the insurer has no incentive to lower the audit fee and increase the premium by any given amount since it would be reimbursed for the total (of premium and audit fee) by the insured in any case. Now consider the alternative where an insurer accepts a higher audit fee and reduces its premium accordingly. Here again, since the sum of the audit fee and the premium are fixed at the most efficient level, the insurer has no incentive to report a lower premium (than the one truly commensurate with the risk) and higher audit fee since the total reimbursed amount is the same. In addition, because the lower premium—signaling falsely better quality of financial statements—would result in higher (and misleadingly inflated) prices paid for the insured's securities, higher damages would be claimed by shareholders against the insurer when the prices later tumble upon revelation of the truth. Thus, such aberrant behaviours will not occur in equilibrium.

[24] We reserve the term 'FSI' to the regime depicted in Program IV wherein the auditor is hired by the insurer. When the auditor is hired by the firm in Programs II and III, we simply refer to the availability of insurance, rather than 'FSI'.

FIGURE 1

TIME LINES FOR PROGRAMS I–IV



Before stating the programs, it is necessary to outline the process by which investors derive their inferred returns and describe how it influences the manager's decision problem in implementing the optimal x (details are provided in Appendix A). This outline also highlights the differences in the structure of investor beliefs across Setting I where the insurance premium is not observed and Settings II–IV where it is observed.

In Setting I, investors start with prior beliefs represented by $\vec{v} = \{v_1, v_2, \ldots, v_L\}$ where v_l denotes the beliefs regarding the (strategically optimal) level of x implemented by a firm f with private signal ω_l.[25] Thus, in Setting I, the inferred return for firm f upon observing a report $\theta_f = j$ under beliefs $\vec{v}$ is given by (see Appendix A for the details):[26]

$$E[r|\theta_f = j, \vec{v}] = \sum_i r_i P(i|j, \vec{v}) = \sum_{l=1}^{L} \left\{ \sum_{i=1}^{j} r_i \frac{P(j, i|\omega_l, v_l)}{P(j|\omega_l, v_l)} \right\} P(\omega_l) \tag{8}$$

In Settings II–IV, investors observe the premium, π_f, charged to firm f and update their beliefs. The updating process involves two steps: (a) investors will update their beliefs regarding the quality chosen by firm f to a value x_f consistent with the premium π_f; and (b) they will update their beliefs regarding the private signal ω_f based on the quality associated with π_f. For example, if firm f is observed to pay the lowest premium corresponding to the highest x, investors will infer not only that firm f has chosen the highest possible x, but may also infer that the choice of the highest x indicates a high ω_f as well. The corresponding expected return (also derived in Appendix A) is given by:

$$E[r|\theta_f = j, \vec{v}, \pi_f] = \sum_{l=1}^{L} \left\{ \sum_{i=1}^{j} r_i \frac{P(j, i|\omega_l, x_f)}{P(j|\omega_l, x_f)} \right\} P(\omega_l|\pi_f) \tag{9}$$

In either case, the inferred returns determine the funding probability contingent on choosing overall quality x. Denote this probability by $FP_f(x|\omega_f, \vec{v})$ in Setting I and $FP_f(x|\omega_f, \pi_f)$ in Settings II–IV. The decision problem for firm f's manager is the choice of quality $x_f = \{q_f, e_f\}$ that maximizes the benefits of funding net of the cost of implementing x_f.

The insurer is assumed to break even through a suitable choice of *ex-ante* premium, π_f, and an *ex-post* adjustment. This assumption of *ex-post* break-even is common in the insurance literature and represents the ability to impose costs on the insured in the form of higher future premia. In our context, we assume that the

[25] Given our assumption that firm types are drawn independently, all firms with the same private signal ω_l face identical decision problems regarding the optimal implementation of x. We simplify the belief structure by assuming that each firm with a given private signal ω_f has a single x choice assigned to it. A more general formulation would set the perceived quality v_f to be a probability measure over possible levels of x.

[26] The summation in the last expression over i only extends up to j because all errors are over statements—$P(j|i, v_l) = 0$ for $i > j$.

insurer sets an initial premium $\pi_f(\hat{x})$ based on the auditor's report regarding the overall quality of the financial statements and imposes an *ex-post* adjustment $\sigma(\hat{x}, x)$ (on firm or auditor depending on the context) that allows the insurer to break even. However, the insurer does not wish to depend on this *ex-post* adjustment and tries to make it as small as possible. Lastly, we assume that the audit fee, $F(x, e)$ in Programs I, II & III, and $F(\hat{x}, e)$ in Program IV, implements the audit effort e and report $\hat{x}$ by the auditor.

Program I: Current Regime

$$\max_{q,e,F} \quad B \times FP_f(x|\omega_f, \vec{v}) + \alpha[(1+E(r|\omega_f))(I + FP_f(x|\omega_f, \vec{v})(1-B)) - \mathcal{L}_f(x) - F(x,e)]$$

subject to

$$F(x,e) = C(e) + \mathcal{L}_a(x,e) \qquad \text{(AF)}$$
$$FP_f(x|\omega_f, \vec{v}) = Probability\{E[r|\omega_f, \vec{v}] \geq \hat{r}^*\} \qquad \text{(FD)}$$
$$v_f = x^*(\omega_f) = (q^*(\omega_f), e^*(\omega_f)) \qquad \text{(RE)}$$

where (AF), (FD) and (RE) are respectively the Audit Fee, Funding Probability and Rational Expectations constraints.

Program II: Premia Disclosed with independent auditor hired by the firm and reports $\hat{x} = x$

$$\max_{q,e,F} \quad B \times FP_f(x|\omega_f, \vec{v}) + \alpha[(1+E(r|\omega_f))(I + FP_f(x|\omega_f, \vec{v})(1-B)) - \pi_f - F(x,e)]$$

subject to

$$F(x,e) = C(e) + \mathcal{L}_a(x,e) \qquad \text{(AF)}$$
$$FP_f(x|\omega_f, \vec{v}) = Probability\{E[r_f|\omega_f, \vec{v}] \geq \hat{r}^*\} \qquad \text{(FD)}$$
$$\pi_f = \mathcal{L}_f(x) \qquad \text{(BE)}$$
$$v_f = x^*(\omega_f) = (q^*(\omega_f), e^*(\omega_f)) \qquad \text{(RE)}$$

where (BE) is the insurer break-even constraint.

Program III: Premia Disclosed with a (non-independent) auditor hired by client-firm.

$$\max_{\hat{x},q,e,F} \quad B \times FP_f(x|\omega_f, \vec{v}) + \alpha[(1+E(r|\omega_f))(I + FP_f(x|\omega_f, \vec{v})(1-B)) - (\pi_f + F(\hat{x}, x, e)) - \sigma_f(\hat{x}, x)]$$

subject to

$$F(\hat{x}, x, e) = C(e) + \mathcal{L}_a(x,e) \qquad \text{(AF)}$$
$$FP_f(x|\omega_f, \vec{v}) = Probability\{E[r|\omega_f, \vec{v}] \geq \hat{r}^*\} \qquad \text{(FD)}$$
$$\pi_f = \mathcal{L}_f(\hat{x}) \qquad \text{(IP)}$$
$$\pi_f \leq \mathcal{L}_f(x) \qquad \text{(CO)}$$

$$\sigma_f(\hat{x}, x) = [\mathcal{L}_f(x) - \mathcal{L}_f(\hat{x})] \quad \text{(BE)}$$
$$v_f = x^*(\omega_f) = (q^*(\omega_f), e^*(\omega_f)) \quad \text{(RE)}$$

where (IP) and (CO) are respectively the insurance premium and competitive constraints.

Program IV: FSI

$$\max_{q,e,F} \quad B \times FP_f(x|\omega_f, \vec{v}) + \alpha[(1 + E(r|\omega_f))(I + FP_f(x|\omega_f, \vec{v})(1 - B)) - (\pi_f + F(\hat{x}, e))]$$

subject to

$$\hat{x} = \text{argmax}_{\hat{y}}(F(\hat{y}, e) - \sigma(\hat{y}, x)) \quad \text{(AF)}$$
$$FP_f(x|\omega_f, \vec{v}) = Probability\{E[r|\omega_f, \vec{v}] \geq r^*\} \quad \text{(FD)}$$
$$\min_{x,e} \mathcal{L}_f(x) \quad \text{(IP)}$$
$$\pi_f \leq \mathcal{L}_f(x) \quad \text{(CO)}$$
$$\sigma_a(\hat{x}, x) = [\mathcal{L}_a(x, e) - \mathcal{L}_a(\hat{x}, e)] \quad \text{(BE)}$$
$$v_f = x^*(\omega_f) = (q^*(\omega_f), e^*(\omega_f)) \quad \text{(RE)}$$

The objective function faced by managers in all four programs is to maximize benefits less expenses. Their goal is to maximize their own perquisites by boosting the firm's capital base through their reporting strategies less the expected cost of being over-aggressive. The main differences in this equation across the programs stems from disclosing the insurance premium (absent in Program I and present in all the others) and the nature of the *ex-post* transfer to the insurer (absent in Program II, made by the firm in Program III and by the auditor in Program IV). The insurance premium is revealed to the market in Programs II, III and IV and affects the probability of being funded. However, masking the overall quality of the financial statements (i.e., inducing $\hat{x} \neq x$) results in an *ex-post* transfer, $\sigma(x, \hat{x})$ from the firm in Program III and from the auditor in Program IV.

The (IP) equation represents the level of the premium set initially by the insurer based on the $\hat{x}$ reported to them by the auditor. This premium is disclosed to investors as a signal on the overall quality. (Note that in Program II and IV, $\hat{x} = x$ because the auditor either reports the the truth because he is independent or is induced to do so in equilibrium.) To keep the programs comparable, the cost of the audit is always borne by the firm. In other words, even when the insurer hires the auditor (under FSI), the costs of the audit are reimbursed by the client-firm.

The (BE) equation represents the break-even condition for insurers. Both this equation and the (CO) condition are motivated by an assumption of perfect competition in the insurance industry. The (CO) condition is based on the logic that the firm can, if it chooses to do so, reveal its true overall quality to the insurer and obtain a fair premium. The insurer, in turn, is not worried about undercharging on the premium because the insurance contract allows for an *ex-post* adjustment if the initial assessment of x is erroneous.

