Managerial Reporting, Overconfidence, and Litigation Risk*

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Abstract

We examine how the threat of legal penalties affects an entrepreneur's reporting behavior when the entrepreneur can misrepresent his privately observed information, the entrepreneur is optimistic about the firm's prospects relative to investors, and investors incorporate the possibility of legal damages when valuing the firm. We find that higher expected legal penalties do not always cause the entrepreneur to be more cautious but might increase misreporting. We highlight how this relation depends crucially on the extent of entrepreneurial overconfidence, legal frictions, the internal control environment, and the precision of the entrepreneur's information.

Keywords: Mandatory Disclosure, Litigation, Overoptimism.

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1 Introduction

A fundamental feature of the accounting landscape is that management must exercise discretion in the reporting of a firm's affairs. Management's subjective beliefs about the firm's prospects affect how it exercises its discretion. Management is often optimistic about its firm's opportunities, and this confidence is typically most pronounced when an entrepreneur seeks capital from investors to exploit a nascent opportunity (e.g., Bankman 1994; Arabsheibani, et al. 2000). In the event of fraudulent material misstatement or omission of information, Rule 10b-5 and Section 10b of the Securities Exchange Act of 1934 and Sections 11 and 12 of the Securities Act of 1933 provide investors with the right to take legal action. These legal remedies are conventionally viewed as deterring firms from reporting fraudulently (e.g., Francis, et al. 1994; Skinner 1994; Kasznik and Lev 1995; Grundfest and Perino 1997; Trueman 1997; Johnson, et al. 2001).

This paper models how the threat of legal penalties affects an entrepreneur's financial reporting behavior when he is more optimistic than investors about the firm's prospects and can misrepresent private information. We find that the connection between the strictness of the legal environment and the entrepreneur's reporting behavior is more subtle than the conventional view suggests. Indeed, we show that an increase in expected legal penalties for misreporting does not necessarily lead to more truthful reporting, but can lead to more misreporting. Assuming investors' beliefs are correctly calibrated, this misreporting leads to overinvestment and a reduction in expected social welfare.

We consider a model with two players: an entrepreneur, who is endowed with an investment project, and a representative investor. The entrepreneur's prior belief about the project's success probability can be higher than the investor's belief; that is, the entrepreneur might be overconfident about the firm's prospects. The entrepreneur does not have any private wealth and therefore seeks to raise capital from investors to finance the project. The model proceeds in four stages: In the first stage, the entrepreneur privately observes a noisy signal about the firm's project, which might be good or bad, and uses this signal to update his beliefs about the project's probability of success. In the second stage, the entrepreneur chooses a level of manipulation effort in an attempt to misrepresent his signal and then issues a report. In the third stage, the investor decides whether to finance the project. When the entrepreneur issues a favorable report, the investor finances the project in return for an equity stake in the firm; on the other hand, when the entrepreneur release an unfavorable report, the project is not financed and the game ends. In the fourth stage, if the project is financed, the outcome is realized and the players' payoffs are determined.

We model the securities laws as imposing legal damages on the entrepreneur when he reports fraudulently and the project is financed but fails. Litigation does not serve a meaningful role when the entrepreneur relies solely on debt financing. In contrast, it has an intricate effect on the entrepreneur's reporting behavior when the entrepreneur relies on a mix of equity and debt financing. In the case of a successful lawsuit, the entrepreneur pays damages out of his share of the firm's net payoffs. Investors anticipate the possibility of these legal damages when determining their equity stake in the firm. Accordingly, the legal remedies under the federal securities laws not only punish an entrepreneur for deviant reporting, which we term the *punishment effect*, but also assuage investors in the event of an unsuccessful outcome, which we term the *insurance effect*.

Coupling the punishment and insurance effects, the paper examines the impact of a change in the legal environment on the entrepreneur's reporting behavior. On one hand, a shift to a stricter legal regime increases the entrepreneur's expected cost of misreporting, reducing incentives for manipulation. On the other hand, heightened expected penalties raise the investor's expected payoff, which lowers the equity stake the investor demands if she finances the project. This reduction in the cost of capital, in turn, makes implementing the project more attractive to the entrepreneur and hence increases his incentive to manipulate negative information in an attempt to obtain financing.

In this light, we emphasize three relations. First, we show that when the entrepreneur is overconfident relative to investors, the insurance effect can dominate the punishment effect. If this is the case, an increase in legal damages does not mitigate but rather accentuates the entrepreneur's incentives to misreport. The broad intuition for this result is that an optimistic entrepreneur, believing the probability of failure is relatively small, is not particularly anxious about the risk of being punished but is strongly motivated by the prospect of receiving a large residual payoff if the project is financed and is successful.

Second, we establish that the effect of heightened legal damages on reporting behavior crucially depends on the way those damages are shared between the investor and the attorney. When the legal environment is characterized by large frictions such that the plaintiff's attorney captures a substantial portion of the damages, the insurance effect is weak, and the link between legal penalties and misreporting is negative, as conventional wisdom suggests. In contrast, when legal frictions are small, the insurance effect is pronounced, and the link between penalties and misreporting can be positive. This argument implies that penalties imposed by the SEC are more effective in discouraging manipulation compared to damages collected by investors because SEC penalties do not compensate investors.

Third, we explore how the effectiveness of the internal control environment, which was substantially altered following implementation of the Sarbanes Oxley Act of 2002, affects the relation between legal damages and entrepreneurial misreporting. We show that raising the penalties for violation of the federal securities laws in a weak internal control environment, ironically, might weaken the quality of a firm's financial reporting.

The accounting literature examining mandatory disclosure behavior is enormous; see Verrecchia (2000) and Beyer, et al. (2010) for comprehensive surveys of this literature. The antecedent literature may be coarsely partitioned on the assumption made about the ability of the firm's management to manipulate the report. Initially the disclosure literature assumed that management could withhold its private information but if management disclosed it, then it had to do so truthfully (e.g., Verrecchia 1983; Dye 1985). Subsequent work relaxed this assumption and modeled management as being able to dissemble: one stream of literature modeled management as suffering a direct cost from lying (e.g., Fischer and Verrecchia 2000; Guttman, et al. 2006) and another characterized management as engaging in cheap-talk and incurring an indirect cost from lying (e.g., Newman and Sansing 1993; Gigler 1994; Stocken 2000). While this antecedent literature attributes the cost of misreporting to various sources, including the presence of reputational, competitive, and legal concerns, Trueman (1997) is the only paper of which we are aware to explore the link between legal damages awarded under Rule 10b-5 and the managerial disclosure of forward-looking information.

