Financial Statements Insurance

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VERY PRELIMINARY

1 Introduction

The largest corporate bankruptcy filed in the U.S., that of Enron Corp in 2001, was preceded by a string of disclosures about errors and corrections to their financial statements.[1] The presence of such errors in financial statements highlights the fact that market participants pricing securities based on financial statements face two inter-related problems. The first is to assess the quality of the information contained in the financial statements as a basis for making projections about the future. The second is to actually make projections about future cash flows and to fold these projected cash flows back into a 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 the financial statements can lead to pricing distortions and inefficient market allocations.

Several causes have been suggested for contributing to the current state of affairs. The major cause, perhaps, is the tendency by management to inflate stock prices for personal gain through deceit, 'cooking the books'- misrepresentations in financial reporting - and other unethical behavioral practices and more importantly, the failure of the auditing profession to fulfill their role as independent gatekeepers. Currently, the incentives driving auditors' behavior may not elicit unbiased reports. Auditors are paid by the companies they audit and thus depend on CEOs and CFOs, who effectively decide on their employment and compensation. This creates an inherent conflict of interest that is endemic to the relation between the clients firm management (the principal) and the auditor (the agent).

Unfortunately, these alleged causes cannot be remedied with equal effectiveness. Prosecution and punishment may not adequately deter wrongdoing, as intentional misrepresentation

[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.

is difficult to discover or prove. Overhauling the regulatory structure and adding layers of supervision and monitoring by the government would be inefficient and socially wasteful and little can be done in the short run to cultivate ethical personalities. Rather, we believe that the solution lies in market mechanisms that eliminate the perverse incentives of gatekeepers, most notably the auditors. We need an institutional mechanism that eliminates the conflict of interest auditors face and properly align their incentives with those of shareholders.

This paper presents a financial statement insurance mechanism that promotes improved alignment of incentives, and hence better quality audits. We show analytically that the introduction of financial statement insurance can significantly mitigate market inefficiencies arising from uncertainty regarding the quality of financial statements.[2] The basic structure of Financial Statement Insurance (FSI) may be described as follows (details may be found in Ronen (2002) and in Ronen and Cherny (2002)). Instead of appointing and paying auditors, companies would purchase financial statement insurance that provides coverage to investors against losses suffered as result of misrepresentation in financial reports. The insurance coverage that the companies are able to obtain is publicized, along with the premiums paid for the coverage. The insurance carriers then appoint – and pay – the auditors who attest to the accuracy of the financial statements of the prospective insurance clients. Those announcing higher limits of coverage and smaller premiums will distinguish themselves in the eyes of the investors as the companies with higher quality financial statements. In contrast, those with smaller or no coverage or higher premiums will reveal themselves as those with lower quality financial statements. Every company will be eager to get higher coverage and pay smaller premiums lest it be identified as the latter. A sort of Gresham's law in reverse would be set in operation, resulting in a flight to quality.

[2]An analogy is the product warranty market. For example Grossman (1981) shows that managers use full disclosure of private information to maintain the value of the product they sell. When managers do not disclose, buyers or investors discount the price to reflect their expectations of hidden information of low product quality.

Before addressing the economic consequences arising from financial statement insurance and related procedural changes, we present arguments that suggest that a critical economic factor in the recent debacles was the misaligned incentives of the auditors. In particular, a coincidence of circumstances created an environment within which the misaligned incentives of the auditors brought about a disastrous failure in the gate keeping function and a consequent misallocation of capital.

In the current social arrangement, auditors face a conflict of interest. They are paid by the companies they audit and look to the CEOs and CFOs of the same company to facilitate their continued engagement into the indefinite horizon. According to sound principles of corporate governance, auditors are supposed to be the agents of the shareholders but in practice, it is management that engages the auditor. Although shareholders vote on management's recommendation of which auditor's services to hire, the decision is effectively made by management. This arrangement creates an inherent conflict of interest for the auditor. It is the management of the company that engages the auditor and ultimately pays for the services and hence determines auditing and consulting fee structures 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 without the limitations on non-audit services imposed by the Sarbanes-Oxley Act of 2002 - effectively guarantees that the auditor complies with management's wishes.

It is altogether clear that under the current institutional setting, the anticipation of potential gains from acquiescing to management's wishes more than offsets the threat of legal liability against auditors from shareholder class action suits. Furthermore, a large proportion of shareholder recoveries in audit failure-related class action suits is made out of the corporation's own resources. Ironically, such recoveries diminish the wealth of shareholders who purchased the shares at prices potentially inflated as a result of misrepresentations even further due to deadweight losses arising from the cost of defending the suit. It is tempting to suggest that an increase in the liability exposure of the auditors can deter malpractice but it falls short on two grounds. One, it fails to address the misallocation of risk and resources. Imposing higher litigation penalties on the auditor ex post does not enhance the ability of society to distinguish, ex ante, between firms with intrinsically high returns from the Enrons and Worldcoms of the world that have intrinsically low or negative returns but misrepresent themselves as high-return firms. Two, increasing exposure to liability and instituting high legislated penalties may drive auditors out of the business of auditing altogether. Again not a welcome prospect.

In proposing Financial Statement Insurance, we argue that the intractable conflict of interest imposed on auditors cannot be rectified through legislation, regulation, enforcement, or litigation as long as auditors are engaged by the management of the firms they audit. Instead, what is needed is an agency relationship between the auditor and an appropriate principal whose economic interests are aligned with the goals of promoting better disclosures and greater economic efficiency. In other words, there is the need to align the interest of shareholders (acting as the principal) with the auditor (acting as the agent).[3] The only way to remove the inherent conflict of interest facing the auditor is by severing the agency relation between the firm's management and the auditor. In the context of a free market mechanism, insurance carriers can serve the role of such a principal. The critical features of the FSI scheme underlying this study are:(i) the shift of the decision on auditor employment from the client-management to the insurer; and (ii) the effect of publicizing the premium charged

[3]Such a realignment of interests would contribute towards 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 corporations 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].

to different firms. The primary goal is to formalize these two features and to demonstrate that the provision of FSI linked with appropriate disclosure provisions leads to firms voluntarily improving the quality of disclosure.

In Section 2, we develop a formal model for analyzing the link between financial statement quality and economic efficiency. We then examine the consequences of allowing signaling through the insurance premium. Next we examine the consequences of making the auditor an agent of the insurance- carrier rather than client-management under an assumption that the auditor acts an individual utility maximizer. Conclusions are presented in Section 5.

2 Model

We develop a model of investment in projects where the rate of return makes it socially suboptimal to invest in certain projects.[4] Specifically, we assume there are N firms in the economy with possible rates-of-return $r_1 < r_2 < \ldots < r_N$. The rate-of return of each firm, r_i, is drawn randomly and independent of other firms by nature at the start of the period. We assume that there are M units of capital that need to be allocated to these N firms, $M < N$. In addition, we assume that there is an alternative investment with known rate-of-return r^* with $r_{N-M+1} > r^*$. In a first-best, where each firm's rate-of-return is common knowledge, only the best M firms will obtain investment. However, in second-best scenario, where the firm-type is not known to investors, it is possible for firms with low rates of return to obtain financing by misrepresenting their future prospects. The model we construct uses a framework where firm-type is unknown to investors but the supply of capital is based on an audited financial report issued by the firm. In addition, the firm is assumed to have the ability to strategically bias financial reports in order to ensure the inflow of capital.

[4]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 time-periods.

The managers of a firm typically decide on the quality of financial statements. They also typically benefit both in pecuniary and non-pecuniary ways from capital inflows. In our framework, we model this by defining a benefit to the firm above and beyond the investment from capital inflows, represented by a parameter B for benefits. To summarize, by ensuring a capital inflow, the firm's management generates both a return r_i which is passed back to shareholders and a benefit B for themselves.[5]

The investors' problem is to decide whether to allocate capital to a firm based on the quality of its audited financial report θ. To make this decision, on observing a report $\theta_f = j$ from a given firm, f, investors must estimate the expected return for that firm, $E[r|\theta_f = j] = \hat{r}_{jf}$. However, firms have the ability to choose the quality (i.e., accuracy) of the reporting system θ in a strategic fashion. Therefore, in trying to estimate $\hat{r}_{jf}$, investors have to take into account the possibility that the report may be overstated because of the firm's choice of a low-quality financial reporting system. The next step in the modeling process is to formalize the notion of the quality of financial reporting systems and the bias introduced by low-quality financial statements.

In our formulation, the lower the quality of financial statements (fsq), the greater the probability that the firm's rate-of-return is overstated. To arrive at this feature, we let $q \in \mathbf{Q} \subset \Re^{\mathbf{n}}$ and $e \in \mathbf{E} \subset \Re^{\mathbf{m}}$ denote two parameters that determine financial statement quality (fsq). q is chosen by the firm and e by the auditor from possible $\mathbf{E}$ and $\mathbf{Q}$ sets that are both assumed to be compact. To arrive at a definiton of fsq, it is necessary to link q and e with the likelihood of overstatement. Assumption 1 below formalizes this relationship.

[5]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 latter case, the purchase of stock exerts an upward pressure on its price hence decreasing the firm's cost of capital. As a result the firm would be able to finance investment projects that it could not afford without the price increase (- 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 increased value of its stock and options holdings.