In all four settings, the cost to investors of false reporting has a direct component that is remedied (at least partially) through the penalties imposed by the litigation system, and an indirect one measured as misapplied investment. As we are interested only in the relative levels of the indirect cost, we hold the direct costs, that is, the litigation penalties constant across regimes and ensure that these costs are borne by the client-firm in all settings. In Program I, this cost is paid directly by the client-firm. In Programs (II)–(IV), the expected costs are paid out by the firm as an insurance premium (note that with risk neutrality, the actual uncertain cost is the same, in utility terms, as the expected cost to both client-firm and insurer). In Program II, where the auditor is truly independent, x is assumed to be known by the insurer whereas in Programs III and IV the insurer has to rely either on the firm or the auditor to make an assessment of x.

The critical difference across Programs III and IV lies in the *ex-post* settlement associated with the (BE) constraint. In Program III, the insurer breaks even by settling up with the client-firm through a premium adjustment, $\sigma_f(\hat{x}, x)$ whereas in Program IV, the settling up takes place with the auditor. In fact, the structure ensures that $\hat{x} = x$ in Program IV and *ex-post* transfers do not take place in equilibrium.[27] In Program III, the true overall quality of the financial statements is identified only *ex-post* through the litigation discovery process and if benefits to funding are large enough, the firm is willing to pay these *ex-post* transfers (after the true quality is revealed) in exchange for the *ex-ante* benefits of funding.

The (RE) equation expresses the rational expectations constraint that the beliefs about the x implemented by a firm with private signal ω_f, ν_f coincides with the actual equilibrium choices, $\{q^*, e^*\}$. In contrast, the objective function of the manager is maximized holding beliefs constant. This structure is chosen to incorporate the following two economic features: (a) managers have the ability to set low x's without being detected *ex-ante* but (b) market beliefs will stabilize *in equilibrium* at x levels that will not be undercut by the manager.

We now turn to our main analysis concerning the equilibrium levels of x that are chosen by firms under each of the Programs (I)–(IV). In Programs (II)–(IV), the insurance premium is observable by investors. When the firm implements its optimal level of x, it has to take into account the reaction of investors to the financial report that will eventually be issued, and this reaction depends either on prior beliefs regarding x (Program I) or posterior beliefs formed after observing the insurance premium charged to the firm (Programs (II)–(IV)). x is assumed to be observable to the *insurer* in Program II but not observable in Programs (III)–(IV).

RESULTS

To explain the dynamics of investor–firm interactions arising from the introduction of FSI, we analyze the equilibrium in all four programs. Our goal is to show that the implemented x is highest when insurance premia are revealed *ex-ante* to investors and the auditor is an agent of the insurer rather than the firm. We start with the simpler setting where the auditor is truly independent and reports the level of x implemented by the firm to the insurer. Note that this does not affect the audit effort

[27] Generally, it is in the insurer's interests to force truthful revelation of x as this avoids costly *ex-post* renegotiation.

or the probability of errors in the financial report. All it does is to ensure that the premium truly reflects the x implemented by the firm. We show that in this case (Program II), a simple disclosure of the FSI premium leads to a race to the 'top' and all firms implement high x. In contrast, if the firm can induce the auditor to misreport x to the insurer as in Program(III), all potential benefits of providing insurance are lost providing a rationale for the auditor to become an agent of the insurer as in Program (IV).

We begin with a lemma that lists the basic properties of the inference process. Before stating the lemma, it is useful to summarize the notation about funding probabilities. $FP_f\,(j|\nu_f)$ has been defined earlier as the probability that a firm f with report $\theta_f = j$ will be funded (under posterior beliefs ν_f). Given these probabilities, firm f, by choosing overall quality x, will have an (expected) funding probability, $FP_f(x|\omega_f, \vec{\nu})$, given by:

$$FP_f(x|\omega_f, \vec{\nu}) = \sum_{j=1}^{L} FP_f(j|\nu_f)\,P(j|\omega_f, x) = \sum_{j=1}^{L} FP_f(j|\nu_f)\,P(j|i, x)\,P(i|\omega_f). \qquad (10)$$

In other words, the probability of being funded on a report j depends on investor beliefs ν_f and this is multiplied by the probability of getting a signal j which depends both on the firm's private signal and on the overall quality choice. For a given firm f, let $\hat{r}_j$ denote the inferred rate-of-return under beliefs $\vec{\nu}$ and observed report $\theta_f = j$ (we suppress the dependence on ω_f and $\vec{\nu}$ for notational clarity). In addition, in the special case when the beliefs are that the firm has chosen quality x (i.e., $\nu_f = x$), we denote the vector of inferred returns by $R^x = \{\hat{r}_{1x}, \ldots, \hat{r}_{jx} \ldots, \hat{r}_{Lx}\}$ where $\hat{r}_{jx} = E[r|\theta_f = j, \nu_f = x]$. With this notation, the next lemma lists a number of results that link inferred returns and funding probabilities using the information structure in Assumption 1.

Lemma 1 (Reports, inferences and funding probabilities)

Let ν_f denote the posterior beliefs about the implemented x and private signal type of firm f, and $\hat{r}_{j\nu_f} = E[r|\theta_f = j, \nu_f]$ denote the inferred rate-of-return under belief ν_f.

(1) A higher reported rate-of-return implies a (strictly) greater inferred rate-of-return that is, $\hat{r}_{j\nu_f}$ is increasing in j.

(2) Let ω_f denote the private signal observed by firm f. Then the firm's expected probability of funding by choosing quality x is given by:

$$FP_f(x|\omega_f, \nu_f) = \sum_{j=1}^{L} G(\hat{r}_j)\,P(j|\omega_f, x) = \sum_{i=1}^{L} \left\{ \sum_{j=i}^{L} G(\hat{r}_j)\,P(j|i, x) \right\} P(i|\omega_f). \qquad (11)$$

(3) Suppose that σ_f and ν_f are two different posterior beliefs about firm f with the following properties:

a) Under ν_f, investors believe that $x_f = x$ and $\omega_f = \omega_l$ with the prior probability $P(\omega_l)$.

b) Under σ_f, investors believe that $x_f = x$ and $\omega_f = \omega_1$ (with probability 1). (i.e., under belief v_f, all types pool at x whereas under σ_f, only the ω_1-type picks x).

Then the inferred return $E[r|j, v_f] > E[r|j, \sigma_f]$ for every report j and $FP(x|v_f) > FP(x|\sigma_f)$.

(4) Let ω_f denote the private signal observed by firm f and $y \preceq x$ be two distinct levels of overall quality. Let R^x, R^y, denote the associated vectors of inferred returns (under beliefs $v_f = x$ and $v_f = y$ respectively) and P^x, P^y the probability vectors of observing a report j under quality x, y respectively. Then there is a column-stochastic matrix Γ^{xy} satisfying both the following (vector) equalities:

$$i) R^x \circ \Gamma^{xy} = R^y; \quad ii) \Gamma^{xy} \circ P^y = P^x.$$

(5) Let r be given and $y \preceq x$ be two levels of quality. Let j, k denote the lowest reports such that $\hat{r}_{jx} \geq r^*$ and $\hat{r}_{ky} \geq r^*$. Then*

$$\sum_{l=k}^{L} (\hat{r}_{ly} - r^*) p(l|y) \leq \sum_{l=j}^{L} (\hat{r}_{lx} - r^*) p(l|x).$$

Proof:
See Appendix A. □

The next lemma shows how the probability of funding for firm *f* changes in the *x* choices.

Lemma 2 (Funding probability, welfare, and overall quality choice, *x*)
Let ω_f denote the private signal observed by firm f and x, y two quality levels with $y \preceq x$.

(1) For any investor beliefs $\vec{v}$ about the quality choice of firm f, $FP_f(x|\omega_f, \vec{v}) < FP_f(y|\omega_f, \vec{v})$. Holding investor beliefs fixed, a reduction in quality (i.e., an inflation of the expected report) results in a larger probability of funding.
(2) Suppose that investor beliefs about quality accurately reflect the actual choices of the firm; then $FP_f(x|\omega_f, v_f = x) > FP_f(y|\omega_f, v_f = y)$. Allowing investor beliefs to accurately reflect the actual quality chosen by the firm, a reduction in quality (i.e., an inflation of the expected report) results in a smaller probability of funding.
(3) Suppose that investor beliefs about quality accurately reflect the actual choices of the firm; then welfare is increasing with overall quality.

Proof:

1) Fix any beliefs $\vec{v}$ about the quality choices of firm f. From Lemma 1 (1), $G(\hat{r}_j)$ is increasing in j and by Assumption 1(2), $P(j|i, x)$ is strictly decreasing in x in the sense of FDSD; thus $\sum_{j=i}^{L} G(\hat{r}_j) P(j|i, x)$ is strictly larger for lower x. Therefore, by Lemma 1 (2), the *ex-ante* funding probability, $FP_f(x|\omega_f, \vec{v})$, is strictly decreasing in x.
2) In this case, investor beliefs reflect the actual quality chosen by the firm, x. Denote by $G(R^x)$, the vector $\{G(\hat{r}_{1x}), \ldots, G(\hat{r}_{Lx})\}$ and analogously, define the vector $G(R^y) = \{G(\hat{r}_{1y}), \ldots, G(\hat{r}_{Ly})\}$. It follows from Lemma 1 (2) that $FP_f(x|\omega_f, \vec{v}) = G(R^x) \circ P^x$ where P^x the probability vector of reporting j under quality x, that is $P_j^x = p(j|x, \omega_f)$. Therefore, from Lemma 1, (4)

$$\begin{aligned} FP(y|\omega_f, y) &= G(R^y) \circ P^y = G(R^x \circ \Gamma^{xy}) \circ P^y \\ &\leq G(R^x) \circ (\Gamma^{xy} \circ P^y) = G(R^x) \circ P^x = FP(x|\omega_f, x) \end{aligned}$$

3) Let $y \preceq x$. We will show that for each realized value of the cost of capital r^*, the welfare loss is greater under y than under x. Let j, k be the lowest reports such $\hat{r}_{jx} \geq r^*$, respectively, $\hat{r}_{ky} \geq r^*$. By Lemma 1 (1) every report $l \geq j$ is funded under x while every $l \geq k$ is funded under y. The total social return from investment under quality x (respectively, y) is given by $\sum_{l=j}^{L} (\hat{r}_{lx} - r^*) p(l|x)$ (respectively, $\sum_{l=k}^{L} (\hat{r}_{ly} - r^*) p(l|y)$). However, by Lemma 1 (5), the total return under x is greater than that under y, which is equivalent to increased social welfare within our context. □

The results in the two lemmas above help to derive the equilibria under the current regime when investors only discover x *ex-post* through litigation and in the setting where the disclosure of the insurance premium provides *ex-ante* information to the market.