Our analysis of the relation between expected legal damages and entrepreneurial misreporting depends on two key ingredients. First, we assume that investors price the firm's stock recognizing that they will receive a part of any damage award. In contrast, in Trueman (1997) investors do not participate in damages. In light of Menon and Williams' (1994) empirical evidence that investors value the right to recover investment losses from auditors when pricing a firm's stock, we view this ingredient as comporting with the institutional environment.[1] Second, players can have differing prior beliefs about the firm's prospects. This assumption, which distinguishes our paper from the extant firm disclosure literature, reflects the observation that entrepreneurs are often overly exuberant about their firms' prospects.[2] In the absence of either of these two ingredients, we show that higher legal penalties will lower managerial manipulation—consistent with the conventional view.

Our paper tackles issues that might guide policy-makers and regulators as they consider the effect of the litigation environment on firms' reporting behavior. Some of the most prominent legal scholars in the United States have impugned almost every aspect of Rule 10b-5 claiming that it fails to deter fraud, fails to compensate investors, and inappropriately calculates damages (Alexander 1996; Spindler 2008). Moreover, this criticism seems to have eroded application of Rule 10b-5 and led to several legal reforms, including key provision in the Private Securities Litigation Reform Act of 1995 (see Spindler 2008 for further details). Our paper highlights that

[1] Dye (1993) models auditors as providing investors with partial insurance in the event of an audit failure.

[2] Van den Steen (2010) offers a survey of the rapidly growing literature that models players as having different prior beliefs. He notes that this assumption is not the same as endowing players with private information that cannot be communicated, an assumption often made in the extant disclosure literature.

the relation between potential legal penalties and firm reporting behavior is subtle and depends crucially on the particular features of the institutional environment such as entrepreneurial optimism, legal frictions, and the strength of the internal control system. Consequently, it suggests care must be exercised when reforming the anti-fraud mechanisms in the federal securities laws.

The paper proceeds as follows: Section 2 outlines the model. Section 3 characterizes features of the unique equilibrium, outlines the social welfare consequence of manipulation, and analyzes how the report varies with the entrepreneur's prior beliefs, legal damages, and efficiency of the internal control system. Section 4 concludes. All proofs are contained in the appendix.

2 Model

Consider a risk-neutral entrepreneur who does not have any private wealth and wishes to raise capital from investors to finance an investment project. The required amount of capital is denoted by $I > 0$. The project, if implemented, either succeeds or fails. In case of success, the project generates future cash flows of X_G, and in case of failure, the project generates future cash flows of X_B, with $X_G > I > X_B > 0$. The entrepreneur's and the investor's prior subjective beliefs about the probability of project success are denoted by α_E and α_I, respectively. An important assumption in our model is that the entrepreneur may be overconfident relative to the investor about the project's prospects; that is, $\alpha_I \leq \alpha_E < 1$. To avoid the uninteresting case in which the reporting of additional information does not affect the investment decision, we assume the investor expects the project to just break even in the absence of additional information, that is, $\alpha_I X_G + (1 - \alpha_I) X_B - I = 0$. The players' beliefs

(α_E, α_I) are common knowledge.

The entrepreneur can raise debt and equity to finance the project. We denote the capital provided by debt holders and equity holders as I_d and I_e, respectively, with $I_e + I_d = I$ and $I_e, I_d \geq 0$. The risk free rate of return is zero. Following Malmendier and Tate (2005), we assume the entrepreneur has an exogenous capacity for debt, R, that is smaller than the going-concern value, that is, $X_B > R$. Given the entrepreneur is risk-neutral and overconfident regarding the value of the project, he prefers debt financing over equity financing. Accordingly, $I_d^* = R$ and $I_e^* = I - I_d^*$.[3]

The assumption that $X_B > I_d^* = R$ implies that providers of debt financing always can recover the principal amount they lent the firm. This condition ensures a meaningful role for litigation: if this condition is not satisfied, then the providers of debt financing would receive X_B in case of failure. As there are then no assets remaining in the firm that the plaintiff can claim, neither the shareholders nor the debtholders would choose to sue the entrepreneur when the firm fails. As a consequence, the role of damages on the entrepreneur's reporting behavior, which is the focus of this study, would be moot. Given $X_B > I_d^*$, it is useful to define $X_G^N = X_G - I_d^*$, $X_B^N = X_B - I_d^*$, and $\Delta = X_G^N - X_B^N$. Since the providers of debt financing are not at risk, we focus on the providers of equity financing and refer to the representative equity investor simply as the investor.

The game has four stages. In stage one, the entrepreneur obtains a noisy signal $S \in \{S_G, S_B\}$. Signal S is informative about the project's prospects (the state $X_\bullet$)

[3] In Leland and Pyle (1977), a risk-averse entrepreneur can signal favorable private information by holding a greater equity stake in the firm (see also Baldenius and Meng, 2010). In our setting, the entrepreneur cannot increase the fraction of the firm's equity he retains because he does not have any private wealth and is fully exploiting the debt financing that is available.

and reflects either good news, $S = S_G$, or bad news, $S = S_B$. The precision or informativeness of the signal is determined by the parameter $p \in (1/2, 1)$. We assume the precision $p = \Pr(S_G|X_G) = \Pr(S_B|X_B)$ is exogenous and common knowledge.

In stage two, the entrepreneur releases a report $R \in \{R_G, R_B\}$. In the absence of manipulation, the entrepreneur reports $R = R_i$ when $S = S_i$, where $i \in \{G, B\}$. However, the entrepreneur can exert effort $m \in [0, 1]$ in an attempt to fraudulently manipulate the report and claim R_i even though $R_i \neq S_i$. The entrepreneur may choose to manipulate in both directions. Given effort m, manipulation is successful (i.e., $R_i \neq S_i$) with probability m and unsuccessful (i.e., $R_i = S_i$) with probability $(1 - m)$. The entrepreneur's direct cost of manipulation is given by $km^2/2$, where $k > 0$. This cost can be interpreted as the cost of manipulating the accounting system, including forging documents, deceiving the auditor, misleading the board of directors, and the like.[4] As the parameter k increases, it becomes more costly for the entrepreneur to successfully manipulate his signal.[5]

In stage three, the investor decides whether to finance the project given the entrepreneur's report R. When the investor finances the project, she provides the required capital I_e in return for an equity stake of $\beta_i \in [0, 1]$ given the entrepreneur has claimed R_i, where $i \in \{G, B\}$. The investor's equity stake is determined assuming the investor is risk-neutral and participates in a competitive capital market, and therefore earns expected profits of zero. We will also refer to β_i as the entrepreneur's cost of capital.