Let i denote the true type of a firm, that is, a firm whose expected rate of return is r_i. Then under fsq choices q, e, the firm's reported-type distribution is denoted by $P(j|i, q, e)$; that is, for a firm f of type i, the probability that the report $\theta_f = j$ (i.e, firm f is reported as having a rate-of-return r_j) is $P(j|i, q, e)$. The key structural issue is to define how the probability of overstatement changes in fsq. This relationship is described in our first assumption.

Assumption 1 (FSQ and First-Degree Stochastic Dominance)

The probability of overstatement increases in the sense of first-degree stochastic dominance as fsq decrases. More formally, $P(j|i, q, e) = 0$ *for* $j < i$ *and for* $j \geq i$*,*

$$\frac{\partial}{\partial q_l}\Big(P(i|i, q, e)\Big) \;>\; 0 \qquad \text{for every } i \tag{1}$$

$$\frac{\partial}{\partial e_m}\Big(P(i|i, q, e)\Big) \;>\; 0 \qquad \text{for every } i \tag{2}$$

$$\frac{\partial}{\partial q_l}\Big(\sum_{j \geq k > i}^{N} P(j|i, q, e)\Big) \;<\; 0 \qquad \text{for every } k \tag{3}$$

$$\frac{\partial}{\partial e_m}\Big(\sum_{j \geq k > i}^{N} P(j|i, q, e)\Big) \;<\; 0 \qquad \text{for every } k \tag{4}$$

By assumption, all errors are one-sided, that is, a firm may overstate but never understate its rate of return. This formulation is consistent with a one- sided correction policy in that firms diligently investigate to see if the true rate of return is lower than that implied by the financial report. We also assume that quality is determined jointly by the financial controls instituted by the firm and the type of corrective action taken by auditors. In other words, auditors could, if they so chose, increase the quality of the financial report by choosing a higher value of e.

Notice that the $P(j|i, q, e)$ summed over all j is 1, and hence, the derivatives of all these terms summed over j is zero. The content of Assumption 1 is that the likelihood of an accurate report, $P(i|i, q, e)$, increases in q and e whereas the probability of an erroneous report decreases.

While it is possible to derive all our results under the specification of Assumption 1, we choose a specific form for $P(j|i, q, e)$ that allows us to simplify the presentation of the results.

$$P(j|i,q,e) \quad = \quad \begin{cases} 0 & if\ j < i \\ q + e - qe & if\ j = i \\ \frac{(1-q)(1-e)}{N-i} & if\ N \geq j \geq i+1 \end{cases} \tag{5}$$

In the context of our analysis, under Equation 5, we represent financial statement quality through the joint factor $1 - (1 - q)(1 - e) = q + e - qe$. The firm, on its own, can ensure any level of error between $(1 - \overline{q})$ and $(1 - \underline{q})$. The auditor can improve the fsq through the choice of e. At the lowest level $e = 0$, fsq remains at the firm's choice $(1 - q)$ and the auditor fails to effect any improvement. We assume that the highest level, $\overline{e}$, is close to 1.[6] If the audit effort implemented is $\overline{e}$, the error probability, $(1 - q)(1 - \overline{e})$, is close to zero irrespective of the choice of q. In other words, if the auditor decides on the highest level of care, the type of the firm is revealed almost perfectly irrespective of the firm's choices. To summarize, under our specification, $\underline{q}$ represents the minimum fsq that is forced under current institutional standards whereas $\overline{q}$ represents the highest level achievable without intervention by the auditor. The auditor can improve fsq through his choice of $e \in [0, \overline{e}]$ where $\overline{e}$ is assumed to be close to 1. Thus the auditor can either fail to improve fsq at all or improve it to a level where it is close to perfect.

Because financial statement quality is unobservable, (Bayesian) rational investors will form conjectures regarding this quality. Denote by $\vec{\nu} = \{\nu_1, \nu_2, \ldots, \nu_N\}$, the market beliefs regarding the financial statement quality levels, that is, a (typical) investor believes that a firm with rate-of-return r_i issues financial statements of quality ν_i. These beliefs determine the set of financial reports θ that will be funded. Specifically, on observing a firm, f, issuing a report $\theta_f = j$, investors will have to infer a conditional distribution over the possible types

[6] $\overline{e}$ is chosen to be strictly less than 1 to avoid some uninteresting cases relating to corner solutions.

of the firm, and thereby, a rate of return.

2.1 Investor Beliefs and Inferences

We develop in this section a Bayesian investor's inference procedure linking observed reports and inferred firm type. Let us fix a set of beliefs regarding audit quality, $\vec{\nu}_i$; that is, a firm whose true type is i is believed by investors to generate reports of fsq ν_i. Here, ν_i represents the beliefs regarding the combined factor $q_i + e_i - q_i e_i$. Under these beliefs regarding fsq, the probability that a firm of type i and perceived fsq ν_i is reported as type $j \geq i$ is denoted by $P(j|i, \nu_i)$. Note that since firm types are drawn independently, the distribution of reports of each firm is independent of other firms. Consequently, in assessing the probability distribution of reports of a firm of type i, only the component ν_i is relevant. From the specification in Equation (5), under beliefs $\vec{\nu}$, the expected probability distribution of reports for a firm $i < N$, written as $P(\theta_f = j|i, \vec{\nu})$, is given by:

$$P(\theta_f = j|i, \vec{\nu}) = P(\theta_f = j|i, \nu_i) \quad = \quad \begin{cases} 0 & j < i \\ \nu_i & j = i \\ \frac{(1-\nu_i)}{(N-i)} & j > i \end{cases} \tag{6}$$

The highest firm type $i = N$ is always reported correctly because the highest type cannot be overstated while understatement is ruled out by model specification.

The next step is to infer the type of a firm, f, that issues a report θ_f. Since all available information is contained in the report, all firms that issue the same report are treated identically. Given that a signal $\theta_f = j$ is transmitted by firm f (of unknown type), investors derive a probability distribution over the possible types of f. Given the specification in Equation (5), investors expect to see report $\theta_f = j$ with some probability from all firms of true type $i \leq j$. These probabilities depend on the perceived fsq $\vec{\nu}$ as follows:

$$P(\theta_f = j|\vec{\nu}) \quad = \quad \sum_{i=1}^{j} P(\theta_f = j|i, \nu) \quad = \quad \sum_{i=1}^{j-1} \frac{(1-\nu_i)}{N-i} + \nu_j.$$

Using this identity, the probability distribution of types assigned to a firm f that reports $\theta_f = j$ under beliefs $\vec{\nu}$ is therefore given by:

$$P(i|\theta_f = j, \vec{\nu}) \quad = \quad \begin{cases} 0 & \text{f is of type } i > j \\ \frac{\nu_j}{\left[\sum_{i=1}^{j-1}(1-\nu_i)(N-i)^{-1}\right]+\nu_j} & \text{f is of type } i = j \\ \frac{(1-\nu_i)(N-i)^{-1}}{\left[\sum_{i=1}^{j-1}(1-\nu_i)(N-i)^{-1}\right]+\nu_j} & i < j \end{cases} \tag{7}$$

The consequent expected return for a firm f which has been given a report $\theta_f = j$ under beliefs $\vec{\nu}$ may be determined as:

$$\hat{r}_{jf} = E[r|\theta_f = j, \vec{\nu}] \quad = \quad \sum_{i=1}^{j} P(i|\theta_f = j, \vec{\nu}) r_i \tag{8}$$

After observing a set of reports $\vec{\theta} = \{\theta_1, \ldots, \theta_N\}$, investors fund those firms whose expected rates-of-return are greater than r^*. That is, to each report profile $\vec{\theta}$, we can attach a number of units of capital $M(\vec{\theta}) \leq M$ that will be allocated to these firms.

Knowing investor beliefs $\vec{\nu}$, a firm f of type i determines the optimal level of fsq. This determination involves two stages of a backward optimization process. At the second-stage, the firm hires an auditor who will set a level of error-correction e that improves the quality of the financial report. At the first-stage, the firm must choose its own quality implementation q taking into account the auditor's decision at stage-two. For reasons of simplicity, we assume that all levels of q involve the same cost.[7] Let $\vec{q} = \{q_1, q_2, \ldots, q_N\}$, $\vec{e} = \{e_1, e_2, \ldots, e_N\}$ denote the actual quality choices of firms and their respective auditor. Firm f now issues a report which may be overstated with some probability based on Equation 7 with total fsq $q_f + e_f - q_f e_f$ replacing ν_f. The investors therefore observe a vector of N reports, $\vec{\theta} = \{\theta_1, \ldots, \theta_N\}$, and based on this observation, decide on which firms obtain funding. The returns are then realized for the firms.

[7] This assumption may be justified in the following way. Firms collect information for their own decision purposes. They then aggregate them into financial statements. All levels of aggregation have approximately the same cost.