Proposition 1 (Equilibrium in Program I (current regime))
If the benefits from funding, B, are such that for every $y < x$:

$$\begin{aligned} & B\left\{\frac{[FP_f(y|\omega_f, \vec{v}) - FP_f(x|\omega_f, \vec{v})]}{x - y}\right\} \\ & > \left\{\frac{\alpha}{[1 - \alpha(1 + E(r|\omega_f))]}\right\}\left\{Max_q \left|\frac{\partial}{\partial q}(F(q, e) + \mathcal{L}_f(q, e))\right| \right. \\ & \left. + Max_e \left|\frac{\partial}{\partial e}(F(q, e) + \mathcal{L}_f(q, e))\right|\right\} \end{aligned} \tag{12}$$

(i.e., B is large enough to ensure that the benefits from funding exceed the incremental cost from increasing overall quality for each private-signal type), then the equilibrium overall quality level chosen by the firm is $\underline{x} = \{\underline{q}, \underline{e}\}$, that is, the lowest possible level of overall quality. Consequently, as benefits to the manager from funding increases, capital is allocated to low rate-of-return firms with greater probability.

Proof:
Before proceeding to the proof, we note that Lemma 2 (1) implies that the term in parentheses on the left-hand-side is positive and that (4) implies that the right-hand-side is positive. The mean-value-theorem of calculus ensures that for any $\boldsymbol{x} = \{q, e\}$ and $\boldsymbol{y} = \{q', e'\}$:

$$[(F(q,e)+\mathcal{L}_f(x)-(F(q',e')+\mathcal{L}_f(y)] \leq (x-y)\left\{Max_q\left|\frac{\partial}{\partial q}(F(q,e)+\mathcal{L}_f(q,e))\right|+Max_e\left|\frac{\partial}{\partial e}(F(q,e)+\mathcal{L}_f(q,e))\right|\right\} \quad (13)$$

As a result, the condition in (12) ensures that

$$B[1-\alpha(1+E(r|\omega_f))]FP_f(y|\omega_f,\vec{v})-B[1-\alpha(1+E(r|\omega_f))]FP_f(x|\omega_f,\vec{v}) > \alpha\{[F(x,e)+\mathcal{L}_f(x)]-[F(y,e)+\mathcal{L}_f(y)]\} \quad (14)$$

However, the inequality in (14) ensures that the manager's payoff (given in equation (3)) is higher with the choice of y than with x. Since x and y were arbitrary choices, the manager maximizes utility by choosing the lowest possible overall quality $\{\underline{q}, \underline{e}\}$. Note also that B^* is any value satisfying (12) with equality, then any $B > B^*$ also sets off a race to the bottom with regard to overall quality. □

Proposition 1 shows that if the benefits to funding are large enough, it sets off a race to the bottom in terms of overall quality. We now proceed to analyze the effects of introducing FSI. Before presenting that argument, we note that if $y \preceq x$ then the break-even premia associated with these quality levels, $\pi(x)$ and $\pi(y)$ satisfy $\pi(x) < \pi(y)$. This is an immediate consequence of Assumption 1.

Assume that each firm purchases insurance and that the premiums charged to firms are observable. Suppose now that in equilibrium some firm f sets $x_f < x_L$, where x_L is the quality choice of a firm receiving the highest possible private signal ω_f. Then, the premium charged to firm f, π_f, is strictly larger than π_L—and investors will infer that firm f is of some type other than L. Thus, the inferred rate-of-return conditional on observing π_f will be different from that based on the prior beliefs, $\vec{v}$. We will show that the disclosure of π_f and attendant changes in the inferred rate-of-return lead to an equilibrium where all firms pool at the highest level of internal quality.

Proposition 2 (Equilibrium with revelation of premia (Program II))
If the benefits from funding, B, are such that for every $y < x$:

$$B\left\{\frac{[FP_f(x|\omega_f,\vec{v})-FP_f(y|\omega_f,\vec{v})]}{x-y}\right\} > \left\{\frac{\alpha}{[1-\alpha(1+E(r|\omega_f))]}\right\}\left\{Max_q\left|\frac{\partial}{\partial q}(F(q,e)+\mathcal{L}_f(q,e))\right|+Max_e\left|\frac{\partial}{\partial e}(F(q,e)+\mathcal{L}_f(q,e))\right|\right\}$$

(i.e., B is large enough to ensure that the benefits from funding exceed the incremental cost from increasing overall quality for each private-signal type), then the

equilibrium overall quality levels chosen by the firm is to set $\bar{x} = \{\bar{q}, \bar{e}\}$, that is, the highest possible level of overall quality. The association between management benefits (perquisites) and misallocation of capital is negated through the provision of insurance premia that are publicly disclosed (note, however, that in this program, we assume that the auditor will not misreport x to the insurer).

Proof:
Before proceeding to the proof, we note that x and y have been interchanged in the term in parentheses on the left-hand-side, and it is positive from Lemma 2 (2). Let $\bar{x} = \{\bar{q}, \bar{e}\}$ denote the highest quality choice of q and e. Denote the associated break-even premium by $\bar{\pi}$. A rational expectations equilibrium is given by the following beliefs:

(1) whenever $\pi_f = \bar{\pi}$, then $E[r|\theta_f = j, \bar{\pi}] = \sum_{l=1}^{L} E[r|\theta_f = j, \omega_l, \bar{\pi}]p(\omega_l)$ (conditional probability after observing $\bar{\pi}$ equals unconditional probability at the highest level of quality $\bar{\pi}$ corresponding to beliefs that all firm-types choose the quality level $\bar{\pi}$.);
(2) whenever $\pi_f > \bar{\pi}$, then $E[r|\theta_f = j, \pi_f] = E[r|\theta_f = j, \omega_1, x_f]$ where x_f is the quality level corresponding to π_f.

First, by Lemma 1 (3), $FP(\bar{x}|\text{ all types pooling at } \bar{x}) > FP(\bar{x}|\omega_1, \bar{x})$. Next for any $\pi_f > \bar{\pi}$, the associated quality, $x_f < \bar{x}$. Next, by Lemma 2 (2), $FP(\bar{x}|\omega_1, \bar{x}) > FP(x_f|\omega_1, x_f)$. Putting these two inequalities together, $FP(\bar{x}|\bar{\pi}) > FP(x_f|\pi_f)$ (under the belief structure outlined above). Therefore, the funding probability declines whenever $\pi_f \le \bar{\pi}$ is observed, that is, whenever, $x_f < \bar{x}$ is implemented by firm f. As in Proposition 1, the condition on B ensures that the manager's utility is strictly greater with x rather than y. Therefore, every firm will implement $\bar{x}$. □

The fact that defections from high quality are detected and immediately penalized results in the 'flight to quality' documented in Proposition 2. Specifically, high-type firms gain from setting high x. If low-type firms can muddy investor perceptions through low x, high-type firms are also driven to exaggerate their own outcomes, leading to the result in Proposition 1. In contrast, in Proposition 2, by staying with high x, good firms force others to follow suit or be identified as low types. Thus, low-type firms either abandon their quest for capital or accept a much lower probability of being able to mislead investors in equilibrium.

We note that a key feature of the equilibrium derivation stems from the payoff structure of the insurer. Insurers do not benefit from firms obtaining funding. In contrast, the firm benefits directly from raising capital and high-type firms and low-type firms have different preferences over quality. If the firm controls the audit effort, alternative communication mechanisms for conveying quality (such as publicizing the audit fee) may fail (see Appendix C). The conflicting incentive structures (with regard to quality) across types makes it harder to make accurate inferences about quality based on the audit fee as compared with inferences based on the insurance premium.

The choice of audit effort (as opposed to the firm's type) constitutes an endogenous hidden *action*. Signaling about endogenous hidden action that is strategically chosen by some participants but unobservable to others is qualitatively different from signaling exogenous hidden information (DeGroote, 1990). Intuitively, if the hidden information is exogenous (such as the firm's type), then the sender chooses the best signal while holding type constant. However, if the hidden information is an action, the sender of the signal may change both the action and the signal. Under these circumstances, it is much harder to set up separating equilibria. For example, if a particular signal-action combination yields the highest payoff, all senders will choose that particular signal-action combination. In our context where there is both hidden exogenous and endogenous information, for any internal quality choice q of the firm, the insurer's payoff is always maximized at the cost minimizing level of audit effort; in contrast, even while holding internal quality fixed, the firm's payoffs are maximized either at high or low audit effort depending on the firm's type. For this reason, shifting the control of the audit effort to the insurer is critical in deriving the equilibrium in Program IV.

In general, one can obtain economically unintuitive sequential equilibria by specifying implausible off-equilibrium beliefs. The standard device to rule out 'bad equilibria' is to impose restrictions on such off-equilibrium beliefs. In the simple case of two rates of return discussed in the example (see below), a direct proof can be given that 'pooling-at-the-top' is the only equilibrium that meets the universal divinity test.

Lemma 3 (refinement test)
The equilibrium where all firms pool at the highest level of overall quality x is the only one that satisfies the universal divinity refinement criterion.

Proof:
See Appendix A. □

Auditor as an Agent of the Insurer
In this section, we provide an economic rationale for shifting the responsibility for engaging an auditor from the firm to the insurer. We first discuss the situation where the firm purchases FSI but continues to hire the auditor (Program III). We emphasize that this is not an implementation of FSI—under FSI, the auditor is an agent of the insurer. Rather, we analyze this situation to highlight why FSI requires that the auditor stop being an agent of the firm. Let $F(\hat{x}, x, e)$ denote the cost *to the firm* of getting the auditor to exert effort e and report the quality as $\hat{x}$ when the true quality is x. The auditor can be incentivized to report the true x but the firm may not desire the true x to be revealed.[28]

[28] Note that the revelation principle cannot be invoked in our setting because the market's funding strategies have to be *ex-post* rational and any form of precommitment is precluded. In the absence of precommitment to funding schemes, the revelation principle cannot be invoked and the firm will not implement a system where the true x is revealed.