In stage four, the project's outcome is realized. In case of project failure, the

[4] Teoh, Wong, and Rao (1998), Teoh, Welch, and Wong (1998a,b), among others, provide evidence that firms manipulate their financial report around the date of their initial public offerings.

[5] Demski, Frimor, and Sappington (2004) and Dutta and Gigler (2002) employ an equivalent representation of the entrepreneur's manipulative effort.

investor investigates whether the entrepreneur manipulated the report. If this is the case, the entrepreneur faces a positive probability of litigation and the expected legal penalty is $D > 0$. Since the maximum amount of damages the entrepreneur is capable of paying is his share of the firm's net payoff, it follows that $D \leq (1-\beta) X_B^N$. The investor and the plaintiff's attorney share in the damages: the investor's share of the expected damages equals γD and the attorney's contingency fee equals $(1-\gamma) D$, where $\gamma \in [0,1]$. If the entrepreneur did not manipulate the report, then we presume there is no basis for litigation against the entrepreneur; the Private Securities Litigation Reform Act of 1995 and the Securities Litigation Uniform Standards Act of 1998 have heightened the pleading standards for a securities action to be admitted to trial. Thus, in short, the entrepreneur faces litigation risk only in the case in which he manipulates the report and the project is financed but fails.[6]

In the last stage, the players' payoffs are determined. When the investor does not provide financing, the payoffs to both players are zero. In contrast, when the investor provides financing, investment occurs and the payoffs depend on the report and the outcome. Specifically, when the entrepreneur claims R_i and outcome X_j transpires, the entrepreneur's payoff U_E is given by

$$U_E = (1-\beta_i) X_j^N - \Phi D \tag{1}$$

[6] The expected legal penalty D is a convolution of the damages awarded and the probability the court imposes liability on the firm under the securities laws. Since the court's adjudication function (and hence the probability of liability) is specific to each legal action and is currently subject to ongoing legal debate (Alexander 1996, Spindler 2008), we parsimoniously model the result of the convolution as the expected legal penalty D. Further, we choose not to model the attorney's effort when litigating and assume the expected probability of a successful lawsuit is independent of γ.

and the investor's payoff U_I is given by

$$U_I = \beta_i X_j^N + \Phi\gamma D, \tag{2}$$

where $i, j \in \{G, B\}$, and where the indicator variable $\Phi = 1$ if $R_i \neq S_i$ and $j = B$, and $\Phi = 0$ otherwise. Expression (1) implies the entrepreneur only pays damages when he misrepresents his privately observed information *and* the project is unsuccessful. The investor shares the court awarded damages with her attorney and hence receives a net damage reimbursement of γD.

The timing of events and the summary of notation is outlined in Figure 1.

[Figure 1]

A key feature of this model is that the entrepreneur and investors have heterogeneous prior beliefs about the probability that the project will be successful. While it has long been recognized that players might hold differing prior beliefs and that this view is not inconsistent with the assumption that players are rational (e.g., Harsanyi, 1968), there has recently been renewed interest in the effects of heterogeneous priors on player behavior (see Brunnermeier and Parker 2005; Van den Steen 2010). Heterogeneous priors have been shown to rationalize a variety of seemingly irrational behaviors, including overconfidence in choice of actions (Van den Steen 2004), the favorable price movement on the first day of trading following an initial public offering (Morris 1996), the winner's curse arising in private value auction settings (Compte 2002), and speculative bubbles in assets prices (Scheinkman and Xiong 2003).

To motivate why players might openly disagree about the likelihood of success of alternative actions, Van den Steen (2004) succinctly characterizes a "choice-driven overoptimism" mechanism. He supposes players randomly under or over estimate the probability of success of the various opportunities in their opportunity sets and that a player chooses to pursue the opportunity in the set that the player regards as having the greatest probability of success. As a consequence, a player—entrepreneur—is likely to be more optimistic than the other players—investors—about the opportunity the firm is seeking to pursue. He notes that this mechanism is similar to the winner's curse notion in the auction literature in the sense that random variation coupled with a player's systematic choice induces a systematic bias.

The assumption that players have different prior beliefs does not contradict the economic paradigm that players are rational. Rational players are required to use Bayes' rule to update their prior beliefs but are not required to have common prior beliefs. Indeed, Harsanyi (1968, 495-6) pointed out that "so long as each player chooses his subjective probabilities (probability estimates) independently of the other players, no conceivable estimation procedure can ensure consistency among the different players' subjective probabilities," and further, "by the very nature of subjective probabilities, even if two individuals have exactly the same information and are at exactly the same high level of intelligence, they may very well assign different subjective probabilities to the very same events."

3 Equilibrium Analysis

To characterize the equilibrium, consider first the entrepreneur's reporting strategy when he observes the favorable signal, S_G. Given $\alpha_I X_G + (1 - \alpha_I) X_B - I = 0$, the investor believes that the project's expected net present value is non-negative when a favorable signal is reported, $R = R_G$, even though she is aware that the report might be manipulated. Thus, upon observing a favorable report, the investor is willing to finance the project. Because the investor will not finance the project if an unfavorable report is issued, which we shall establish in a moment, it follows that the entrepreneur will always truthfully report if he observes a favorable signal; that is, if $S = S_G$, then $R = R_G$.

Consider the entrepreneur's reporting strategy when he observes the unfavorable signal, S_B. If the entrepreneur issues an unfavorable report, R_B, then the investor will not finance the project and the game ends. The investor is unwilling to finance the project because she believes, conditional on a negative report, that the project has a negative expected payoff; moreover, even if the investor offers financing, she cannot recover any damages in case of failure when the entrepreneur truthfully reports an unfavorable signal. Given the investor's response to an unfavorable signal, the entrepreneur can pursue the investment opportunity only if he manipulates the signal and releases a favorable report.