In our framework, firms can "cheat" investors in the short-run by using financial statements of lower quality than that perceived by the market, that is, a firm of type i can set $q_i + e_i - q_i e_i < \nu_i$. However, such a situation cannot obtain in a (rational) equilibrium. Therefore, in equilibrium, we require that $\{\nu_1, \ldots, \nu_N\} = \{q_1 + e_1 - q_1 e_1, \ldots, q_N + e_N - q_N e_N\}$, that is, in equilibrium, the market appropriately "discounts" reported financial values based on the quality of the financial statements. Firms can "cheat" and produce financial statements of lower quality to obtain capital, but such cheating cannot be sustained in equilibrium. In other words, an equilibrium in our context has to be self-enforcing in the sense that given investor beliefs $\vec{\nu}$, no firm wants to defect to a different quality $q_i + e_i - q_i e_i \neq \nu_i$ even though they can do so *without being detected*. However, low quality financial statements may increase the exposure of the firm for penalties under various statutes and under case law.

2.2 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 inaccurate financial reports. Such penalties act both to increase the quality of financial statements and to provide some level of compensation to investors. For the purposes of analysis, we assume that the coverage under the proposed FSI scheme is the same as the expected recovery under the current institutional arrangements. In general, FSI permits more direct and less restrictive coverage than the penalties imposed by the Securities Acts. That is, FSI directly insures investors against misrepresentations in the financial statements rather than under the present regime where insurance is "indirect" in that it covers the liability of directors and auditors. Aspects of the FSI schemes outlined in Ronen (2002) that are not addressed in our formal analysis are discussed in Section 4.

We model liability as an expected cost proportional to the likelihood of Overstatement. That is, a firm that sets fsq at q will be found liable with probability $\gamma_f(1-q)$ and then faces a penalty K. The expected liability cost is then $\gamma_f(1-q)K$, which we rewrite as $K_f(1-q)$ where $K_f = K\gamma_f$. Similarly, we assume that the auditor is found liable with probability $\gamma_a(1-q)(1-e)$ and that the liability when found guilty is K_a. Introducing more sophisticated penalty schemes, for example, basing damages on the level of distortion in the financial statements, has no substantive implications for our analysis.[8]

Because firms and investors are assumed to be risk-neutral, there are no risk- sharing considerations and insurance does not directly enhance economic efficiency. Rather, the premium functions purely as a signaling device. An important consequence of introducing financial statements insurance relates to the public disclosure of the premium. Such disclosures reveal the quality of the financial statements to investors and makes it possible for firms to capture the benefits of implementing high quality financial systems. In particular, when financial statement insurance premia are publicly reported, investors can infer which financial statements are truly of high quality and channel their investments in a more efficient fashion.

3 Results

The main focus of our formal analysis is to establish two results:

(1) To show that a public disclosure of the insurance premium charged on the financial statement increases the efficiency of capital allocation; and

[8] In practice, damages would depend in a complicated way on a number of other factors such as the volume of shares purchased during the class period, a damage amount per share that is related to the degree of price inflation "distortion" caused by misrepresentations, and the magnitude of the latter, in addition to its likelihood.

(2) To show that switching the audit employment contract to the insurer in addition to disclosing the premium increases both the quality of financial reporting and the efficiency of capital allocation.

We begin by motivating the first result through an example. In order to make the example as simple as possible, we suppress the role of the auditor and assume that the insurer can observe, costlessly, the quality of the financial statement.

An Example

Suppose that $N = 2$ and $M = 1$, that is, there are two firms competing for one unit of capital and assume the absence of an audit so that $fsq = q$. For the purposes of this example, define ν_i as the perceived quality of firm of type i. Denote the possible rates-of-return as $r_1 < r_2$. In addition, assume that society would prefer that only firms with rate-of-return r_2 gets funding, that is, the alternative use of capital is r^* where $r_1 < r^* < r_2$. We first show that this is not achievable if fsq is hidden.

We assume that there is enough accuracy in accounting that high reports will always be funded, that is, $\underline{q}r_2 + (1 - \underline{q})r_1 > r^*$. Let us analyze the optimal quality choice of a firm, f, of type 1. There are two possible reports such a firm might issue: $\theta = 1$ or $\theta = 2$. Under our structure, the report $\theta = 1$ identifies the firm as type 1 and precludes funding. However, there is a possibility of funding if f issues the report $\theta_f = 2$. Now, the other firm may be either of type 1 or type 2 with equal probability $\frac{1}{2}$. In order to compute their optimal quality choice, firm f has to make an assessment of what the other firm will do. We assume that the beliefs about quality are represented by ν_1, ν_2 where a firm of type i is believed to set quality level ν_i. Thus, firm f makes the following assessments for any level of fsq q:

(1) If the other firm is of type 1, it will set fsq ν_1 and then the probabilities are: (i) $(1 - q)\nu_1$ that firm f will be reported as 2 while the other firm will be reported as 1 and $(1 - q)(1 - \nu_1)$ that both firms will be reported as 2. Thus the probability of funding is

$(1-q)\nu_1 + \frac{1}{2}(1-q)(1-\nu_1)$.

(2) If the other firm is of type 2, it will always be reported as type 2; therefore, f will be funded only if it is reported as type 2 also. Consequently, the probability of funding is $\frac{1}{2}(1-q)$.

Putting these two possibilities together, firm f of type 1 assesses the probability of funding at fsq choice q as: $\frac{1}{2}[(1-q)\nu_1 + \frac{1}{2}(1-q)(1-\nu_1)] + \frac{1}{2}[\frac{1}{2}(1-q)] = \frac{1}{2}(1-q)(\frac{1}{2}\nu_1 + 1)$. Thus, they maximize the probability of funding by setting $q = \underline{q}$.

Assume that the benefits of funding are large relative to the costs of low quality, the optimum fsq choice of a type 1 firm is $q = \underline{q}$. There are three configurations of firm types: (i) both of type 1 (probability $\frac{1}{4}$); (ii) one of each type (probability $\frac{1}{2}$); and (iii) both of type 2 (probability $\frac{1}{4}$)). Therefore, the probability that capital is misallocated to a low type firm in equilibrium is:

$$\frac{1}{4}[1-\underline{q}^2] + \frac{1}{2}[\frac{1}{2}(1-\underline{q})] = \frac{1}{2} - \frac{1}{4}(\underline{q} + \underline{q}^2)$$

In contrast, consider the case where the firm's choice of fsq is known to the insurer who 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. In this example, the following is seen to be an equilibrium:

- Both Firm types choose fsq $q = \overline{q}$, i.e., the highest quality financial statement, and pay the associated insurance premium $\pi(\overline{q})$.
- Any firm that is observed to have a premium $\pi > \pi(\overline{q})$ is classified as a type 1 firm and denied funding

To see that this represents an equilibrium, let q_1 represent the equilibrium fsq choice of Firm 1; either $q_1 < \overline{q}$ or $q_1 = \overline{q}$. If, $q_1 < \overline{q}$, the premium rate for firm 1, $\pi(q_1) > \pi(\overline{q})$ and Firm 1 is identified as the low rate-of-return firm. Thus, Firm 1 is never provided capital and the social rate-of-return rises to r_2. If however, Firm 1 mimics Firm 2 and sets $q_1 = \overline{q}$, both firms have the same premium $\pi(\overline{q})$ and cannot be separated. However, the probability of Firm 1 obtaining capital drops to $\frac{1}{4}[(1 - \overline{q}^2] + \frac{1}{2}[\frac{1}{2}(1 - \overline{q})]$.

Notice in this example that if Firm 1 sets $q_1 < \overline{q}$, then Firm 2's optimal response is to set $q_2 = \overline{q}$ – this policy allows Firm 2 to be funded with probability 1 at a minimum insurance cost. However, if Firm 2 sets $q_2 = \overline{q}$, Firm 1's best strategy is to "mimic" and set $q_1 = \overline{q}$. Setting $q_1 = \overline{q}$ increases the funding probability to a strictly positive level and reduces the premium. This leads to the equilibrium described above. In contrast, we show that the setting where Firm 1 sets $q_1 = \overline{q}$ and Firm 2 sets $q_2 < \overline{q}$ is untenable in equilibrium. For in such a situation, by increasing q slightly, Firm 2 reduces insurance costs without reducing the funding probability. Thus, $q_1 = \overline{q}$, $q_2 < \overline{q}$ can never be an equilibrium. Therefore, the only equilibrium in this Example is for both firms to set $q_i = \overline{q}$.

□

This example does not incorporate a role for the auditor. However, 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 auditor employment is determined by the insurer, sufficient incentives may be provided to elicit truthful revelation regarding the financial statement quality. Once fsq is known (perhaps imperfectly) to the insurer, premia reveal information about fsq. In particular, when firms defect from the anticipated level of fsq, that is, if $q_i < \nu_i$, investors find out about this through the premium and prior to trade. We are then essentially back in the situation discussed in the example.

The example has the characteristics of a signaling model where firms gets separated out through the level of the insurance premium. However, there is an important difference between the economics underlying a standard signaling model and that developed in Example 1. In a standard signaling model, the differential costs of signals across types arises from an exogenous factor related to type. In contrast, in the setting of the example, the cost of signals differs across types because of an endogenous factor – the reaction of providers of capital. For this reason, the initial beliefs of investors plays a significant role in the analysis.