When the auditor continues as an agent of the firm truthful revelation of x may be impossible *ex-ante*. However, litigation will typically reveal the true x *ex-post*. The insurer will find it possible to make an adjustment $\sigma_f(\hat{x}, x)$ with the firm (because the insurer has a contractual relationship only with the firm). The key point is that this transfer is made *ex-post* and will not be known at the time of trading. Hence the firm does not internalize the cost of the low quality, *ex-ante*.

The initial premium observed by the market (Constraint (IP)) reflects the overall quality reported by the auditor to the insurance company rather than the true x. Under these circumstances, the firm will always have incentives to set low x to increase the probability of funding while incentivizing the auditor to over-report the x. Market participants will anticipate this and set funding strategies based on low x precipitating a race to the bottom as shown in the next proposition.

Proposition 3 (Equilibrium with the auditor as firm's agent)
Assume that the benefits from funding, B, are such that for every y < x:

$$B\left\{\frac{[FP_f(x|\omega_f,\vec{v})-FP_f(y|\omega_f,\vec{v})]}{x-y}\right\}$$
$$>\left\{\frac{\alpha}{[1-\alpha(1+E(r|\omega_f))]}\right\}\left\{Max_q\left|\frac{\partial}{\partial q}(F(q,e)+\mathcal{L}_f(q,e))\right|+Max_e\left|\frac{\partial}{\partial e}(F(q,e)+\mathcal{L}_f(q,e))\right|\right\}$$

(i.e., B is large enough to ensure that the benefits from funding exceed the incremental cost from increasing overall quality for each private-signal type), and that the auditor is hired by the firm and may misrepresent the overall quality of the audit to the insurer. Then the equilibrium overall quality levels chosen by the firm is to set $\underline{\boldsymbol{x}}=\{\underline{q},\underline{e}\}$, *that is, the lowest possible level of overall quality.*

Proof:
We begin by noting that the insurer is indifferent across breaking even *ex-ante* or *ex-post*. From the insurer's perspective, the premium can be set based on the auditor's assessment of x, $\bar{x}$, and adjusted later through the transfer $\sigma_f(\hat{x}, x)$. As explained in the discussion preceding equation (7), the firm can (with no extra cost) incentivize the auditor to report $\hat{x}=\bar{x}$ by setting fees as follows:

$$F(\hat{x},x,e)=\begin{cases}F(x,e) & \text{if } \hat{x}=\bar{x}\\ =0 & \text{Otherwise}\end{cases}$$

Program III is therefore essentially equivalent to Program I: all firms induce the auditor to report $\bar{x}$ (with off-equilibrium beliefs that any firm choosing $x<\bar{x}$, as manifested in $\pi>\bar{\pi}$, received signal ω_1). Therefore, all firms pay the premium corresponding to $\bar{x}$ and, hence, investors learn nothing from observing the premium. For this reason, the *ex-ante* beliefs, $\vec{v}$, are not updated after observing the client-firm's insurance premium and the equilibrium in Program III then becomes the same as in Program I, that is, one where all firms set the lowest possible level of x. Summarizing, the equilibrium is one where all firms choose the lowest level $\underline{x}$ but pay premia corresponding to the highest level $\bar{x}$. The equilibrium beliefs of investors is that the overall quality is the lowest level resulting in the same equilibrium as in Program I. □

In contrast, Program IV leads to the same equilibrium as in Program II where all firms pool at the highest overall quality level. The key step again is the updating of beliefs by investors after observing the premium. We assume that the insurer offers a schedule $\pi(\hat{x})$ and sets the auditor's transfer function $\sigma_a(\hat{x}, x)$ in such a way as to ensure that the auditor reveals x truthfully (see details in proposition 4). As a consequence, the equilibrium is the same as in Program II.

Proposition 4 (Equilibrium with the Auditor as the Insurer's Agent)
Assume that the benefits from funding, B, are such that for every $y < x$:

$$B\left\{\frac{[FP_f(x|\omega_f, \vec{v}) - FP_f(y|\omega_f, \vec{v})]}{x-y}\right\}$$
$$> \left\{\frac{\alpha}{[1-\alpha(1+E(r|\omega_f))]}\right\}\left\{Max_q\left|\frac{\partial}{\partial q}(F(q,e)+\mathcal{L}_f(q,e))\right| + Max_e\left|\frac{\partial}{\partial e}(F(q,e)+\mathcal{L}_f(q,e))\right|\right\}$$

(i.e., B is large enough to ensure that the benefits from funding exceed the incremental cost from increasing overall quality for each private-signal type). Under the FSI regime where the auditor is hired by the insurer (and premia are publicly disclosed), there is an equilibrium where all firms set $\bar{\mathbf{x}} = \{\bar{q}, \bar{e}\}$. In addition, if L = 2, this is the only equilibrium meeting the divinity criterion.

Proof:
Given that the auditor bears the cost of misreporting x, he or she would typically choose to underreport x. However, the competition (CO) constraint ensures that the firm can always get quoted a fair premium elsewhere and so the insurer does not wish x to be under-reported. Under these circumstances, the *ex-ante* premium π_f correctly reflects the overall quality x chosen by the firm. The inferences drawn from π_f are the same as in Program II resulting in the same equilibrium where all firms pool at the highest level of overall quality. □

An Example
We provide an example that demonstrates the effects of FSI in ensuring a flight to quality. In order to keep the example as simple as possible, we simplify the strategic role of the auditor and assume that the insurer can observe the x levels.

We assume that there are N firms each of which can have two possible rates of return, that is, that there are two types (L = 2). In addition, we assume that the internal quality choice $q = q$, is one-dimensional and lies in $[0, \bar{q}]$, where $\bar{q} < 1$. Next, we assume that the private information is perfect, and that $\omega_l = 1, 2$ reveals the expected rate-of-return as r_l. We set $V(q, e) = q$ (that is, $x = q$) and $P(i|i, q) = q$ for $i = 1, 2$. So with a quality level q, the probability that the firm's type is reported correctly is q, and, as there are only two types, the probability of the firm being misclassified is $1 - q$. Let the beliefs of investors be represented by v_i; the firm that receives a private signal that its rate-of-return is r_i is expected to set its q at v_i. Assuming that each firm-type is equally probable, the inferred rates-of return are as follows:

$$\hat{r}_2 = E[r|\theta_f = 2] = \frac{r_1(1-v_1)+r_2}{(1-v_1)+1} = \frac{1-v_1}{2-v_1}r_1 + \frac{1}{2-v_1}r_2 \tag{15}$$

$$\hat{r}_1 = E[r|\theta_f = 1] = r_1 \tag{16}$$

The funding probability from selecting q for a firm that receives private signal $\omega_l = 1$ is given by:

$$FP(q,1) = qG(\hat{r}_1) + (1-q)G(\hat{r}_2,) \tag{17}$$

(recall that G denotes the distribution function of r^*). Because $\hat{r}_2 > \hat{r}_1$, it follows that the funding probability is strictly decreasing in q for every type 1 firm. In contrast, a firm with private signal $\omega_l = 2$ has a realized rate-of-return 2 and its funding probability is unaffected by the choice of q (because it's type cannot be overstated).

Assuming that the benefits of funding are sufficiently high, the firm with a low private signal will set $q_1^* = 0$. The implied type of such a firm has $l = 2$ always. That is to say, such a firm is invariably misclassified. Thus the only report observable by investors is $\theta_f = 2$ for every firm. It follows that when $r^* \le \frac{r_1 + r_2}{2}$ all firms are funded and when $r^* > \frac{r_1 + r_2}{2}$ no firm is funded. As there are a total of N firms in the economy, $N/2$ of them (in expectation) are of high-type.

(1) Therefore, when all firms are funded, an expected amount of ($N/2$) units of capital are wrongly allocated and the associated loss is: $(N/2)\int_{r_1}^{(r_1+r_2)/2}(r^*-r_1)g(r^*)dr^*$.[29]

(2) When no firms are funded, a total of ($N/2$) firms may wrongly be denied capital with associated loss: $\int_{(r_1+r_2)/2}^{r_2}(r_2-r^*)g(r^*)dr^*$.

The total negative returns associated with the misallocation of capital may then be written as:

$$(N/2)\int_{r_1}^{r_2}\min\{r^*-r_1, r_2-r^*\}g(r^*)dr^* \tag{18}$$

In contrast, consider the case where the firm's choice of q is known to the insurer, which then sets a premium based on the level of coverage. We shall assume that the cost of coverage is strictly decreasing in quality, that is, $\pi(q)$ is decreasing in q. As in Proposition 2, the following is seen to be an equilibrium:

- both Firm types choose $q = \overline{q}$, i.e., the highest quality financial statement, and pay the associated (low) insurance premium $\pi(\overline{q})$;

[29] $g(r^*)$ is the density function corresponding to the distribution function $G(r^*)$

- any firm that is observed to have a premium $\pi > \pi(\bar{q})$ is classified as a type-1 firm.