When the entrepreneur contemplates misreporting unfavorable information, he faces the following trade-off. On one hand, misreporting bad news is beneficial because it is the entrepreneur's only chance to obtain financing for the project. On the other hand, manipulating information is costly to the entrepreneur because it involves a direct cost $km^2/2$ and yields the possibility of a lawsuit if the project fails. Faced with this calculus, after observing an unfavorable signal, the entrepreneur chooses a level of manipulation effort, m, that solves

$$\max_m m\left[(1-\beta_G(\widehat{m}))\left(X_B^N + \Delta \Pr(X_G|S_B)\right) - D\Pr(X_B|S_B)\right] - km^2/2, \tag{3}$$

where $\widehat{m}$ is the investor's conjectured level of manipulation, $\beta_G(\widehat{m})$ is the equity share the investor demands upon observing a favorable report,

$$\Pr(X_G|S_B) = \frac{(1-p)\alpha_E}{(1-p)\alpha_E + (1-\alpha_E)p},$$

and

$$\Pr\left(X_B|S_B\right) = \frac{(1-\alpha_E)p}{(1-p)\alpha_E + (1-\alpha_E)p}.$$

The first-order condition for an optimal level of m is given by

$$(1-\beta_G(\widehat{m}))\left(X_B^N + \Delta \Pr\left(X_G|S_B\right)\right) - D\Pr\left(X_B|S_B\right) - km = 0. \tag{4}$$

We now step back and determine the stake in the firm the investor requires to inject capital I_e. In a competitive market, the investor's expected return in case of a favorable report R_G equals the investment I_e in the firm; that is,

$$\beta_G(\widehat{m})\left(X_B^N + \Delta \Pr\left(X_G|R_G\right)\right) + \gamma D \Pr(X_B, S_B|R_G) = I_e, \tag{5}$$

where

$$\Pr\left(X_G|R_G\right) = \frac{\left(p + \widehat{m}\left(1-p\right)\right)\alpha_I}{\left(p + \widehat{m}\left(1-p\right)\right)\alpha_I + \left(1-p+\widehat{m}p\right)\left(1-\alpha_I\right)}$$

and

$$\Pr(X_B, S_B|R_G) = \frac{\widehat{m}p(1-\alpha_I)}{\alpha_I p + (1-\alpha_I)(1-p) + \widehat{m}\left(\alpha_I(1-p) + (1-\alpha_I)p\right)}.$$

Substituting $\Pr\left(X_G|R_G\right)$ and $\Pr(X_B, S_B|R_G)$ into (5) and solving for $\beta_G(\widehat{m})$ yields

$$\beta_G(\widehat{m}) = \frac{I_e\left(p\alpha_I + \left(1-p\right)\left(1-\alpha_I\left(1-\widehat{m}\right)\right)\right) + \widehat{m}p(1-\alpha_I)\left(I_e - \gamma D\right)}{X_B^N\left(1-p+\widehat{m}p\right)\left(1-\alpha_I\right) + X_G^N\left(p+\widehat{m}\left(1-p\right)\right)\alpha_I}. \tag{6}$$

Before characterizing the equilibrium choice of manipulative effort, it is helpful to explore how the firm's cost of capital $\beta_G(\widehat{m})$ varies with changes in the environmental parameters when the level of $\widehat{m}$ is kept constant. The following lemma, which highlights two relations used extensively in the paper, establishes that the cost of capital decreases in the expected damage award D and the portion of the damage award that the investor retains γ.

Lemma 1 *$\partial\beta_G(\widehat{m})/\partial D < 0$ and $\partial\beta_G(\widehat{m})/\partial\gamma < 0$.*

In equilibrium, the conjectured level of manipulation equals the entrepreneur's optimal choice of manipulation, $m^* = \widehat{m}$. The equilibrium level of manipulation, m^*, is obtained by substituting $\beta_G(m^*)$ given in (6) into (4), which yields the equilibrium condition

$$\begin{aligned} & m^* k\left((1-p)\alpha_E + (1-\alpha_E)p\right) \\ = \; & (1-\beta_G(m^*))\left((1-p)\alpha_E X_G^N + (1-\alpha_E)pX_B^N\right) - D(1-\alpha_E)p. \end{aligned} \tag{7}$$

It remains to specify conditions that ensure the equilibrium effort choice m^* is properly specified. To ensure an interior solution with $m^* < 1$, the marginal cost of manipulation cannot be too small; thus, we assume in what follows that $k > \bar{k}$, where

$$\bar{k} \equiv \frac{\left(1 - \frac{I_e - \gamma D p(1-\alpha_I)}{X_B^N + \Delta\alpha_I}\right)\left(X_G^N(1-p)\alpha_E + X_B^N(1-\alpha_E)p\right) - D(1-\alpha_E)p}{(1-p)\alpha_E + (1-\alpha_E)p}. \tag{8}$$

Further, to ensure a unique level of manipulation effort, we assume the investor demands a larger stake in the firm, $\beta_G(m^*)$, as the equilibrium level of manipulation increases. The relation $\partial\beta_G(m^*)/\partial m^* > 0$ is satisfied when the damages the investor obtains are not too large relative to the size of the investment in the firm; that is, if

$$\gamma D < \frac{\alpha_I \Delta\left(2p-1\right) I_e}{p\left[X_G^N \alpha_I p + X_B^N\left(1-\alpha_I\right)\left(1-p\right)\right]}. \tag{9}$$

Assumption (9) implies that an increase in the equilibrium level of manipulation has an adverse effect on the entrepreneur's cost of capital. This assumption also ensures that the expected damages the investor obtains in the case of a successful lawsuit cannot exceed her initial investment, $\gamma D < I_e$. The equilibrium can now be described as follows:

Proposition 1 *In equilibrium, the entrepreneur reports truthfully when $S = S_G$ and chooses a unique level of manipulation effort $m^* \in (0, 1)$ when $S = S_B$. The investor provides capital I_e in exchange for the equity stake $\beta_G(m^*) \in (0, 1)$ when $R = R_G$ and does not finance the project when $R = R_B$.*

In the following analysis, we first consider how the entrepreneur's manipulation of the report affects social welfare. We then show how the entrepreneur's manipulation choice varies with the level of overconfidence, expected legal damages, and efficiency of the internal control system.

3.1 Social Welfare

To tackle the welfare consequences of entrepreneurial manipulation, we need to specify the objective prior probability of project success. Since entrepreneurs are often regarded as being overly exuberant about their firm's prospects (e.g., Bankman 1994; Arabsheibani, et al. 2000), we view investors as being correctly calibrated. Accordingly, the objective probability of success of the project is regarded as being α_I. When the entrepreneur always communicates truthfully, the investment decision is efficient: the project is not financed when the entrepreneur observes and reports unfavorable information and is financed otherwise. However, when the entrepreneur can manipulate, the misreporting of an unfavorable signal leads to overinvestment in the project. Therefore, from a social welfare perspective, manipulation is unambiguously undesirable. Changes in the firm's environment that reduce the extent of entrepreneurial manipulation enhance the efficiency of the investment decision and thereby increase expected social welfare.

3.2 Effect of Change in Prior Beliefs

The observation that the willingness of entrepreneurs to report in a biased fashion is increasing in their exuberance about their firms' prospects is formalized in the next proposition.