Let $\{\nu_1, \nu_2\} = \vec{\nu}$ 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 $\vec{\nu}$; 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 only fund the report $\theta = 2$.

When there are more than two types, this simple logic breaks down on intermediate reports, that is, it is no longer the case that higher reports are funded in preference to lower reports. If lower reports are preferred by investors (as can happen under some beliefs $\vec{\nu}$), then the relation between types and endogenous signaling costs (through the premium) becomes unintuitive. To avoid this possibility, we impose such restriction on beliefs as would ensure that investors prefer to fund higher reports rather than lower reports. This restriction is presented as Assumption 1 below. It is clear that with sufficiently high quality financial statements, this would indeed be the case.[9]

Assumption 2 (Correlation between beliefs and Types)
Higher type firms are believed to have higher fsq, that is, $\nu_1 \leq \nu_2 \leq \ldots \nu_n$. Note that there is no assumption about the actual quality, that is, it is possible for example that $\nu_i = 0$ for every i.

Without Assumption 1, it is possible that higher reports are associated with a lower expected type leading to some very unintuitive consequences. This is a general problem in rational expectations models – "perverse" beliefs can result in equilibria with "bizarre" properties.

[9]For example, when e_i is sufficiently close to 1 for every i, $\hat{r}_{jf}$ is almost the same as r_j. Therefore, only the M highest reports will be funded.

It may be possible to show that equilibria where low reports are funded in preference to high reports are untenable under a more sophisticated analysis of belief formation. [10] However, we take a direct approach by ruling such a possibility out by assumption. The beliefs in Assumption 1 are motivated by the fact that high-type firms are believed to be more likely to benefit from revealing their true type and the belief that the lower the firm's type, the more that firm would benefit from a lower quality report. This is certainly intuitive from an economic standpoint and greatly simplifies the analysis. We also note that as long as $q, e < 1$, there is some (small) probability that every firm could receive the highest report, that is, the report profile $\{N, N, \ldots, N\}$ occurs with positive probability.

Our first result, contained in Lemma 1 below, is a key consequence of Assumption 1 (and indeed, Assumption 1 and Lemma 1 are interchangeable).

Lemma 1 (Increasing probability of funding in reported value)

The probability of being funded either stays the same or increases in the reported type.

Proof:

Suppose that $k \geq i$. We have to show that $\hat{r}_{kf} \geq \hat{r}_{if}$; if this is the case, then a firm s with report $\theta_s = k$ is funded in preference to another, t with report $\theta_t = i$.

From (7), we have that for any given firm, f,:

$$\hat{r}_{kf} = \frac{\nu_k r_k + \sum_{j=1}^{k-1}[(1-\nu_j)/(N-j)]r_j}{\nu_k + \sum_{j=1}^{k-1}[(1-\nu_j)/(N-j)]} \qquad \hat{r}_{if} = \frac{\nu_i r_i + \sum_{j=1}^{i-1}[(1-\nu_j)/(N-j)]r_j}{\nu_i + \sum_{i=1}^{j-1}[(1-\nu_j)/(N-j)]}$$

Because $r_i \geq r_j$ for $i \geq j$, it follows that:

$$\begin{aligned}\hat{r}_{kf} &= \frac{\nu_k r_k + \sum_{j=1}^{k-1}[(1-\nu_j)/(N-j)]r_j}{\nu_k + \sum_{j=1}^{k-1}[(1-\nu_j)/(N-j)]} \\ &\geq \frac{\nu_k r_i + \sum_{j=i}^{k-1}[(1-\nu_j)/(N-j)]r_i + \sum_{j=1}^{i-1}[(1-\nu_j)/(N-j)]r_j}{\nu_k + \sum_{j=i}^{k-1}[(1-\nu_j)/(N-j)] + \sum_{j=1}^{i-1}[(1-\nu_j)/(N-j)]} \qquad (9)\end{aligned}$$

[10] In particular, constructing a multi-period model where investors learn about q_i from period to period may rule out unintuitive belief structures.

Consider the expression $\psi(a) = \dfrac{ar_i + \sum_{j=1}^{i-1}[(1-\nu_j)/(N-j)]r_j}{a + \sum_{j=1}^{i-1}[(1-\nu_j)/(N-j)]}$ as a function of a. A direct differentiation shows that

$$\psi'(a) \quad = \quad \frac{\sum_{j=1}^{i-1}[(1-\nu_j)/(N-j)](r_i - r_j)}{\left[a + \sum_{j=1}^{i-1}[(1-\nu_j)/(N-j)]\right]^2} \quad \geq 0$$

Setting $a_1 = \nu_i$ and $a_2 = \nu_k + \sum_{j=i}^{k-1}[(1-\nu_j)/(N-j)]$, it follows from Assumption 1 and the positivity of all other terms that $a_2 \geq a_1$. Thus $\psi(a_2)$ is greater than $\psi(a_1)$. However, $\psi(a_2)$ is exactly the last expression in Equation (9); therefore, it follows that $\hat{r}_{kf} \geq \hat{r}_{if}$ as required.

□

Lemma 1 shows that investors prefer to fund firms whose financial reports imply a greater rate-of-return. We next analyze the impact of this policy on the probability that a particular firm will be funded.

3.1 Funding Probability

In this section we develop the notation and structure related to the probability that a given firm will obtain funding under fsq choices $\vec{q}, \vec{e}$. For any given firm f, the funding probability, FP_f, depends both on its own reporting choices and the level of "report inflation" selected by other firms. However, the fsq choices of other firms are not directly observable; therefore, firm f's decisions depend on their beliefs regarding the other firms fsq choices. Because it does not have any significant implications, we assume that firm f's beliefs regarding the other firms choices are the same as investors' beliefs, that is, each firm believes that the quality choices are $\vec{\nu}$. Consequently, we denote a firm f's assessment of its funding probability under choices q, e as $FP_f(q, e|\vec{\nu})$.

To obtain this funding probability $FP_f(q, e|\vec{\nu})$, we first analyze the situation conditional on a realized report profile $\vec{\theta} = (\theta_1 = i_1, \theta_2 = i_2, \ldots, \theta_N = i_N)$. It is very important to emphasize two points: (i) it is quite possible that $i_s > i_t$ even though Firm s is of lower type than Firm t; and (ii) that the investors' information about firm type is based only on the observed report and conjectures about fsq – so if $\theta_s = \theta_t$, then the firms s and t would be treated in exactly the same fashion.

After observing $\vec{\theta}$, because of Lemma 1, investors will fund $M(\vec{\theta}) \leq M$ firms with the highest reports. Define

$$T_f(\vec{\theta}) = |\{j : \theta_j > \theta_f\}|; \qquad t_f(\vec{\theta}) = |\{j : \theta_j = \theta_f\}|$$

In addition, for any realization $\vec{\theta} = \{\theta_1, \ldots, \theta_N\}$ we define $\vec{\theta}_{-f} = \{\theta_1, \ldots \theta_{f-1}, \theta_{f+1}, \ldots \theta_N\}$ to be the $N-1$-vector with component f omitted. Analogously, we write $\vec{q}_{-f}$, $\vec{e}_{-f}$ for the $N-1$-vector with firm f's choices omitted. With these definitions, the probability of getting capital conditional on a report profile $\vec{\theta}$ can be summarized as in the next lemma:

Lemma 2 (Funding probabilities)

Suppose that some report profile $\vec{\theta}$ is observed. The probability that a firm f will be funded (under beliefs $\vec{\nu}$) is denoted by $FP_f(\theta_f|\vec{\theta}_{-f}, \vec{\nu})$ (FP represents the funding probability). Then:

(1) f will never be funded, that is, $FP_f(\theta_f|\vec{\theta}_{-f}, \vec{\nu}) = 0$, if $T_f(\vec{\theta}) \geq M(\vec{\theta})$

(2) f will always be funded, that is, $FP_f(\theta_f|\vec{\theta}_{-f}, \vec{\nu}) = 1$, if $T_f(\vec{\theta}) + t_f(\vec{\theta}) \leq M(\vec{\theta})$.

(3) f will be funded with probability $FP_f(\theta_f|\vec{\theta}_{-f}, \vec{\nu}) = \frac{[M - T_f(\vec{\theta})]}{t_f(\vec{\theta})}$ if $T_f(\vec{\theta}) < M(\vec{\theta}) < T_f(\vec{\theta}) + t_i(\vec{\theta})$.

Proof:

After observing the report profile $\vec{\theta}$, investors will work downwards starting from the highest report. By the time they consider firms with reports θ_f, they would have expended $T_f(\vec{\theta})$ or M units of capital depending on which amount is smaller. If $T_f(\vec{\theta}) \geq M$, all the capital would have been exhausted and firm i will receive no funding. If not, $M - T_f(\vec{\theta}) > 0$ and these remaining units of capital will be allocated to $t_f(\vec{\theta})$ firms that all obtain the same report as type f. Obviously, all firms with report θ_f are funded if $T_f(\vec{\theta})+t_f(\vec{\theta}) \leq M$ proving the second part of the lemma. The third part of the lemma follows on noting that $M-T_f(\vec{\theta})$ units of capital are allocated randomly to $t_f(\vec{\theta})$ firms if $T_f(\vec{\theta})+t_f(\vec{\theta}) \geq M$.