To see that this represents an equilibrium, let q_1^* represent the equilibrium quality choice of Firm f that has received private signal ω_1; either $q_1^* < \bar{q}$ or $q_1^* = \bar{q}$. If, $q_1^* < \bar{q}$, the premium rate for firm f, $\pi(q_1^*) > \pi(\bar{q})$, and its inferred rate-of-return is r_1 irrespective of the report. Therefore, it's probability of funding is $G(r_1)$. If, however, Firm f mimics the high private-signal firm and sets $q_1^* = \bar{q}$, the inferred rates of return are given by

$$\bar{r}_2 = E[r|\theta_f = 2] = \frac{r_1(1-\bar{q}) + r_2}{(1-\bar{q})+1} = \left[\frac{1-\bar{q}}{2-\bar{q}}\right] r_1 + \left[\frac{1}{2-\bar{q}}\right] r_2$$

$$\bar{r}_1 = E[r|\theta_f = 1] = r_1$$

and the probability of funding increases by $(1-\bar{q})[G(\bar{r}_2) - G(r_1)]$ (i.e., by the higher probability of funding when the firm is reported as 'type-2'). Note that the total social loss now becomes:

(1) $(N/2)(1-\bar{q})\int_{r_1}^{\bar{r}_2}(r^* - r_1)\, g(r^*)\, dr^*$ because low-type firms are funded; and
(2) $(N/2)\int_{\bar{r}_2}^{r_2}(r_2 - r^*)\, g(r^*)\, dr^*$ because high-type firms are not funded.

with attendant total social loss:

$$(N/2)\int_{r_1}^{r_2} \min\{(1-\bar{q})(r^* - r_1), r_2 - r^*\}\, g(r^*)\, dr^* \tag{19}$$

Because $\min\{(1-\bar{q})(r^* - r_1), r_2 - r^*\} \leq \min\{r^* - r_1, r_2 - r^*\}$, (18) and (19) shows that the social loss is reduced through the provision of FSI.

Notice in this example that if a firm with private signal $\omega_l = 1$ sets $q_1 < \bar{q}$, then the best response for the firm with the high private signal is to set $q_2 = \bar{q}$—this separating policy leads to funding with probability $G(r_2)$ at a minimum insurance cost. If, however, the firm with the high private signal sets $q_2 = \bar{q}$, the best strategy for a firm with low private signal is to 'mimic' and set $q_1 = \bar{q}$. Mimicry increases the funding probability (and leads to the equilibrium described above). In contrast, when the type-1 firm sets $q_1 = \bar{q}$ and the type-2 firm sets $q_2 < \bar{q}$ the situation is untenable in equilibrium because by increasing q slightly, the type-2 firm reduces insurance costs but still separates itself from the type-1 firm. Thus, $q_1 = \bar{q}$, $q_2 < \bar{q}$ should never be an equilibrium. Hence, the only plausible equilibrium is for both firms to set $q_i = \bar{q}$ (see Lemma 3). □

This example does not incorporate a role for the auditor, but a little reflection shows that the core intuition survives in a more complex setting where reports are influenced by an auditor acting under moral hazard. In particular, if the fee of the auditor is determined by the insurer, sufficient incentives may be provided to elicit truthful revelation regarding the auditor's assessment of the firm's x. Once x is known (perhaps imperfectly) to the insurer, premium levels reveal this information to investors. In particular, when firms defect from the anticipated level of x, that is, if a firm has been charged a higher than anticipated premium π_f, investors find out about this before trading. This allows investors to alter their funding strategies and we are then essentially back in the situation discussed in the example.

The example has the characteristics of a signaling model where firms are separated out through the level of the insurance premium but the cost associated with signals has a special structure that should be clarified. In a standard signaling model, there is a difference in cost for a given signal across types (arising from an exogenous factor related to type). This difference deters the low type from choosing the same signal as the high type. In contrast, in the setting of the example, the cost of financial statement quality is the same for all firms. The differential cost arises because the choice of high quality reveals the firm's true type and is thus indirectly more costly for the low-type firm.

Let $\{v_1, v_2\} = \vec{v}$ represent the beliefs of investors. In this example, the expected return on the high report, $\theta = 2$, is some weighted average of r_2 and r_1 with the weights depending on $\vec{v}$; in addition, because firm 2 always issues report $\theta = 2$, the weight on r_2 is strictly positive. In contrast, the report $\theta = 1$ necessarily implies that the rate-of-return is r_1. Thus, rational investors would fund the report $\theta = 2$ with a greater probability than the report $\theta = 1$. In general, ensuring that higher reports are funded with greater probability requires some form of regularity assumption; in our formulation, this is the role of Assumption 1.

The analysis in this example assumes that the insurance premium is based on the actual level of x chosen by firms. This was the setting analyzed in Proposition 2. More generally, the insurer relies on the auditor's assessment of x to set the premium. In such a setting, the auditor reports x strategically in order to maximize his or her own payoffs, and the revelation of the premium to investors does not break the race to the bottom with regard to overall quality *so long as the auditor functions as an agent of management* (Proposition 3). That is, firms would prefer to get the auditor to report a higher level of x to the insurance company and thereby to investors than the one that has been chosen. As rational insurers and investors will anticipate this 'bias', the equilibrium unravels to the lowest choice of x. In contrast, when the auditor functions as an *agent of the insurer*, the pooling at the highest quality again becomes the rational equilibrium (Proposition 4).

CONCLUSION

Several causes have been advanced in the media for the 'accounting' meltdown: irrational exuberance, infectious greed, moral turpitude of executives, unethical accountants, misleading financial statements and related 'ills'. We have argued that the inherent conflict of interest in the auditor–client relationship and the unobservability of financial statement quality, coupled with incentives to 'cook the books' are among the potential culprits. FSI, as developed here, provides a market-based solution that acts as an effective check on the issuance of overly biased financial statements. First, the publicization of the insurance premium will credibly signal the quality of the insured's financial statements and direct investments toward better projects. Second, by transferring the auditor hiring decision to the insurer, FSI eliminates the auditor's inherent conflict of interest. At the same time, the ability to signal the quality of financial statements will provide companies with incentives to improve the quality of their financial statements. Hence, FSI will result in fewer misrepresentations and smaller shareholder losses.

Under the present regime, auditors' legal liability is not an effective tool for inducing truth telling in financial statements because the costs of such liability are essentially covered by the client-firms. As mentioned, the FSI scheme effectively eliminates the conflict of interest that came to light in the aftermath of accounting scandals. Yet FSI has other important benefits: the credible signalling of financial statement quality leads to an improvement of such quality, and consequently, decreases in shareholder losses, and the better channelling of savings to socially desirable projects.

REFERENCES

Baker, G. P., M. C. Jensen and K. J. Murphy, 'Compensation and Incentives: Practice vs. Theory', *Journal of Finance*, Vol. 63, No. 3, 1988.

Butler, H. N. and L. E. Ribstein, *The Sarbanes-Oxley Debacle*, AEI Press, 2006.

Cunningham, L. A., 'A Model Financial Statement Insurance Act', *Connecticut Insurance Law Journal*, Vol. 11, 2004a.

——, 'Choosing Gatekeepers: The Financial Statement Insurance Alternative to Auditor Liability', *UCLA Law Review*, Vol. 52, 2004b.

DeGroote, X., 'A Note on the Strategic Transmission of Endogenous Information', *Economics Letters*, Vol. 34, No. 2, 1990.

Kaplow, L. and S. Shavell, 'Optimal Law Enforcement with Self-Reporting of Behavior', *The Journal of Political Economy*, Vol. 102, No. 3, 1994.

Lacker, J. M. and J. A. Weinberg, 'Optimal Contracts under Costly State Falsification', *The Journal of Political Economy*, Vol. 97, No. 6, 1989.

Levitt, A., *Take On the Street*, Pantheon Books, 2002.

Milgrom, P., 'Good News and Bad News: Representation Theorems and Applications', *Bell Journal of Economics*, Vol. 12, No. 2, 1981.

Robbins, E. H. and B. Sarath, 'Ranking Agencies Under Moral Hazard', *Economic Theory*, Vol. 11, 1998.

Romano, R., 'The Sarbanes-Oxley Act and the Making of Quack Corporate Governance', *Yale Law Journal*, Vol. 114, 2005.

Ronen, J., 'Post-Enron Reform: Financial Statement Insurance, and GAAP Re-visited', *Stanford Journal of Law, Business & Finance*, Vol. 8, No. 1, 2002.

APPENDIX A DETAILS OF THE INFORMATION STRUCTURE

The Bayesian inference process that formalizes the relation between report and hidden type starts with the joint probability distribution of i, ω_f, j at a given level of x:

$$P(i,\theta_f=j,\omega_f,x)=P(j|i,x)P(i,\omega_f)=P(j|i,x)P(i|\omega_f)P(\omega_f) \tag{20}$$

Equation (20) states that once the type, i, is realized, the probability of report j is determined by the actual value of i and x, and is independent of the earlier imperfect signal ω_f. Built into this equation is the fact that the joint distribution of i and ω_f is unaffected by the choice of x—that is, the financial reporting choice affects only the reported rate-of-return and not the actual rate-of-return r_i. It follows that

$$P(i,\ j|\omega_f,x)=P(j|i,x)P(i|\omega_f) \tag{21}$$

The next step is to describe how the beliefs $\vec{v}$ translate to a joint distribution of types and reports, $P(i,j|\vec{v})$. This process involves the following steps.

(1) Firm f receives a private signal ω_f with probability $P(\omega_f)$. A firm receiving private signal ω_f is conjectured to choose an overall quality of v_f.
(2) Under this belief, the joint distribution of reports and types for a firm receiving ω_f is $P(i, j|v_f, \omega_f)$.
(3) Therefore, the joint distribution of $P(i,j|\vec{v})=\sum_{l=1}^{L}P(i,j|\omega_l,v_l)P(\omega_l)$

Using (21) and the inference process above, the expected rate-of-return for a firm that has reported $\theta_f = j$ is given by (note that the true type i cannot exceed j as errors are always overstatements)

$$E[r|\theta_f=j,\vec{v}]=\sum_{l=1}^{L}\left\{\frac{\sum_{i=1}^{j}r_iP(j|i,v_l)P(i|\omega_l)}{\sum_{i=1}^{j}P(j|i,v_l)P(i|\omega_l)}\right\}P(\omega_l) \tag{22}$$

At this stage, we make the important qualitative observation that all firms that issue a particular report $\theta_f = j$ are assigned the same inferred expected rate-of-return. We contrast this with the situation where in addition to a financial report, θ_f, firms also report their insurance premium, π_f.