Proposition 2 *The equilibrium level of manipulation, m^*, is increasing in the entrepreneur's prior probability of success, α_E.*

To develop intuition for how a change in the entrepreneur's prior probability, α_E, affects his trade-off between the benefits and costs of misreporting, suppose the entrepreneur has observed an unfavorable signal. After observing this signal, the entrepreneur revises the probability of success to $\Pr(X_G|S_B) = (1-p)\alpha_E / ((1-p)\alpha_E + (1-\alpha_E)p)$. The entrepreneur is more confident that the project will succeed even after learning negative news for larger values of α_E; that is, $\Pr(X_G|S_B)$ is increasing in α_E. Because the entrepreneur generates a positive payoff only when the project is implemented and succeeds, the entrepreneur's expected benefit associated with misreporting increases when α_E increases. In addition, when α_E increases, the entrepreneur views project failure and hence litigation as less likely, which lowers the entrepreneur's expected cost of misreporting. Accordingly, entrepreneurs that are more exuberant are more inclined to manipulate the report.

3.3 Effect of Change in Legal Damages

To discourage firms from offering misleading reports, the anti-fraud provisions of Section 11 and Section 12 of the Securities Act of 1933, Section 10(b) of the Securities Exchange Act of 1934 and the SEC promulgated Rule 10b-5 state, among other things, that it is unlawful to knowingly make an untrue statement or omit a material fact. Section 11 and 12 of the Securities Act applies to a firm's registration statement required when issuing shares. Rule 10b-5 applies to both primary and secondary market transactions. Since the expected legal damages vary from case to case and depend on the requirements relating to pleading, discovery, class representation, liability, and awards, we use the parameter D to summarize the expected penalties when the entrepreneur misreports and the project fails.[7]

In this section, we analyze the effect of a change in the legal environment—specifically a change in D—on the entrepreneur's incentive to misrepresent his privately observed information. The entrepreneur's motivation to misreport is driven by two counteracting forces: On one hand, if the expected damages D increase, misreporting becomes more costly to the entrepreneur, which reduces his willingness to manipulate. We call this the *punishment effect*. On the other hand, because the investor recovers a fraction of the damages, γD, the investor is prepared to provide the required capital in exchange for a lower equity stake, β_G, when expected damages increase. A lower cost of capital, β_G, in turn, makes implementing the project more attractive to the entrepreneur. Given that the project is only financed when a favorable report is released, the entrepreneur has a stronger incentive to manipulate negative information in an attempt to exploit the lower cost of capital. We call this the *insurance effect*.

With the punishment and insurance effects in mind, we turn to explore the effect of

[7] As an example of how damages might vary, the measure of damages under Section 11 or Rule 10b-5 allow plaintiffs to recover the difference between the price paid and the price when the suit was filed less any amount that the defendant proves was not attributable to the fraud. Section 12 permits rescissory damages, which equal the amount necessary to place the plaintiff back in the original position at the time of the transaction. This measure implicitly assumes that the plaintiff would not have traded were it not for the defendant's fraud.

introducing heterogeneous beliefs and litigation frictions on entrepreneurial reporting behavior. When the entrepreneur is more optimistic than the investor about the project's probability of success, that is $\alpha_E > \alpha_I$, the insurance effect can dominate the punishment effect. In this circumstance, an increase in expected penalties D leads to more and not less misreporting.

To develop intuition for this relation, suppose the entrepreneur has observed an unfavorable signal and consider the effects of a change in D on the entrepreneur's trade-off between the benefits and costs of misreporting. For high values of α_E, the entrepreneur views the conditional probability of project failure as being relatively small. Accordingly, the entrepreneur is not that troubled by the threat of potential damages. Thus, the punishment effect associated with an increase in D is relatively weak. On the other hand, because the investor views the probability of failure as being more likely to occur than the entrepreneur, the investor expects a damage award to be more likely. In anticipation of a larger expected damage award, the investor demands a lower equity stake β_G, which, in turn, increases the residual the entrepreneur obtains if the project is successful, $(1-\beta_G)X_G^N$. The prospect of a high residual in case of success is especially attractive to an entrepreneur who is confident that the project will be successful, leading to stronger incentives to manipulate negative information in an attempt to obtain financing. Thus, the insurance effect associated with an increase in D is stronger for more optimistic entrepreneurs. As a result, for sufficiently high values of α_E, the insurance effect dominates the punishment effect, and the relation between expected damages and misreporting is positive. This discussion is formalized in the next proposition.

Proposition 3 *Suppose $\gamma > 0$. There exists a threshold $\alpha_E^T(k, \gamma) \in (\alpha_I, 1)$ such that:*

i) for $\alpha_E < \alpha_E^T(k, \gamma)$, an increase in expected damages D leads to a lower *level of* *manipulation, i.e., $dm^*/dD < 0$.*

ii) for $\alpha_E > \alpha_E^T(k,\gamma)$, an increase in expected damages D leads to a higher *level of manipulation, i.e., $dm^*/dD > 0$.*

While we emphasize circumstances in which the entrepreneur is more optimistic than the investor, it is worthwhile noting that when the players have homogeneous beliefs about the project's probability of success, $\alpha_E = \alpha_I$, an increases in expected damages always reduces the level of manipulation. This relation is consistent with the conventional view.

The next proposition offers insights into how legal frictions affect the relation between a firm's reporting behavior and changes in legal damages. Frictions arise because lawyers retain a nontrivial share of any damage payments between the firm and the plaintiff (Grundfest 2007; Spindler 2008). When legal frictions are low, that is γ is high, the investor recovers a large portion of the damage award, strengthening the insurance effect. Thus, an increase in expected damages, D, is more likely to lead to a higher level of misreporting when litigation frictions are low than when they are high. This result highlights that it is not only the presence of damages but, importantly, how the investor and the plaintiff's attorney share the damage award that affects the firm's reporting behavior.