□

The point arising from Lemma 2 is that conditional on $\vec{\theta}$ the funding probabilities are independent of $\vec{\nu}$ (as long as $\vec{\nu}$ is increasing in type). Using this result, we determine the funding probability of a given firm by summing these probabilities across all report profiles. Let us write $FP_f(j|\vec{\theta}_{-f}) = FP_j(\theta_f = j|\vec{\theta}_{-f})$ for the probability that a firm f with report $\theta_f = j$ is funded for a given realization of $\vec{\theta}_{-f}$ (as described in Lemma 2). Then the probability of funding for a firm f of type i under choices q, e conditional on a realization of $\vec{\theta}_{-i}$ is:

$$FP_f(q,e|\vec{\theta}_{-f}) = \sum_{j=i}^{N} FP_f(j|\vec{\theta}_{-f})P(j|i,q,e) \tag{10}$$

where $P(j|i,q,e)$ is the probability that a firm of type i will issue a report j under the choices q, e. Further, the probability distribution of $\vec{\theta}_{-f}$ expected by firm f is determined by their beliefs regarding $\vec{\nu}_{-f}$ and is independent of the type of firm f or the choices q, e.[11]. Therefore, the overall funding probability for a firm f of type i with strategic choices q, e with beliefs $\vec{\nu}_{-f}$ is obtained as follows:

$$FP_f(q,e|i,\vec{\nu}_{-f}) \quad = \quad \sum_{\vec{\theta}_{-f}} \left[\sum_{j=i}^{N} P(j|i,q,e) FP_f(j|\vec{\theta}_{-f})\right] P(\vec{\theta}_{-f}|\vec{\nu}_{-f}) \tag{11}$$

Because the choices of q and e only affect the distribution of θ_f, we can rewrite the sum on the right-hand-side of Equation (11)in a more convenient fashion as a component that depends only on beliefs and a component that depends on the choices q, e. For a fixed report $\theta_f = j$, let:

$$w_f(j|\vec{\nu}_{-f}) = \sum_{\vec{\theta}_{-f}} FP_f(j|\vec{\theta}_{-f})P(\vec{\theta}_{-f}|\vec{\nu}_{-f}) \tag{12}$$

[11]This follows from the assumption that firm-types are i.i.d.

Because $FP_f(j|\vec{\theta}_{-f})$ is increasing in j and independent of the type of f, w_f is an increasing function of j and independent of the type of f as well. Consequently, the probability of funding for a firm of true type i which chooses q, e given beliefs $\vec{\nu}_{-f}$ regarding other firms' fsq choices is:

$$\begin{aligned} FP_f(q,e|i,\vec{\nu}_{-f}) &= \sum_{j=i}^{N} w_f(j|\vec{\nu}_{-f}) P(j|i,q,e) \\ &= w_f(i|\vec{\nu}_{-f})(q+e-qe) + \sum_{j=i+1}^{N} w_f(j|\vec{\nu}_{-f}) \frac{(1-q)(1-e)}{N-i} \end{aligned} \tag{13}$$

The structure of Equation (13) summarizes investor behavior within our model and we present its main characteristics. The funding probability for any firm f has the following properties:

(1) The component w_f is independent of firm f (both type and fsq choices) and is determined completely by beliefs regarding the fsq choices of firms other than f.

(2) Firm f of type i affects funding probabilities through fsq choices that determine its own report distribution, $P(\theta_f = j|i,q,e)$.

The next Proposition shows a critical feature of how the probability of funding for firm f changes in the fsq choices.

Proposition 1 (Funding probability and fsq choice)

Let firm f be of type $i < N$. Then $FP_f(q,e|\vec{\nu}_{-f})$ is a strictly decreasing function (measured through First-Degree Stochastic Dominance) of q and e.

Proof:

Fix some values $\vec{\nu}_{-f}$. These values will determine some probability distribution $P(\vec{\theta}_{-f}|\vec{\nu}_f)$.[12] For any $\vec{\theta}_{-f}$, it is immediate from Lemmas 1 and 2 that the funding probability $FP_f(j|\vec{\theta}_{-f})$

[12]In detail, the probability distribution would be the convolution of $N-1$ identical distributions, one for each firm. For a given firm f, the probability distribution of θ_f is given by $P(\theta_f = j) = \frac{1}{N}\sum_{i=1}^{N} P(\theta_f = j|i,\nu_i)$.

is always weakly increasing in reported type $\theta_f = j$, and therefore, that w_f is also weakly increasing in j. We assert that for type $i < N$, w_f is strictly increasing for some j. To see this, consider a report profile where all other firms are reported as the highest type, $\vec{\theta}_{-f} = (N, N, \ldots, N)$. This profile occurs with some positive probability under every choice $\vec{q}_{-f}, \vec{e}_{-f}$. In this case, $FP_f(i|\vec{\theta}_{-f}) = 0$ whereas $FP_f(N|\vec{\theta}_{-f}) > 0$. That is, if all other firms are reported as the highest type and firm f is reported as less than the highest type, it will not be funded whereas if firm f is also reported as the highest type, it has a positive probability of being funded. From Equation 12, every term in the sum for $w_f(N|\vec{\nu}_{-f})$ is weakly higher than the corresponding one for $w_f(i|\vec{\nu}_{-f})$ and at least one term (corresponding to $\vec{\theta}_{-f} = (N, N, \ldots, N)$ is strictly greater. It follows that $w_f(N|\vec{\nu}_{-f}) > w_f(i|\vec{\nu}_{-f})$.

Further, for $i < N$, it follows directly from the definition that $P(j|i, q, e)$ is strictly decreasing in both q and e in the sense of First-Degree stochastic dominance. Therefore,

$$FP_f(q, e|i, \vec{\nu}_{-f}) = \sum_{j=i}^{N} w_f(j|\vec{\nu}_{-f}) P(j|i, q, e)$$

is strictly decreasing in q, e for every specification of $\vec{\nu}_{-f}$.

□

For future use, we write down the derivative of the funding probability as functions of q, e for any firm f of type $i < N$.

$$\frac{\partial FP_f(q, e|i, \vec{\nu}_{-f})}{\partial q} = \left[w_f(i|\vec{\nu}_{-f}) - \sum_{j=i+1}^{N} \frac{w_f(j|\vec{\nu}_{-f})}{N - i} \right] (1 - e) < 0 \tag{14}$$

$$\frac{\partial FP_f(q, e|i, \vec{\nu}_{-f})}{\partial e} = \left[w_f(i|\vec{\nu}_{-f}) - \sum_{j=i+1}^{N} \frac{w_f(j|\vec{\nu}_{-f})}{N - i} \right] (1 - q) < 0 \tag{15}$$

The right-hand-side of both expressions is strictly negative (for any firm of type $i < N$) because w_f is weakly increasing in j and $w_f(N|\vec{\nu}_{-f}) > w_f(i|\vec{\nu}_{-f})$. Therefore, the average of the negative terms under the summation sign exceeds the first positive term.

We are ready to state and solve the formal maximization problem under the current institutional arrangements and contrast it with the situation that would prevail under FSI.

3.2 The Effect of FSI

In this section, we present the formal maximization problem for firms and analyze the consequences for the strategic choices of q and e. The firm's problem is to maximize payoffs through a suitable choice of fsq. This involves both their own choice of q and implementation of e through suitable incentives offered to the auditor. Recall that the litigation costs for the firm are $K_f(1-q)$ whereas the auditor faces an expected penalty, $K_a(1-q)(1-e)$. Finally, let $C(e)$ denote the cost of providing an audit of quality e. We shall assume that $C(e)$ is convex and increasing in $e \in [0, \overline{e}]$.

We now state the formal maximization program for analyzing the effects of introducing FSI in two separate situations – (i) where e is observable by the principal and (ii) where e is unobservable by the principal. In each setting, we analyze the consequences of (i) making insurance premia observable and (ii) switching the auditor from being an agent of the firm to becoming an agent of the insurance company. We analyze two different situations with regard to the auditor's effort because this choice affects the probability of overstatement. Arguably, the firm is privy to whether overstatements take place, and they are aware of the auditor's correction strategy. In the next section, we shall drop this assumption and analyze the situation where the auditor's corrective actions are assumed to be unobservable and the auditor is an agent functioning under moral hazard in the classical sense.