Denoting the inferred rate-of-return under beliefs $\vec{v}$ conditional on both report $\theta_f = j$ and premium π_f by $E[r|\theta_f=j,\pi_f,\vec{v}]$, we obtain:

$$E[r|\theta_f=j,\vec{v},f]=\sum_{l=1}^{L}\left\{\frac{\sum_{i=1}^{j}r_iP(j|i,v_l)P(i|\omega_l)}{\sum_{i=1}^{j}P(j|i,v_l)P(i|\omega_l)}\right\}P(\omega_l|\pi_f,\vec{v}) \tag{23}$$

The key difference between (22) and (23) is that the premium reveals something about x, and this in turn is reflected in the inferred rate-of-return through *a posterior probability distribution* about the private signal types that will end up with that premium. That is, after observing a premium π_f, investors infer x_f corresponding to π_f and then use their beliefs $\vec{v}$ to estimate the private signal of firm f. To illustrate further, suppose that a firm with the lowest private signal type ω_1 is assumed to choose a low x, v_1 with a resulting premium π_1. Then, conditional on observing that firm f has been offered a low premium $\pi_f < \pi_1$, the probability weight $P(\omega_1|\pi_f, \vec{v}) = 0$. In other words, firms will be able to reveal their private signals through the premiums they pay and thereby affect the inferred report-contingent rate-of-return.

The inferred rate-of-return for firm f depends on beliefs $\vec{v}$ and can differ from the actual distribution, $P(i|j, x)$. However, we impose the condition that *in-equilibrium*, $v_f = x(\omega_f)$ where $x(\omega_f)$ denotes the x implemented by a firm f with private information ω_f. This is an important point that needs to be emphasized. Firms have the ability to distort the perceived level of x but this is not a stable 'equilibrium' situation. For an equilibrium to be sustainable, it must be optimal for firms and auditors to set x levels that are consistent with investor beliefs.

A Proof of Lemma 1

1) Suppose that $k > j$. We have to show that a firm s with report $\theta_s = k$ has a higher inferred rate-of-return than another, t, with report $\theta_t = j$.

From (22):

$$E_s[r|\theta_s = k, \vec{v}] = \sum_{l=1}^{L} \left\{ \frac{\sum_{i=1}^{k} r_i P(k|i, v_l) P(i|\omega_l)}{\sum_{i=1}^{k} P(k|i, v_l) P(i|\omega_l)} \right\} P(\omega_l)$$

$$E_t[r|\theta_t = j, \vec{v}] = \sum_{l=1}^{L} \left\{ \frac{\sum_{i=1}^{j} r_i P(j|i, v_l) P(i|\omega_l)}{\sum_{i=1}^{j} P(j|i, v_l) P(i|\omega_l)} \right\} P(\omega_l) \tag{24}$$

Define for $1 \le a \le j - 1$:

$$\hat{\xi}_{al} = \frac{P(k|a, v_l) P(a|\omega_l)}{\sum_{i=1}^{k} P(k|i, v_l) P(i|\omega_l)}; \quad \psi_{al} = \frac{P(j|a, v_l) P(a|\omega_l)}{\sum_{i=1}^{j} P(j|i, v_l) P(i|\omega_l)}$$

Define for $a = j$:

$$\hat{\xi}_{al} = \hat{\xi}_{jl} = \frac{\sum_{i=j}^{k} P(k|i, v_l) P(i|\omega_l)}{\sum_{i=1}^{k} P(k|i, v_l) P(i|\omega_l)}; \quad \psi_{al} = \psi_{jl} = \frac{P(j|j, v_l) P(j|\omega_l)}{\sum_{i=1}^{j} P(j|i, v_l) P(i|\omega_l)}$$

Note that by definition, $\sum_{a=1}^{j} \hat{\xi}_{al} = \sum_{a=1}^{j} \psi_{al} = 1$, that is, $\hat{\xi}_{al}$ and ψ_{al} are probability distributions. Now let $w_a = \dfrac{\hat{\xi}_{al}}{\psi_{al}}$. Then:

$$\begin{aligned} w_a &= \left\{ \frac{\left[\sum_{i=1}^{k} P(k|i, v_l) P(i|\omega_l)\right]}{\left[\sum_{i=1}^{j} P(j|i, v_l) P(i|\omega_l)\right]} \right\}^{-1} \left\{ \frac{P(k|a, v_l) P(a|\omega_l)}{P(j|a, v_l) P(a|\omega_l)} \right\} \quad \text{for} \quad a < j \\ &= \left\{ \frac{\left[\sum_{i=1}^{k} P(k|i, v_l) P(i|\omega_l)\right]}{\left[\sum_{i=1}^{j} P(j|i, v_l) P(i|\omega_l)\right]} \right\}^{-1} \left\{ \frac{\sum_{i=j}^{k} P(k|i, v_l) P(i|\omega_l)}{P(j|j, v_l) P(j|\omega_l)} \right\} \quad \text{for} \quad a = j \end{aligned}$$

Because all probabilities are positive, the last expression shows that for $a = j$,

$$w_j \geq \left\{ \frac{\left[\sum_{i=1}^{k} P(k|i, v_l) P(i|\omega_l)\right]}{\left[\sum_{i=1}^{j} P(j|i, v_l) P(i|\omega_l)\right]} \right\}^{-1} \left\{ \frac{P(k|j, v_l) P(j|\omega_l)}{P(j|j, v_l) P(j|\omega_l)} \right\}$$

Noting that from Assumption 1 (1),

$$b > a, k > j \Rightarrow \frac{P(k|b, v_l)}{P(k|a, v_l)} > \frac{P(j|b, v_l)}{P(j|a, v_l)} \Rightarrow \frac{P(k|b, v_l)}{P(j|b, v_l)} > \frac{P(k|a, v_l)}{P(j|a, v_l)}$$

It follows that: $w_a = \left\{ \frac{\left[\sum_{i=1}^{k} P(k|i, v_l) P(i|\omega_l)\right]}{\left[\sum_{i=1}^{j} P(j|i, v_l) P(i|\omega_l)\right]} \right\}^{-1} \left\{ \frac{P(k|a, v_l)}{P(j|a, v_l)} \right\}$ is increasing in a. Consequently,

$$\begin{aligned} E_s[r|\theta_s = k, \vec{v}] &= \sum_{l=1}^{L} \left\{ \frac{\sum_{i=1}^{k} r_i P(k|i, v_l) P(i|\omega_l)}{\sum_{i=1}^{k} P(k|i, v_l) P(i|\omega_l)} \right\} P(\omega_l) \\ &= \sum_{l=1}^{L} \left\{ \sum_{i=1}^{j} r_i \hat{\xi}_{il} \right\} P(\omega_l) = \sum_{l=1}^{L} \left\{ \sum_{i=1}^{j} r_i w_i \psi_{il} \right\} P(\omega_l) \\ &> \sum_{l=1}^{L} \left\{ \left[\sum_{i=1}^{j} w_i \psi_{il} \right] \times \left[\sum_{i=1}^{j} r_i \psi_{il} \right] \right\} P(\omega_l) = \sum_{l=1}^{L} \left\{ [1] \times \sum_{i=1}^{j} r_i \psi_{il} \right\} P(\omega_l) \\ &= E_t[r \mid \theta_t = j, \vec{v}] \end{aligned} \tag{25}$$

Equation (25) establishes that $\hat{r}_j = E_f[r|\theta_f = j, \vec{v}]$ is increasing in j proving Lemma 1(1).

2) Taking expectations over all reports j yields Lemma 1 (2).
3) As in Equation (23), if all firms pool at the quality level x,

$$E[r|\theta_f = j, \text{all firms pooling at } x, x] = \sum_{l=1}^{L} \left\{ \frac{\sum_{i=1}^{j} r_i P(j|i, x) P(i|\omega_l)}{P(j|\omega_l, x)} \right\} P(\omega_l)$$

Let $\omega_k > \omega_l$. The probability ratios

$$\left[\frac{P(j|i, x) P(i|\omega_l)}{P(j|\omega_l, x)} \right] \left[\frac{P(j|i, x) P(i|\omega_k)}{P(j|\omega_k, x)} \right]^{-1} = \left[\frac{P(i|\omega_l)}{P(i|\omega_k)} \right] \left[\frac{P(j|\omega_k, x)}{P(j|\omega_l, x)} \right]$$

are increasing in i, that is, the posterior distribution of i contingent on observing a report j is increasing in type. It follows that $E[r|\theta_f = j, \omega_k, x] > E[r|\theta_f = j, \omega_l, x]$ whenever $\omega_k > \omega_l$. Therefore, $E[r|\theta_f = j, \omega_k, x] > E[r|\theta_f = j, \omega_1, x]$ for every $k > 1$ and consequently, $E[r|\theta_f = j, \text{pooling}, x] > E[r|\theta_f = j, \omega_1, x]$. Since the inferred return is higher on every signal, the funding probability is also higher at the expectation across signals, $FP(x|\text{pooling at } x, x) > FP(x|\text{only } \omega_1 \text{ chooses } x, x)$.

4) The proof is by construction: Γ^{xy} and Λ^{yx} are related as follows:

$$\Gamma_{ij}^{xy} = \Lambda_{ji}^{yx} \frac{p(\theta = i|x)}{p(\theta = j|y)} = \Lambda_{ji}^{yx} \frac{p(i|x)}{p(j|y)}$$

Denote the vector $[r_1, \ldots, r_L]$ by R and for each x, define a matrix $\mathcal{Q}^x$ by

$$\mathcal{Q}^x = \begin{bmatrix} \frac{p(1,1|x)}{p(1|x)} & \frac{p(1,2|x)}{p(2|x)} & \cdots & \frac{p(1,L|x)}{p(L|x)} \\ 0 & \frac{p(2,2|x)}{p(2|x)} & \cdots & \frac{p(2,L|x)}{p(L|x)} \\ . & . & . & . \\ . & . & . & . \\ 0 & \cdots & 0 & \frac{p(L,L|x)}{p(L|x)} \end{bmatrix}$$

where $p(i, j|x)$ is the joint probability of realizing return r_i after observing a signal $\theta = j$ under quality level x. Then $R \circ \mathcal{Q}^x = R^x$ and $R^x \circ \Gamma^{xy} = R \circ \mathcal{Q}^x \circ \Gamma^{xy}$. Next, from the definition of Γ^{xy} it follows that:

$$\begin{aligned} \sum_j \mathcal{Q}_{ij}^x \Gamma_{jk}^{xy} &= \sum_j \mathcal{Q}_{ij}^x \Lambda_{kj}^{yx} \frac{p(j|x)}{p(k|y)} = \sum_j \frac{p(i,j|x)}{p(j|x)} \Lambda_{kj}^{yx} \frac{p(j|x)}{p(k|y)} = \frac{1}{p(k|y)} \sum_j p(i,j|x) \Lambda_{kj}^{xy} \\ &= \frac{1}{p(k|y)} \sum_j \Lambda_{kj}^{yx} \mathcal{P}_{ji}^x = \frac{1}{p(k|y)} \mathcal{P}_{ki}^y = \frac{p(i,k|y)}{p(k|y)} \end{aligned} \tag{26}$$

In other words, $\mathcal{Q}^x \circ \Gamma^{xy} = \mathcal{Q}^y$. So

$$R^x \circ \Gamma^{xy} = R \circ \mathcal{Q}^x \circ \Gamma^{xy} = R \circ \mathcal{Q}^y = R^y.$$

The final step is to show that $\Gamma^{xy} \circ P^y = P^x$. Writing $P^y = [p(\theta = 1|y), \ldots, p(\theta = L|y)]$,

$$\Gamma_{ij}^{xy} \circ P_j^y = \sum_j \Lambda_{ji}^{xy} P_i^x = P_i^x \sum_j \Lambda_{ij}^{xy} = P_i^x$$

as Λ^{xy} is a column-stochastic matrix.