Proposition 4 *Suppose $\alpha_E > \alpha_E^T(k,1)$. There exists a threshold $\gamma^T \in (0,1)$ such that:*

i) for $\gamma < \gamma^T$, an increase in expected damages D leads to a lower *level of manipulation, i.e., $dm^*/dD < 0$.*

ii) for $\gamma > \gamma^T$, an increase in expected damages D leads to a higher *level of manipulation, i.e., $dm^*/dD > 0$.*

To illustrate the above analysis, consider the following example in which heightened legal penalties induce more misreporting. Suppose that $X_G^N = 20$, $X_B^N = 5$, the precision of the accounting information system is given by $p = 2/3$, and the internal control parameter is $k = 1$. The investor believes that $\alpha_I = 1/2$, whereas the entrepreneur is more sanguine about the firm's prospects and believes $\alpha_E = 9/10$. Legal frictions are fairly low and assumed to be $\gamma = 9/10$. Within this context, we consider two scenarios, both satisfying the constraint that the entrepreneur must be able to settle the damage award out of his share of the firm, i.e., $D \leq (1 - \beta_G(m^*)) X_B^N$. When $D = 1/10$, the investor's equity stake in the firm is given by $\beta_G^* = 0.960$ and the level of manipulation equals $m^* = 0.670$. Alternatively, when the damage award is increased to $D = 2/10$, the investor's equity stake falls to $\beta_G^* = 0.959$ and the level of entrepreneurial manipulation increases to $m^* = 0.674$. Thus, this example highlights that in an environment in which investors recognize the possibility of a damages award for misreporting when valuing the firm, entrepreneurs are more optimistic than the investor about the firm's prospects, and attorney's fees are fairly low, the heightened threat of legal penalties does not necessarily reduce the extent of managerial misreporting and, in fact, can exacerbate it.

Proposition 4 suggests that for an increase in legal penalties to effectively discipline an entrepreneur's reporting behavior in an environment in which the entrepreneur is optimistic relative to investors, legal frictions should be severe. Thus, alternative punishment mechanisms other than the liability mechanism under the federal securities laws might be more appropriate. Consistent with this observation, some legal scholars have argued that a schedule of SEC administered fines more efficiently deters fraudulent reporting behavior than private class actions (Alexander 1996). Indeed, in response to the wave of financial reporting fraud, the Sarbanes Oxley Act was enacted, in part, to create more severe civil and criminal penalties for violation of the securities laws and to allow the SEC to collect penalties from firms that defraud shareholders (see Rezaee 2007).

The effects of greater SEC involvement through its administration of a schedule of penalties can be analyzed within the context of our model by considering the effects of a change in γ while holding the total expected damages D constant. The larger the portion of damages that the SEC collects in the form of penalties, the lower is the portion γ of damages investors receive. The effect of a change in γ is captured in the following proposition.

Proposition 5 *For any level of expected damages D, reducing the portion of damages investors retain, γ, leads to a lower level of manipulation, m^*.*

This finding supports the argument that the compensatory function that transfers damages to investors should be altered to have the SEC play a prominent role in collecting penalties from deviant firms. The intuition underlying this proposition stems from the trade-off between the punishment effect and the insurance effect. When the expected damages D the firm bears for misreporting are fixed, the punishment effect is constant. By reducing the share of the damages γ the investors retain, the insurance effect is weakened and the investor demands a larger interest in the firm. This increase in the cost of capital, in turn, makes implementing the project less attractive to the entrepreneur and hence reduces his incentive to manipulate unfavorable information.

In summary, we observe that increases in expected legal penalties can heighten or suppress entrepreneurs' incentives to misreport. This relation has not been empirically tested. However, several related empirical studies document that stricter legal environments (or the perception thereof) are associated with less frequent voluntary disclosure (e.g., Johnson, et al. 2001; Baginski, et al. 2002; Rogers and Van Buskirk 2009). Our work highlights that an empirical examination of the association between changes in the legal environment and the quality of financial disclosure should partition the sample of firms based on management optimism and litigation frictions.[8] Failure to partition the sample along these dimensions mingles the effect of changes in the litigation regime on reporting behavior and thereby reduces the power of the empirical tests.

3.4 Role of Internal Controls

The Sarbanes Oxley Act of 2002 was drafted to provide corporate governance guidelines, improve the quality of financial reporting, and raise the effectiveness of the audit function (Rezaee 2007). Perhaps one of the most important features of this Act is the requirement in Section 404 that firm management assess the effectiveness of the firm's internal control procedures for financial reporting and publicly report any material weaknesses.

To reflect the role of the internal control system, we assume the entrepreneur incurs a direct cost $km^2/2$ when manipulating the report. This cost can be interpreted as the entrepreneur's cost of overriding the firm's internal control system and deceiving the board of directors or auditors. The higher the marginal cost, k, the more difficult it is to distort information, implying the internal control or governance system is of higher quality.

Intuitively, one might expect that stricter legal penalties become more important in disciplining the entrepreneur when the internal control system is weak. However,

[8] See Malmendier and Tate (2005) for an empirical measure of overconfidence.

as we show in the next proposition, this is not necessarily the case. Suppose the entrepreneur is more optimistic than the investor about the project's success, that is $\alpha_E > \alpha_I$, and the investor receives a relatively large share of the damage award, that is γ is high. Then an increase in expected legal damages D is counterproductive and leads to even more misreporting exactly when the internal control system is not effective at preventing the entrepreneur from manipulating information, that is k is small. Alternatively, if the internal control system is relatively effective, that is, k is large, then an increase in expected legal damages induces a further reduction in misreporting.

Proposition 6 *Suppose that $\alpha_E > \alpha_E^T(\bar{k}, \gamma)$. There exists a threshold $k^T \in (\bar{k}, \infty)$ such that:*

i) for $k < k^T$, an increase in expected damages D induces a higher level of manipulation, i.e., $dm^*/dD > 0$.

ii) for $k > k^T$, an increase in expected damages D induces a lower level of manipulation, i.e., $dm^*/dD < 0$.

To provide the intuition underlying Proposition 6, suppose the internal control system is ineffective. In this case, it is relatively easy for the entrepreneur to manipulate the report. Consequently, after observing a favorable report, the investor believes that the report is likely to have been manipulated. She therefore expects that the probability of a successful lawsuit is relatively high in the event of project failure. Accordingly, an increase in the magnitude of damages D has a strong effect on the investor's expected payoff and the firm's cost of capital β_G. The entrepreneur responds to an increase in expected damages by increasing the level of manipulation in an attempt to obtain financing and exploit the lower cost of capital. Conversely, if the internal control system is effective, then it is costly for the entrepreneur to manipulate the report. Given that reports are likely to be truthful, an increase in potential damages D has a small effect on the investor's expected payoff and hence the firm's cost of capital—the insurance effect is weak. In this case, the punishment effect dominates the insurance effect, and the entrepreneur's incentive to manipulate declines as the potential damages D increase.