To maintain a single common framework for analyzing the two different situations where e is or is not observable, we shall also assume that the auditor is risk-averse with a separable utility function of type $U(x) - C(e)$ where x represents wealth and e the level of effort (error control) exerted by the auditor. In addition, to ensure comparability with the FSI arrangement, we will assume that auditors can currently buy liability insurance at break-even rates. The maximization program for a firm f of type i may now be stated as:

Program I

$$\max_{q,e,F} \quad FP_f(q,e|\vec{\nu}_{-f})B - K_f(1-q) - F$$

subject to

$$U(F - K_a(1-q)(1-e)) - C(e) \geq \overline{U} \quad \text{(IR)}$$

$$\nu_i = q_i + e_i - q_i e_i \quad \text{RE}$$

Some observations are in order. Each firm chooses the level of quality, q and audit effort e that maximize its payoff simultaneously with other firms. It does so based on beliefs about other firms' fsq. For simplicity, we assume that firms and investors hold identical beliefs about unobservable fsq choices. We also assume that the auditor is paid a fee, F, only if he conforms with the firm's desired choice of e (a forcing contract). However, when the auditor complies with the firm's desired level of report "inflation," the auditor is compensated for the expected liability cost, $K_a(1-q)(1-e)$. Described differently, the auditor can purchase liability insurance at a "fair" premium equal to the expected cost $K_a(1-q)(1-e)$ and the firm defrays this premium to the auditor. Here, we are following a standard assumption in the insurance literature that the premium charged breaks-even at the actual strategy choices.[13]

Proposition 1 shows that firms that are not of the highest type increase the probability of funding by lowering fsq. When firms are unable to communicate their financial statement quality through a suitable mechanism, high-type firms are unable to separate themselves from low-type firms by signaling their fsq. Then they too follow suit and choose low fsq. Therefore, the equilibrium can end up being similar to the one in the example where only

[13]One way of justifying this is to allow ex-post adjustment of premia and invoke the law of large numbers. By the law of large numbers, insurers suffer a realized loss, when averaged over many identical clients, that is "almost equal" to the expected loss. They adjust the premium ex-post to equate it with the expected loss per client.

low fsq is implemented. We establish this in our first result

Proposition 2 (Equilibrium with uncertainty regarding Quality)

Suppose that the benefits to funding,B, are very large relative to the penalties for overstatement, K_q, K_a. In addition, suppose that the financial statement quality is unobservable and the auditor is an agent of the firm. Then the equilibrium quality levels are for every firm to set $q_i = \underline{q}$ where $\underline{q}$ is the minimum permissible level and implement $e = 0$. Consequently, capital gets to be allocated to low rate-of-return firms with relatively high probability.

Proof:

We first sketch the argument. From Proposition 1, it follows that there are strict benefits to reducing fsq, $q + e - qe$, for any firm with $i < N$ irrespective of the perceived strategy choices of other firms. If these benefits are sufficiently large, every firm of type $i < N$ will implement $q = \underline{q}$ and $e = 0$ (note that the firm of type N always issues report N at any level of quality and is irrelevant to the analysis). Consequently, the only rational beliefs are that every firm sets the lowest level of fsq and this is the optimal response.

More formally, we set up the Lagrangian:

$$\begin{aligned}\mathcal{L}(q, e, F, \lambda) = FP_f(q, e|\vec{\nu}_{-f})B \quad &- \quad K_f(1-q) - F \\ &+ \quad \lambda\left[U(F - K_a(1-q)(1-e)) - C(e) - \overline{U}\right] \end{aligned} \tag{16}$$

where $\lambda \geq 0$. The related first-order conditions are:

$$\begin{aligned}\frac{\partial \mathcal{L}}{\partial q} &= B\frac{\partial FP_f}{\partial q} + K_f + \lambda U'[F - K_a(1-q)(1-e)]K_a(1-e) = 0 \\ \frac{\partial \mathcal{L}}{\partial e} &= B\frac{\partial FP_f}{\partial e} + \lambda\left(U'[F - K_a(1-q)(1-e)]K_a(1-q) - C'(e)\right) = 0 \\ \frac{\partial \mathcal{L}}{\partial F} &= -1 + \lambda U'[F - K_a(1-q)(1-e)] = 0 \end{aligned} \tag{17}$$

Substituting from the last equation into the first equation and dividing the first two equations by B, we obtain:

$$\begin{aligned}\frac{\partial FP_f}{\partial q} &+ \left[\frac{K_f + K_a(1-e)}{B}\right] = 0 \\ \frac{\partial FP_f}{\partial e} &+ \left[\frac{K_a(1-q) - \left[U'(F - K_a(1-q)(1-e))\right]^{-1} C'(e)}{B}\right] = 0 \end{aligned} \tag{18}$$

The first term in each of these equations is strictly negative (from Equations 14 and 15) whatever be the beliefs $\vec{\nu}_{-f}$. The second term is close to 0 (or negative in the second equation) if B is large; thus, the program has the corner solution $q = \underline{q}$ and $e = 0$ for all sufficiently large B.

□

More generally, we note that totally differentiating the first order conditions in B yields:

$$\begin{aligned}\frac{\partial^2 \mathcal{L}}{\partial q^2}\frac{\partial q}{\partial B} &= -\frac{\partial FP_f}{\partial q} \\ \frac{\partial^2 \mathcal{L}}{\partial e^2}\frac{\partial q}{\partial B} &= -\frac{\partial FP_f}{\partial e}\end{aligned} \tag{19}$$

Because the partials on the right-hand-side are both negative, it follows that both q and e decrease in the level of B. In other words, as the benefits to funding increase, the fsq level drops in this setting.

In contrast to the first setting, we now analyze the situation where the auditor works for the insurer. In this setting, the firm again sets the fsq, q_i but the auditor reports q_i back to the insurance company. For simplicity, assume that the auditor reports the true value q_i back to the insurance company. The insurance company sets the premium based on the probability of a financial statement error, $(1 - q_f)(1 - e_f)$. We assume again that the coverage is for all the incurred liability costs (i.e. recoveries to investors under both the current regime and the proposed FSI regime are set to be equal.) The contrasting program with the insurer is outlined next. The main difference is that the insurance premium is revealed to the market. In addition, the insurer implements e through a suitable incentive scheme.

Denote the observed profile of insurance premia by $\vec{\pi}$ where π_f is the premium charged to firm f. For each premium profile $\vec{\pi}$, we have to calculate the funding probabilities (analogous to

2) for every realized profile $\vec{\theta}, \vec{\pi}$. That is, we need a quantification of $FP_f(\theta_f, \pi_f | \vec{\theta}_{-f}, \vec{\pi}_{-f})$. In turn, this funding probability depends on *posterior beliefs over firm types* after observing $\vec{\pi}, \vec{\theta}$. To calculate an equilibrium in this context, we have to first specify beliefs about the premium levels given to each firm-type in equilibrium. Let us denote by $\vec{\sigma}$ the beliefs regarding the premium level given to firm i. Then the maximization program for a firm f of type i is given by:

Program II

$$\max_{q,e,F} \quad FP_f(q, e | i, \vec{\nu}_{-f}, \vec{\sigma})B - \pi_f$$

subject to

$$\pi_f = \min_e K_f(1-q) + F \qquad \text{(BE)}$$

$$U(F - K_a(1-e)(1-q)) - C(e) \geq \overline{U} \qquad \text{(IR)}$$

$$\nu_i = q_i + e_i - q_i e_i; \quad \sigma_i = \pi(q_i, e_i) \qquad \text{(RE)}$$

The two differences are (i) that the premia offered to each firm, $\vec{\pi} = \{\pi_1, \ldots, \pi_N\}$ are observable; and (ii) the level of audit control, e, is chosen to minimize the total cost to the insurer which consists of the expected claim cost and the audit fee. The premium itself is assumed to be the break- even value for the insurer (constraint (BE))– a common assumption in the insurance literature and consistent with the break-even premium used earlier. To maintain comparability with Program I, we also let the expected litigation cost to be deducted from the audit fee.

It is obvious that the optimal level of F will force equality in the (IR) constraint. Therefore, we can set $F = V(C(e) + \overline{U}) + K_a(1-q)(1-e)$ where $V = U^{-1}$. It follows that for each value of q, e, the premium may be rewritten as:

$$\pi_f(q,e) = K_f(1-q) + K_a(1-q)(1-e) + V(C(e) + \overline{U}) \tag{20}$$

For each q, let $e(q)$ denote the level of e that minimizes $\pi_f(e,q)$, that is, $e(q)$ is obtained by solving:

$$\frac{\partial \pi_f}{\partial e} = -K_a(1-q) + V'(C(e) + \overline{U})C'(e) = 0 \tag{21}$$

By differentiating this expression again in q, we find that:

$$\left[V''(C(e) + \overline{U})(C'(e))^2 + V'(C(e) + \overline{U})C''(e)\right] \frac{\partial e^*(q)}{\partial q} + K_a = 0 \tag{22}$$

Because U is concave and increasing, $V = U^{-1}$ is convex and increasing. C is convex by definition. It then follows from Equation 22 that $e(q)$ is strictly decreasing in q. Therefore, there is an invertible relationship between $e(q)$ and q. We use this to establish the following benchmark result.

Lemma 3 (Revelation Through Premium)

The level of the premium reveals the choice of q and the choice of the fsq.

The observed premia are of the type:

$$\pi_f = K_a(1-q)(1-e(q)) + K_f(1-q) + V(C(e(q)) + \overline{U}) \tag{23}$$

From the envelope theorem, it follows that:

$$\frac{d\pi_f}{dq} = \frac{\partial \pi_i}{\partial q} = -K_a(1-e(q)) - K_f < 0 \tag{24}$$

Therefore the premium charged by the insurer is strictly decreasing in the level of quality q. It follows that $\pi(q)$ may be inverted to infer the level of q. In turn, the level of q determines $e(q)$, and therefore, the fsq $q + e + qe$ can be perfectly inferred from the observed $\pi(q)$.