(5) Let P^{xj}, P^{yk} denote the vectors P^x, P^y with the first j (respectively, k) components set to 0. Let R^* denote the constant vector whose L-components are all r^*. Then $\sum_{l=j}^{L} (\hat{r}_{lx} - r^*) p(l|x) = (R^x - R^*) \circ \mathcal{P}^{xj}$ and $\sum_{l=j}^{L} (\hat{r}_{ly} - r^*) p(l|y) = (R^y - R^*) \circ \mathcal{P}^{yk}$. Because the columns of $\mathcal{Q}^x$ and $\mathcal{Q}^y$ add to one, it follows that $R^* \circ \mathcal{Q}^x = R^* = R^* \circ \mathcal{Q}^y$.

Therefore:

$$\sum_{l=k}^{L}(\hat{r}_{ly}-r^*)\,p(l|y)=\left(R^y-R^*\right)\circ\mathcal{P}^{yk}=(R-R^*)\circ\mathcal{Q}^y\circ\mathcal{P}^{yk}$$
$$=(R-R^*)\mathcal{Q}^x\circ\Gamma^{xy}\circ\mathcal{P}^{yk}=\sum_{l=1}^{L}(\hat{r}_{xl}-r^*)\,w_l \quad (27)$$

where $\begin{bmatrix} w_1 \\ \vdots \\ w_j \\ \vdots \\ w_n \end{bmatrix}=\Gamma^{xy}\circ\begin{bmatrix} 0 \\ \vdots \\ 0 \\ p(j|y) \\ \vdots \\ p(L|y) \end{bmatrix}$.

Since all the Γ_{ij}^{xy} and P_i^y are positive, it follows that every component of $\vec{w}$ is less than the corresponding component of $\Gamma^{xy}\circ P^y = P^x$. It follows that:

$$\sum_{l=1}^{L}(\hat{r}_{lx}-r^*)\,w_l=\sum_{l=1}^{j-1}(\hat{r}_{lx}-r^*)\,w_l+\sum_{l=j}^{L}(\hat{r}_{lx}-r^*)\,w_l\le\sum_{l=j}^{L}(\hat{r}_{lx}-r^*)\,w_l\le\sum_{l=j}^{L}(\hat{r}_{lx}-r^*)\,p(l|x)$$

where the first inequality follows from the fact that $\hat{r}_{lx}<r^*$ for $l<j$ (j is the lowest signal for which $\hat{r}_{jx}\ge r^*$) and $w_l\ge 0$ for every l while the second inequality follows from the fact that $\hat{r}_{lx}\ge r^*$ for $l\ge j$ and $p(l|x)\ge w_l$ for every l. □

B Proof of Lemma 3

Suppose one of the two firms deviates to some off-equilibrium choice x resulting in some premium $\pi_f>\bar{\pi}$ and the off-equilibrium beliefs of investors after observing π_f are such that the firm receiving the signal ω_2 is indifferent between choosing $\bar{\pi}$ or π_f. We will show that the firm with the signal ω_1 would then strictly prefer to choose π_f.

Denote the quality x corresponding to the premium π_f by x_f. Then the indifference assumption on ω_2 is:

$$\begin{aligned}
&FP(\theta=1|\pi_f)\,P(\theta=1|\omega_2,x_f)+FP(\theta=2|\pi_f)\,P(\theta=2|\omega_2,x_f)\\
&\quad=FP(\theta=1|\bar{\pi})\,P(\theta=1|\omega_2,\bar{x})+FP(\theta=2|\bar{\pi})\,P(\theta=2|\omega_2,\bar{x})\\
&\quad\Leftrightarrow FP(\theta=2|\pi_f)\,P(\theta=2|\omega_2,x_f)-FP(\theta=2|\bar{\pi})\,P(\theta=2|\omega_2,\bar{x})\\
&\quad=FP(\theta=1|\bar{\pi})\,P(\theta=1|\omega_2,\bar{x})-FP(\theta=1|\pi_f)\,P(\theta=1|\omega_2,x_f)
\end{aligned}\quad (28)$$

We analyze the left and right sides of (28) separately starting with the left side. Noting that a firm of true type 2 always issues report $\theta=2$, we have the following identities for every ω_i:

$$P(\theta=2|\omega_i,y)=P(r=r_2|\omega_i)+P(\theta=2|r=r_1,y)\,P(r=r_1|\omega_i)$$

Therefore, for the firm with private signal ω_2, the left-hand-side of (28) becomes:

$$\begin{aligned}&[FP(\theta=2|\pi_f)-FP(\theta=2|\bar{\pi})]P(r=r_2|\omega_2)\\&\quad+[FP(\theta=2|\pi_f)P(\theta=2|r=r_1,x_f)-FP(\theta=2|\bar{\pi})P(\theta=2|r=r_1,\bar{x})]P(r=r_1|\omega_2)\\&\quad=[FP(\theta=2|\pi_f)-FP(\theta=2|\bar{\pi})][P(\theta=2|\omega_2)+P(\theta=2|r=r_1,x_f)P(r=r_1|\omega_2)]\\&\quad+FP(\theta=2|\bar{\pi})[P(\theta=2|r=r_1,x_f)-P(\theta=2|r=r_1,\bar{x})]P(r=r_1|\omega_2)\end{aligned}\tag{29}$$

Next, using the two facts that: (i) $FP(\theta=1|\pi_f)=FP(\theta=1|\bar{\pi})=G^*(r_1)$ (because $\theta=1 \Rightarrow r=r_1$) and (ii) $P(\theta=2|\omega_j,y)=1-P(\theta=1|\omega_j,y)$ for every y, the right-hand-side of (28) becomes:

$$\begin{aligned}&P(r=r_1|\omega_2)G^*(r_1)[P(\theta=1|r=r_1,\bar{x})-P(\theta=1|r=r_1,x_f)]\\&\quad=P(r=r_1|\omega_2)G^*(r_1)[P(\theta=2|r=r_1,x_f)-P(\theta=2|r=r_1,\bar{x})]\end{aligned}\tag{30}$$

Substituting from (29) and (30) into (28) and dividing by $P(r=r_1|\omega_2)$, we obtain:

$$\begin{aligned}&\left[\frac{P(r=r_2|\omega_2)}{P(r=r_1|\omega_2)}+P(\theta=2|r=r_1,x_f)\right][FP(\theta=2|\pi_f)-FP(\theta=2|\bar{\pi})]\\&\quad+FP(\theta=2|\bar{\pi})[P(\theta=2|r=r_1,x_f)-P(\theta=2|r=r_1,\bar{x})]\\&\quad=G^*(r_1)[P(\theta=2|r=r_1,x_f)-P(\theta=2|r=r_1,\bar{x})]\end{aligned}\tag{31}$$

Rearranging equation (31), we obtain:

$$\begin{aligned}&\left[\frac{P(r=r_2|\omega_2)}{P(r=r_1|\omega_2)}+P(\theta=2|r=r_1,x_f)\right][FP(\theta=2|\pi_f)-FP(\theta=2|\bar{\pi})]\\&\quad=[FP(\theta=2|\bar{\pi})-G^*(r_1)][P(\theta=2|r=r_1,\bar{x})-P(\theta=2|r=r_1,x_f)]\end{aligned}\tag{32}$$

The funding probability increases in the signal (Lemma 1 (1)), $FP(\theta=2|\bar{\pi})>G^*(r_1)=FP(\theta=1|\bar{\pi})$ and the right-hand-side of (32) is negative (and hence, so is the left-hand-side). Now by the fact that signal ω_2 is good news relative to ω_1, it follows that:

$$\left[\frac{P(r=r_2|\omega_2)}{P(r=r_1|\omega_2)}+P(\theta=2|r=r_1,x_f)\right]>\left[\frac{P(r=r_2|\omega_1)}{P(r=r_1|\omega_1)}+P(\theta=2|r=r_1,x_f)\right]\tag{33}$$

Comparing with (32), we obtain the following inequality (because the left-hand-side in the equation below is *less* negative than the left-hand-side of (32):

$$\begin{aligned}&\left[\frac{P(r=r_2|\omega_1)}{P(r=r_1|\omega_1)}+P(\theta=2|r=r_1,x_f)\right][FP(\theta=2|\pi_f)-FP(\theta=2|\bar{\pi})]\\&\quad>[FP(\theta=2|\bar{\pi})-G^*(r_1)][P(\theta=2|r=r_1,\bar{x})-P(\theta=2|r=r_1,x_f)]\end{aligned}$$

Reversing the process by which equation (32) was derived from (28) we obtain:

$$\begin{aligned}&FP(\theta=1|\pi_f)P(\theta=1|\omega_1,x_f)+FP(\theta=2|\pi_f)P(2|\omega_1,x_f)\\&\quad>FP(\theta=1|\bar{\pi})P(\theta=1|\omega_1,\bar{x})+FP(\theta=2|\bar{\pi})P(\theta=2|\omega_1,\bar{x})\end{aligned}\tag{34}$$

that is, the type with private signal ω_1 would then strictly prefer to defect to x_f. Therefore, under the Universal Divinity criterion, only the lowest ω-type actually is believed to be at the off-equilibrium premium π_f, that is, the equilibrium of Proposition 2 is the only one that meets the divinity off-equilibrium test. □

When $L \geq 3$, the uniqueness of the equilibrium in meeting the divinity test can be established if the equilibrium funding probabilities have the following characteristic:

Assumption 2 (Inferences and Quality)
Let $\vec{v}$, $\vec{\mu}$ denote investor beliefs where $v_l > \mu_l$ for every l. That is, under $\vec{v}$, investors believe that every firm chooses a higher quality than under $\vec{\mu}$. Then investors are more discriminating under $\vec{v}$ than under $\vec{\mu}$ in the following sense: for any two reports $j \geq k$ the inferred returns satisfy:

$$E[r|j,\vec{v}] - E[r|k,\vec{v}] > E[r|j,\vec{\mu}] - E[r|k,\vec{\mu}] \quad (35)$$

The condition in equation (35) states that under beliefs of uniformly lower quality, the inferred rates of return change less sharply in the report. In other words, if investors believe that the overall quality of financial statements of every firm is lower, they place less reliance on financial reports. This is an intuitive economic condition and ought to hold quite generally. However, the derivation of (35) from the information structure of Assumption 1 presents technical difficulties.