4 Conclusion

The effect of the legal environment on firms' reporting behavior has received considerable attention (e.g., Francis, et al. 1994; Skinner 1994, 1997; Trueman 1997; Johnson, et al. 2001; Baginski, et al. 2002; Rogers and Van Buskirk 2009). The broadly held (although not ubiquitous) view in the extant literature is that a heightened threat of legal penalties deters firms from reporting fraudulently. By incorporating important descriptive features of the institutional environment—namely, entrepreneurial optimism, legal frictions, and investor damage awards—into a model of managerial reporting, we offer a nuanced characterization of the effect of legal penalties on firm reporting behavior.

Recognizing that legal penalties under the current securities laws not only *punish* firms for deviant reporting but also *insure* investors in the event of an unsuccessful outcome, we show that an increased threat of litigation does not always reduce and, in fact, might exacerbate the level of misreporting. Specifically, we establish that an increase in expected legal damages is associated with an increase in the frequency of misreporting when: the entrepreneur is exuberant relative to investors about the firm's prospects; litigation frictions are relatively low; and, the internal control system is relatively weak.

Some of the most prominent securities scholars in the United States have criticized the anti-fraud enforcement mechanisms under Rule 10b-5. This criticism seems to have precipitated several legal reforms, including provisions in the Private Securities Litigation Reform Act of 1995 and the Sarbanes-Oxley Act of 2002. In light of the subtle relation between legal penalties and managerial fraudulent reporting, we highlight issues policy-makers and regulators might consider as they further reform the litigation environment. We also formalize some novel predictions about firm reporting behavior that await empirical testing.

Appendix

This Appendix contains the proofs of the formal claims in the paper.

Proof of Lemma 1:

Using (6), and keeping $\widehat{m}$ fixed, it follows that:

$$\frac{\partial \beta_G(\widehat{m})}{\partial D} = \frac{-\widehat{m}p(1-\alpha_I)\gamma}{\left(X_B^N(1-\alpha_I)\left(1-\left(1-\widehat{m}\right)p\right)+X_G^N\alpha_I\left(p+\widehat{m}\left(1-p\right)\right)\right)} < 0,$$

and

$$\frac{\partial \beta_G(\widehat{m})}{\partial \gamma} = \frac{-\widehat{m}p(1-\alpha_I)D}{\left(X_B^N(1-\alpha_I)\left(1-\left(1-\widehat{m}\right)p\right)+X_G^N\alpha_I\left(p+\widehat{m}\left(1-p\right)\right)\right)} < 0. \blacksquare$$

Proof of Proposition 1:

In equilibrium, the conjectured level of manipulation equals the entrepreneur's optimal choice of manipulation, $m^* = \widehat{m}$. The equilibrium level of manipulation, m^*, is obtained by substituting $\beta_G(m^*)$ given in (6) into (4), which obtains the equilibrium condition given in (7). The assumption $\alpha_I X_G + (1-\alpha_I)X_B - I = 0$ (which implies that $X_B^N + \alpha_I \Delta - I_e = 0$) together with condition

$$\gamma D < \alpha_I \Delta \left(2p-1\right) I_e / \left(p\left(\alpha_I p X_G^N + X_B^N\left(1-\alpha_I\right)\left(1-p\right)\right)\right)$$

in (9) ensures $\beta_G(\bullet) \in (0,1)$.

Observe the following: First, for $m = 0$ and

$$D < \left(1-\beta_G(0)\right)\frac{\left(X_G^N(1-p)\alpha_E + X_B^N(1-\alpha_E)p\right)}{(1-\alpha_E)p}, \tag{10}$$

the left-hand side of (7) is less than the right-hand side. Inequality (10) is always satisfied due to the constraint $D \leq \left(1-\beta_G(m^*)\right)X_B^N$. To see this observe that $\left((1-p)\alpha_E + (1-\alpha_E)p\right)/\left((1-\alpha_E)p\right) > 1$ and recall that $d\beta_G(m^*)/dm > 0$ due to assumption (9). Second, when $m = 1$ and $k > \bar{k}$, where $\bar{k}$ is specified in (8), the left-hand side of (7) is greater than the right-hand side.

Third, observe that the left-hand side of (7) is increasing in m whereas, given condition (9), the right-hand side is decreasing in m. It therefore follows from the intermediate value theorem that there exists a unique interior equilibrium.■

Proof of Proposition 2:

Let $z \equiv (1-p)\alpha_E + (1-\alpha_E)p$. Applying the implicit function theorem to the equilibrium condition

$$\begin{aligned} \psi \;\equiv\; & m^* k\left((1-p)\alpha_E + (1-\alpha_E)p\right) \\ & -(1-\beta_G(m^*))\left(X_G^N(1-p)\alpha_E + X_B^N(1-\alpha_E)p\right) + D(1-\alpha_E)p = 0, \end{aligned} \tag{11}$$

(which follows from (7)) yields

$$\begin{aligned} \frac{dm^*}{d\alpha_E} &= -\frac{\partial\psi/\partial\alpha_E}{\partial\psi/\partial m^*} \\ &= \frac{m^*k\,(2p-1) + (1-\beta_G(m^*))\left(\Delta(1-p) - X_B^N\,(2p-1)\right) + Dp}{kz + \frac{\partial\beta_G(m^*)}{\partial m}\left(\Delta(1-p)\alpha_E + X_B^N z\right)}. \end{aligned} \tag{12}$$

Substituting

$$m^*k = \left(\frac{(1-\beta_G(m^*))\,(1-p)\alpha_E\Delta - D\times(1-\alpha_E)p}{((1-p)\alpha_E + (1-\alpha_E)p)} + (1-\beta_G(m^*))\,X_B^N\right)$$

from condition (7) into the numerator in (12) and rearranging yields:

$$\frac{dm^*}{d\alpha_E} = \frac{(1-p)p\left((1-\beta_G(m^*))\,\Delta + D\right)}{kz^2 + z\frac{\partial\beta_G(m^*)}{\partial m}\left(X_G^N(1-p)\alpha_E + X_B^N(1-\alpha_E)p\right)}, \tag{13}$$

which is positive because assumption (9) implies $\partial\beta_G(m^*)/\partial m > 0$.■

Proof of Proposition 3:

Recall $z \equiv (1-p)\alpha_E + (1-\alpha_E)p$. Applying the implicit function theorem to the equilibrium condition (11) yields

$$\begin{aligned} \frac{dm^*}{dD} &= -\frac{\partial\psi/\partial D}{\partial\psi/\partial m^*} \\ &= \frac{-\frac{\partial\beta_G(m^*)}{\partial D}\left(\Delta(1-p)\alpha_E + X_B^N\times z\right) - (1-\alpha_E)p}{kz + \frac{\partial\beta_G(m^*)}{\partial m^*}\left(\Delta(1-p)\alpha_E + X_B^N z\right)} \end{aligned} \tag{14}$$

with

$$\frac{\partial \beta_G(m^*)}{\partial D} = \frac{-m^* p(1-\alpha_I)\gamma}{X_B^N\left((1-p)+m^* p\right)(1-\alpha_I) + X_G^N\left(p+m^*\left(1-p\right)\right)\alpha_I} < 0.$$

As the denominator in (14) is always positive (because assumption (9) implies $\partial\beta_G(m^*)/\partial m^* > 0$), it follows that

$$\frac{dm^*}{dD} \propto \Pi \equiv -\frac{\partial \beta_G(m^*)}{\partial D}\left(\Delta(1-p)\alpha_E + X_B^N \times z\right) - (1-\alpha_E)p, \tag{15}$$

where $\propto$ indicates that the two expressions are proportional to each other, i.e., they have the same sign.