□

Lemma 3 shows that the level of π_f perfectly reveals q_f. Nevertheless, as observed earlier in the example, the situation we model is not a standard signaling game and this perfect revelation does not result in a separating equilibrium. In particular, because there is no exogenous variation in the cost of q across types, we cannot invoke standard theorems in signaling theory. In fact, as illustrated by the example, we argue that pooling equilibria are more natural in our framework.

Before presenting equilibrium arguments, it is worthwhile stating the optimization problem for the firm explicitly. We have already seen that for every choice of q, there is a unique associated value $e(q)$ and $\pi(q)$. The decision problem for a firm f of type i may now be reduced to:

$$\max_q FP_f(q, e(q)|\vec{\sigma}, \vec{\nu}) - \pi(q), \tag{25}$$

where the observed level of π perfectly reveals q.

Suppose now that in equilibrium, some firm type $i < N$ sets $q_i < q_N$, where N is the highest type firm. Then, firm i is never funded in preference to firm N, even when firm type i generates the report N. In contrast, if it sets $q_i = q_N$, firm type i reduces the premium paid and increases its probability of being funded (as in our example). Therefore, a situation where Firm type N chooses the highest quality leads to a pooling equilibrium. In contrast, a situation where type N selects a low level of quality is not tenable since such a firm can always increase payoffs by shifting to a higher quality level that has not been selected by any of the other firm types. This still allows Firm N to distinguish itself but at a lower premium. Therefore, the only equilibrium possible is where all firms pool at the highest level, $\overline{q}$.

We show formally that the under FSI, the equilibrium where every firm picks $\overline{q}$ exists and satisfies the refinement criterion of divinity (Banks and Sobel [1]).

Proposition 3 (Equilibrium with Financial Statement Quality Insurance)

When FSI is made available and premia are disclosed, the equilibrium such that all firms set $q_i = \overline{q}$ *is a rational expectations equilibrium. Therefore, the expected rate of return on the capital invested by society is increased through the provision of FSI.*

Proof:

The equilibrium where all firms choose $q_i = \overline{q}$ is supported by beliefs given by:

(1) $\sigma_i(\overline{q}) = 1/N$ for every $i < 1$;

(2) For $q < \overline{q}$, $\sigma_1(q) = 1$, $\sigma_i(q) = 0$ for every i.

Under this belief structure, the posterior probabilities after observing $\vec{\pi}$ are as follows (contrast with Equation 7): If $\pi_f = \pi(\overline{q})$

$$P(i|\theta_f = j, \vec{\nu}, \vec{\sigma}) \quad = \quad \begin{cases} 0 & \text{f is of type } i > j \\ \frac{\nu_j}{\left[\sum_{i=1}^{j-1}(1-\nu_i)(N-i)^{-1}\right]+\nu_j} & \text{f is of type } i = j \\ \frac{(1-\nu_i)(N-i)^{-1}}{\left[\sum_{i=1}^{j-1}(1-\nu_j)(N-j)^{-1}\right]+\nu_j} & \text{f is of type } i < j \end{cases} \tag{26}$$

If $\pi_f > \pi(\overline{q})$

$$P(i|\theta_f = j, \vec{\nu}, \vec{\sigma}) \begin{cases} 0 & \text{f is of type } i > 1 \\ 1 & \text{f is of type } i = 1 \end{cases} \tag{27}$$

These off-equilibrium beliefs satisfy the "divinity" criterion of Banks and Sobel [1], that is, any beliefs regarding types at $\overline{q}$ that induces any other type to defect to q from $\overline{q}$ makes type 1 strictly better off.

Under the belief system above, any type setting $q < \overline{q}$ when all other firms set $\vec{q}_{-f} = (\overline{q}, \ldots, \overline{q})$ is perceived as type 1 and the funding probability declines in every report profile $\vec{\theta}$. Therefore, $FP_f(q, e|i, \vec{\pi}_{-f}(\overline{q}), \vec{\nu}) \leq FP_f(\overline{q}, e|i, \vec{\pi}_{-f}(\overline{q}), \vec{\nu})$; in addition, $\pi(q) > \pi(\overline{q})$. Therefore, deviating to $q < \overline{q}$ makes every firm type worse off and the equilibrium is for all firms to set $\overline{q}$.

□

The fact that defections from high quality are detected and immediately penalized results in the "flight to quality" documented in Proposition 3. Specifically, high-type firms gain from setting high fsq. However, if low-type firms can muddy investor perceptions through low fsq, high type firms are driven to exaggerate their own outcomes also. This is the economic force underlying Proposition 2. In contrast, in Proposition 3, by staying with high fsq, good firms force others to follow suit or be identified as low types. So low-type firms either have to abandon their quest for capital or accept a much lower probability of being able to mislead investors in equilibrium.

The analysis of this section carries over very easily to the situation where the auditor functions under moral hazard. We demonstrate this through the next two propositions.

3.3 Auditing with Moral Hazard

The primary change in this section is that the auditor chooses e to maximize his own utility. While this results in some changes to the maximization program, the analysis of the optimal fsq is unaffected. However, in order to make this situation meaningful, it is necessary to expand the payment schemes that can be made to the auditor.

In order to keep comparability and to maintain as simple a structure as possible, we introduce a compensation variable τ representing a wealth transfer to the auditor. In the case where the auditor is an agent of the firm, the wealth transfer takes place whenever funding is obtained. This may be viewed as the present value of future fees from a larger company. In contrast, when the Insurer hires the principal, the transfers take place when liability is incurred. In other words, auditors are penalized by the insurer whenever fsq is deemed to be too low by whichever judiciary body that decides the compensation to investors. The formal programs with the transfer included in are discussed in turn.

Program III

$\max_{q,F,\tau} FP_f(q,e|\vec{\nu}_{-f})(B-\tau) - K_f(1-q) - F$

subject to

$FP_f(q,e|\vec{\nu}_{-f})U(F-K_a(1-q)(1-e)+\tau) + (1-FP_f(q,e|\vec{\nu}_{-f}))U(F-K_a(1-q)(1-e)) - C(e) \geq \overline{U}$ (IR)

$\max_e FP_f(q,e|\vec{\nu}_{-f})U(F-K_a(1-e)(1-q)+\tau) + [1-FP_f(q,e|\vec{\nu}_{-f})]U(F-K_a(1-e)(1-q)) - C(e)$ IC

$\nu_i = q_i + e_i - q_i e_i$ RE

Program IV

$\max_q FP_f(q,e|\vec{\nu}_{-f}\vec{\pi})B - \pi_f$

subject to

$\pi_f = \min_{F,\tau} K_f(1-q) + F - \tau$ (BE)

$(1-\gamma)K_a(1-q)(1-e))U(F-K_a(1-q)(1-e) + \gamma K_a(1-q)(1-e)U(F-K_a(1-q)(1-e)-\tau) - C(e) \geq \overline{U}$

$\max_e FP_f(q,e|\vec{\nu}_{-f})U(F-K_a(1-e)(1-q)+\tau) + [1-FP_f(q,e|\vec{\nu}_{-f})]U(F-K_a(1-e)(1-q)) - C(e)$ IC

$\nu_i = q_i + e_i - q_i e_i$ (RE)

In both Programs, the second-best level of effort obtained by solving the (IC) constraint and may be written as $e(q,F,\tau)$. While this function is typically different across the two programs, a symmetric notation is helpful in explaining the solution methods. Let us write $AU(e|q,F,\tau)$ for the auditors expected utility. Then in each program, $e(q,F,\tau)$ solves:

$$\frac{\partial AU}{\partial e} = 0 \tag{28}$$

The Lagrangian for Program III can be set up as before with $e(F,q,\tau)$ replacing e, that is:

$$\mathcal{L}(q,F,\lambda) = FP_f(q,e(q,F,\tau)|\vec{\nu}_{-f})(B-\tau) - K_f(1-q) - F + \lambda\left[AU(e(q,F,\tau)|q,F,\tau) - \overline{U}\right] \tag{29}$$

Again, invoking the envelope theorem if necessary, the first-order conditions are:

$$\begin{aligned}\frac{\partial \mathcal{L}}{\partial q} &= B\frac{\partial FP_f}{\partial q} + K_f + \lambda\frac{\partial AU}{\partial q} = 0\\ \frac{\partial \mathcal{L}}{\partial F} &= -1 + \lambda\frac{\partial AU}{\partial F} = 0\end{aligned}$$

$$\frac{\partial \mathcal{L}}{\partial \tau} = -FP_f + \lambda \frac{\partial AU}{\partial \tau} = 0 \tag{30}$$

The equations are similar to the no moral hazard case and lead to a result that mirrors Proposition 2.

Proposition 4 (Equilibrium without FSI and with Auditor Moral Hazard)

Suppose that the benefits to funding,B, are very large relative to the penalties for overstatement, K_q, K_a. In addition, suppose that the financial statement quality is unobservable and the auditor is an agent of the firm acting under moral hazard. Then the equilibrium quality levels are for every firm to set $q_i = \underline{q}$ where $\underline{q}$ is the minimum permissible level and implement $e = 0$. Consequently, capital gets to be allocated to low rate-of-return firms with relatively high probability.