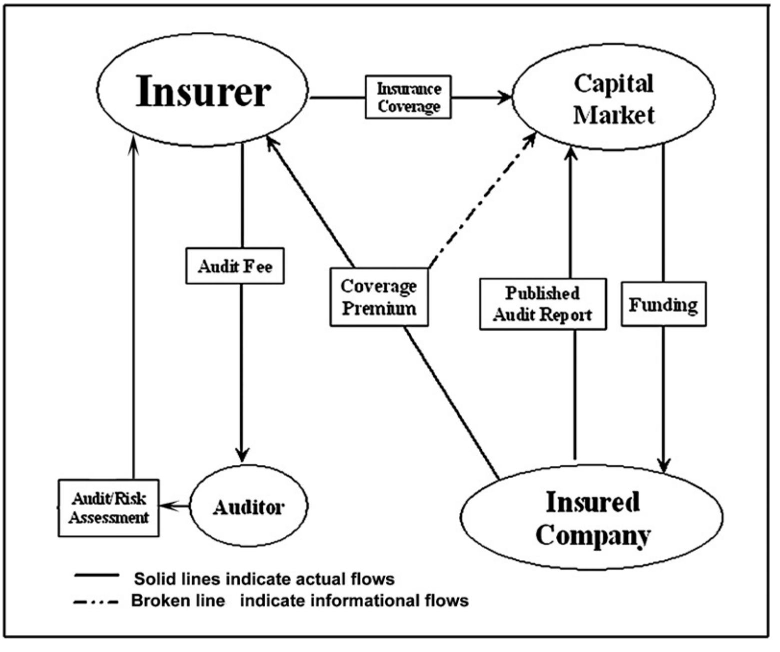
APPENDIX B DESCRIPTION OF THE FSI PROCESS

The FSI process begins with companies that choose to purchase FSI that provide coverage against losses suffered as a result of omissions and misrepresentation (O&M—the inverse of x in our model) in the financial reports. Companies desiring such insurance will solicit from insurance carriers in the year prior (year t-1) insurance coverage for their shareholders against losses caused by O&M in financial statements that occur during the covered year (year t). The carriers would engage an underwriting reviewer (that could be either an independent organization or the external auditor) who would assess the risk of O&M by examining the soliciting companies' internal controls, management incentive structures, the competitive environment, the history of past O&M, past earnings surprises and the market's responses to such surprises, etc. Detailed underwriting review reports would be the basis for the carriers' decisions on whether to offer coverage, the maximum amount of such coverage, and the associated required premium, or they may offer a schedule of coverage amounts and premia.

Based on the insurance offers received, managers would put up in their proxies for shareholders' voting their own recommendation for buying FSI coverage at a given amount and premium (including zero coverage—no insurance). After the vote, the shareholders' approved coverage and premium (including the case of zero coverage) would be publicized, becoming common knowledge. Companies that opt for zero coverage and companies that chose not to solicit FSI coverage would revert to the existing regime under which they would hire an external auditor who opines on their statements. Companies whose shareholders approved insurance coverage would then select an external auditor from a list of audit firms approved by their chosen insurance carrier. The selected external auditor would be hired and paid by the carrier. Audit firms would also be rated by an independent organization (likely the same as the one that conducted the underwriting review). The selected external auditor would coordinate the audit plan with the underwriting reviewer to adopt it to the findings of the review. Eventually, the insurance coverage would become effective only if the auditor issues an unqualified opinion on year t financial statements (sometime in year $t + 1$). If the opinion is not unqualified there would be no coverage, or else, the policy terms would be renegotiated. In either case (no coverage or renegotiated coverage and premium) the renegotiated terms would be publicized. For companies with effective coverage, shareholders' claims for recovery, within the limits of the policies, for losses caused by omissions and misrepresentations that occurred during the covered year would be settled through an expedited judiciary process. A judiciary body, agreed upon in advance by both the insured and the insurer, would submit the claims upon the detection of O&M, hire the necessary experts to estimate the damages, and agree on a settlement within the policy limits with the carrier; the latter may hire its own experts to analyze the damages.[30] The process is depicted in Figure A1.

Figure A1

THE FSI PROCESS



[30] These implications are readily testable. For example, dollar amounts of both the insurance coverage and premium are observed publicly as well as data on shareholder dollar losses, which are available through proxies such as the incidence of litigation suits, the nature of the allegations, and actual dollar settlements. These dollar settlements can then be compared *ex-post* with those that were experienced under the current regime; the comparison will allow us to make inferences regarding changes in shareholder losses. Furthermore, we would be able to observe the association between the level of coverage and premium and the incidence of litigation suits and settlements under an implementation of our suggested mechanism to test the model's implications.

APPENDIX C ALTERNATIVE SIGNALING MECHANISMS

The point of this example is to illustrate again how incentives over the choice of quality play a crucial part in the signaling of endogenous hidden information. We shall analyze Setting (I), with the added feature that the audit fee is correctly and contemporaneously observable, and show that the equilibrium where all the firms choose highest overall quality $\bar{x}$ cannot be sustained; thus, disclosing the audit fee is not equivalent to providing FSI (Setting (IV)). In order to make the point as simply as possible, we shall suppress the subgame over audit incentives and assume that the *ex-post* transfers in place ($\sigma(\hat{x}, x)$) are sufficient to induce the auditor to report the true choice of x to the insurer, or equivalently, as audit effort is observable by the insurer, the true value of internal quality q. We define all the parameters for the problem.

- $x(q, e) = qe, q, e \in [0, 1]$
- $\mathcal{L}_f(x) = \frac{1}{4}(1 - qe) = \frac{1}{4}(1 - x)$
- $\mathcal{L}_a(q, e) = \frac{1}{2}(1 - qe) - \frac{1}{4}e^2 = \frac{1}{2}(1 - x) - \frac{1}{4}e^2$
- $C(e) = \frac{3}{4}e^2$

The idea here is that the probability that there is an error in the financial statements is 1 – qe which is decreasing in both q and e. Since the investment has been normalized to 1, we assume that, on average, the expected recoveries through litigation are a portion of the investment. With this specification, it is easy to check that:

(1) $F(q, e) = C(e) + \mathcal{L}_a(q, e) = \frac{1}{4}e^2 + \frac{1}{2}(1 - qe) + \frac{1}{4}e^2 = \frac{1}{2}\left[e^2 + (1 - qe)\right]$
(2) at $e = 0, F(q, e) = \frac{1}{2} \times 1 = \frac{1}{2}$ for every q and at $e = 1, F(q, e) = \frac{1}{2} + \frac{1}{2}(1 - (q \times 1))$; thus $\{q, e\} = \{0, 0\}$ and $\{q, e\} = \{1, 1\}$ result in the same audit fee $\frac{1}{2}$.

Therefore, the fee $\frac{1}{2}$ is associated with both the highest and the lowest level of audit quality. Hence, it is not rational for investors to believe that the highest quality has been chosen. In fact, with an observed fee of $\frac{1}{2}$, for reasons similar to Proposition 1, the only possible rational belief about quality is that the lowest quality has been chosen and thus, the equilibrium with the highest quality choice is not sustainable in rational expectations.

List of Symbols

(1) $q \in [\underline{q}, \bar{q}]$ denotes internal quality
(2) $e \in [\underline{e}, \bar{e}]$ denotes audit effort
(3) $x = V(q, e)$ denotes overall quality
(4) $\mathcal{L}_f(x)$ denotes the firm's expected liability if quality x is set
(5) $\mathcal{L}_a(x, e) = \mathcal{L}_a(V(q, e), e)$ denotes the auditor's expected liability when internal quality is q and audit effort is e
(6) $C(e)$ denotes the cost of audit effort e
(7) $F(x, e) = \mathcal{L}_a(x, e) + C(e)$ denotes the total audit fee needed to break even under overall quality x and audit effort e

(8) $\omega_1, \ldots, \omega_L$ denotes the private signals of the firm
(9) $P(\omega_l)$ denotes the probability of a firm receiving private signal ω_l
(10) $\vec{v} = \{v_1, \ldots, v_L\} = \{x_1, \ldots, x_L\}$ denotes beliefs about quality where x_i denotes the overall quality chosen by a firm with private signal ω_i
(11) $r_1 < \ldots < r_L$ denote the possible rates of return for a given firm.
(12) $P(i|\omega_l)$ denotes the probability that a firm of private signal ω_l has realized return r_i
(13) $\theta = \{1, \ldots, L\}$ are the possible financial reports that a firm might issue
(14) $P(i|j, \omega_l)$ denotes the probability that the rate-of-return of the firm is r_i given that the financial report was j and the private signal was ω_l
(15) r^* denotes the random cost of capital; $G(r^*)$ denotes the C.D.F of r^*
(16) $FP_f(x|\omega_l, \vec{v})$ is the probability that the firm will be funded on receiving, private signal ω_l, choosing overall quality x when investors beliefs are represented by $\vec{v}$
(17) B is the private benefit reaped by the manager whenever the firm is funded