Proof:

After substituting for λ from the third Equation of (30) into the first and dividing by B, we infer that the corner solution is optimal whenever B is big enough.

$\square$

The analog of Proposition 3 is also straightforward. Here, the proof goes through unchanged implying the following result.

Proposition 5 (Equilibrium with FSI and with Auditor Moral Hazard)

When FSI is made available and premia are disclosed, the equilibrium where all firms set $q_i = \overline{q}$ is a tenable equilibrium. Therefore, the expected rate of return on the capital invested by society is increased through the provision of FSI.

4 Discussion of Results and Implications

The formal analysis is focused on two salient features of the FSI scheme: disclosure of premia and changes in the agency relationship with the auditor. In this section, we discuss the implications of the results and the economic features and institutional arrangements that will have to be put in place to facilitate practical implementation. We discuss the implications of the size of insurance coverage, the likelihood of collusion between the audit firm and the insurance carrier and the possible modifications to GAAP to adapt them to an FSI regime.

4.1 Size of Coverage

The magnitude of potential liability arising from financial statements misrepresentations is one of the key considerations in the FSI scheme. The issue is whether losses stemming from misrepresentations are likely to be too large to be covered by insurance companies. We do not think so. Financial statement misrepresentation losses exist in the current regime and are borne in one way or the other by several players including investors, companies in the form of class action litigation settlements, insurance companies through D&O and malpractice underwriting settlements, and the audit firms and the firms themselves through premium paid on D&O insurance. The effective "premium" companies and auditors now pay is considerably larger that the nominal premium paid for D&O or malpractice insurance. In other words, if losses result from accounting irregularities, someone must be bearing them: either companies themselves through premia and litigation settlements, insurance companies in D&O settlements, the auditors, and or the investors. Our point is that, all things considered, the cost of recoveries through a combination of D&O insurance and settlements currently borne by investors in audit failure cases, would be necessarily lower when the auditor's incentives are aligned with those of investors. Thus the total premia needed to accord investors the same level of recoveries under the current system, including the current D&O premia, audit fees, malpractice premia, and the expected settlements cannot be greater. On the contrary, total losses under FSI are likely to be less because of the incentives of companies to minimize their cost of capital, which will induce them for a given coverage to minimize premia by improving the financial statements quality and hence minimize the loss causing irregularities. This would be reinforced by the better quality audits engendered by the superior auditors' incentives alignment. In other words, even keeping the coverage and the extent to which investors' losses are recouped at no more than it is today we have an improved audit quality, mitigated conflict of interest and more efficient resource allocation.

We should point out that FSI does not guarantee that investors would recoup all of their losses in the event of financial statements misrepresentation. The point is that under the FSI mechanism, shareholders' losses are apt to be less because of the better audit quality and the incentives companies have to improve the quality of their financial statements so as to decrease their cost of capital. Hence, total coverage, even if designed to recoup all losses, would be less than total recoupment without the suggested FSI mechanism.

Were companies to demand (and are granted) large coverages, our FSI model can be readily adapted to handle this situation. Unlike insuring against non-tradable assets such as personal accidents , building fires and the like, insurers can hedge their exposure in underwriting coverage for a securitized assets (equities) by devising suitable straddle strategies to "reinsure" their exposure in capital markets.

Under the FSI proposed mechanism, the insurers, who strictly speaking need not in fact be insurance companies, can purchase options to hedge the risks, or better yet, purchase specialized conditional puts the exercise of which would be triggered by the occurrence of the insured event: misrepresentation or omission. Also note that not all companies (and hence securities) carry the same financial statement risk: some are better than others. Hence, there is a possibility of constructing portfolios that are diversified on the dimension of financial statement risk: the contribution of one security to the aggregate financial statement risk of the portfolio is less then its own financial statement risk.

4.2 Auditor Conservatism

It is tempting to suggest that the FSI scheme might induce an excessive, and harmful, degree of auditor conservatism. This need not be the case. We should point out that class action securities litigations can involve sellers who suffer losses resulting from overly conservative statements as well as the typical purchasers' class. The fact that these were fewer in the past merely reflects the fact that companies' incentives are skewed in the direction of inflating, rather than deflating, earnings. The FSI scheme would tend to balance the incentives and induce less bias and greater accuracy in financial statements. If, for example, FSI induces ultra-conservatism, the incidence of sellers' losses will be expected to increase, prompting a higher insurers' expectation of sellers' claims, in turn inducing them to guide the auditors they hire toward emphasis on greater accuracy. Removing the conflict of interest through the FSI scheme will minimize the potentially adverse effects inflicted by the subjectivity that inheres in accounting decisions. However, as we discuss below, a GAAP reform could reinforce the salutary effects of FSI.

4.3 Collusion between Firm and Insurance Carrier

The model presented in the preceding section is collusion proof. In other words, collusion between the company being audited and the insurance company is not possible under the regime. It may be argued that since the audited firm chooses the FSI carrier out of a list of possible companies, it will be in the interest of the insurance company to offer a premium lower than the competitive rate in order to be selected as the FSI provider. The insurance carrier will have to be compensated for the loss by charging unjustifiably high premium on other policies supplied to the audited company.

Such a carrier faces two potential consequences both of which are adverse: first, the carrier would have to publicize the lower premium as a requirement of the FSI scheme. This would result in a higher price for the stock and higher capitalization which in turn would increase the losses to shareholders upon an event of omission or misrepresentation. Since the losses are an increasing function of the firm's market capitalization, the more inflated the price the larger the price drop in an event of audit failure. The expected coverage cost incurred by the insurance carrier within the limit of the policy would increase offsetting any gains from overcharging on other services. Secondly , since the audit report is publicly observed, the audit firm will have to acquiesce to the collusion between the carrier and company being audited as well for this to work. Thirdly, insurance carriers are subject to a very strict audit by the various regulatory insurance bodies. The observation of too low a premium compared with similar firms would invite regulatory scrutiny and the possible establishment of higher reserves which would impose additional costs on the carrier. Furthermore, it suffices to require public disclosure of all premia (on all insurance lines) paid by the FSI-insured to deter a conspiracy.

4.4 Role of GAAP

The FSI scheme effectively eliminates the conflict of interest that came to light in the aftermath of Enron. But financial statement insurance has other important benefits: the credible signaling of financial statement quality and the consequent improvement of such quality, the decrease in shareholder losses, and the better channeling of savings to socially desirable projects. Although the FSI scheme we propose effectively eliminates the conflict of interest between audited companies and audit firms, this solution can be complemented and reinforced by GAAP reforms, resulting in significant additional indirect benefits.

If implemented, FSI would facilitate an accounting approach based on underlying principles rather than detailed rules akin to UK GAAP. Unlike UK GAAP, the U.S. model encourages corporate officers to view accounting rules as analogous to the Tax Code with detailed specific rules. Traditionally, detailed rules have been championed because they enhance credibility. Uniform application decreases the ambiguity of results and variation in reported numbers. Hence, it enhances comparability and possibly decreases audit costs (by minimizing disputes with clients about accounting choices). Yet detailed rules also decrease the flexibility of management in making accounting choices and thus limit its ability to signal expectations about the prospects of the company that are not shared by the public. If discretion is accorded the manager over which accounting methods to apply in a particular instance, he will, if he wishes to report honestly, employ methods that best reflect the "economic reality" of the company. Restricting his choice by imposing detailed rules limits his ability to convey truthful information if he is so inclined. Along with the flexibility, therefore, incentives should be aligned to elicit truthful information from management. Adopting a "softer" view of GAAP similar to the UK model would allow auditors to report a "true and fair view" of an enterprise rather than attesting to whether or not GAAP rules were followed. But more flexibility to managers can be abused unless incentives of auditors are properly aligned as in FSI. Hence, FSI facilitates the adoption of a principles approach.

The basis for this already exist in the seven Concepts that now constitute the FASB's Conceptual Framework. These Concepts articulate the objectives of financial statements and offer criteria for measurement and reporting that are designed to satisfy the objectives.

5 Conclusion

Several causes have been advanced in the media for precipitating an "accounting" meltdown: irrational exuberance, infectious greed, the stock market bubble, moral turpitude of executives, unethical accountants, non-audit services, and related "ills." We have argued that the inherent conflict of interest in the auditor-client relationship combined with the unobservability of financial statements quality, together, are the likely culprits. Bubbles and exuberance merely magnify the payoffs so that executives are more tempted to "cook the books" and the auditors' conflict of interest is aggravated.

Financial Statement Insurance, as developed in this paper, provides a market- based solution that acts as an effective check on the issuance of overly-biased financial statements. First, by transferring the auditor hiring decision to the insurer, this scheme eliminates the auditors' inherent conflict of interest. Second, the publicization of the insurance coverage and the premium will credibly signal the quality of the insured's financial statements and direct investments towards better projects. 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. This, along with the consequent improvement in audit quality, FSI will result in fewer misrepresentations, and accordingly, in fewer suits and stakeholder losses.

Together with FSI, or even with FSI alone, a financial reporting practice that relies solely on general principles, a Conceptual Framework, will become possible; the need for detailed rules would be obviated improving the flow of accurate and readily interpretable financial information to the market.

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