Using (15) yields

$$\frac{d\Pi}{d\alpha_E} = \frac{\partial \Pi}{\partial \alpha_E} + \frac{\partial \Pi}{\partial m^*}\frac{dm^*}{d\alpha_E} > 0,$$

where we use the fact that $dm^*/d\alpha_E > 0$ (see (13)) and

$$\begin{aligned}
\frac{\partial \Pi}{\partial \alpha_E} &= p\frac{m^*(1-\alpha_I)\gamma(1-p)X_G^N + (1-\alpha_I)X_B^N\left((1-p)+m^* p\left(1-\gamma\right)\right) + w}{X_B^N\left((1-p)+m^* p\right)(1-\alpha_I) + w} > 0,\\
\frac{d\Pi}{dm^*} &= -\frac{\partial^2 \beta_G(m^*)}{\partial D \partial m^*}\left(\Delta(1-p)\alpha_E + X_B^N \times z\right) > 0,
\end{aligned}$$

with $w \equiv X_G^N \alpha_I\left(p + m^*\left(1-p\right)\right)$ and

$$\frac{\partial^2 \beta_G(m^*)}{\partial D \partial m^*} = -\frac{p\left(1-\alpha_I\right)\gamma\left(X_B^N \alpha_I\left(2p-1\right) + X_B^N\left(1-p\right) + \Delta\alpha_I p\right)}{\left(X_B^N\left(1-\alpha_I\right)\left(1-\left(1-m^*\right)p\right) + X_G^N\alpha_I\left(p+m^*\left(1-p\right)\right)\right)^2} < 0. \tag{16}$$

Further, for $\alpha_E = 1$, observe that

$$\Pi = -\frac{\partial \beta_G(m^*)}{\partial D}(1-p)X_G^N > 0,$$

and for $\alpha_E = \alpha_I$, observe that $\Pi < 0$. It follows from the intermediate value theorem that there exists a threshold $\alpha_E^T \in (\alpha_I, 1)$, such that $\Pi > 0$ if and only if $\alpha_E > \alpha_E^T(k,\gamma)$, where

$$\alpha_E^T(k,\gamma) \equiv \frac{A}{A + m^*(k,\gamma)\gamma\left(1-\alpha_I\right)\left(1-p\right)\left(X_B^N + \Delta\right)} \tag{17}$$

with

$$\begin{aligned} A &\equiv X_B^N\left(1-\alpha_I\right)\left((1-p)+m^*(k,\gamma)p\left(1-\gamma\right)\right) \\ &\quad+\left(X_B^N+\Delta\right)\alpha_I\left(p+m^*(k,\gamma)\left(1-p\right)\right). \blacksquare \end{aligned}$$

Proof of Proposition 4:

Recall $z \equiv (1-p)\alpha_E + (1-\alpha_E)p$. Using (15), it follows that

$$\frac{d\Pi}{d\gamma} = \frac{\partial \Pi}{\partial \gamma} + \frac{\partial \Pi}{\partial m^*}\frac{dm^*}{d\gamma} > 0,$$

where we use the fact that

$$\begin{aligned} \frac{\partial \Pi}{\partial \gamma} &= -\frac{\partial^2 \beta_G(m^*)}{\partial D \partial \gamma}\left(\Delta(1-p)\alpha_E + X_B^N z\right) > 0, \\ \frac{d\Pi}{dm^*} &= -\frac{\partial^2 \beta_G(m^*)}{\partial D \partial m^*}\left(\Delta(1-p)\alpha_E + X_B^N z\right) > 0, \\ \frac{\partial m^*}{\partial \gamma} &= -\frac{\partial \psi/\partial \gamma}{\partial \psi/\partial m^*} = -\frac{\frac{\partial \beta_G(m^*)}{\partial \gamma}\left(\Delta(1-p)\alpha_E + X_B^N z\right)}{kz + \frac{\partial \beta_G(m^*)}{\partial m}\left(\Delta(1-p)\alpha_E + X_B^N z\right)} > 0, \end{aligned}$$

with

$$\begin{aligned} \frac{\partial \beta_G(m^*)}{\partial \gamma} &= \frac{-m^* p(1-\alpha_I)D}{X_B^N\left((1-p)+m^*p\right)\left(1-\alpha_I\right) + X_G^N\left(p+m^*\left(1-p\right)\right)\alpha_I} < 0, \\ \frac{\partial^2 \beta_G(m^*)}{\partial D \partial \gamma} &= \frac{-m^* p(1-\alpha_I)}{X_B^N\left((1-p)+m^*p\right)\left(1-\alpha_I\right) + X_G^N\left(p+m^*\left(1-p\right)\right)\alpha_I} < 0. \end{aligned}$$

Further, for $\gamma = 0$, observe that $\Pi = -(1-\alpha_E)p < 0$ and for $\gamma = 1$, note that $\Pi > 0$ if $\alpha_E > \alpha_E^T(k,1)$, where $\alpha_E^T(k,1)$ is defined in (17). Thus, if $\alpha_E > \alpha_E^T(k,1)$ is satisfied, it follows from the intermediate value theorem that there exists a threshold $\gamma^T \in (0,1)$ such that $\Pi > 0$ if an only if $\gamma > \gamma^T$.■

Proof of Proposition 5:

It follows directly from the proof of Proposition 4 that $\frac{dm^*}{d\gamma} = -\frac{\partial \psi/\partial \gamma}{\partial \psi/\partial m^*} > 0$.■

Proof of Proposition 6:

Recall $z \equiv (1-p)\alpha_E + (1-\alpha_E)p$. Using (15) yields

$$\frac{d\Pi}{dk} = -\frac{\partial^2 \beta_G(m^*)}{\partial D \partial m^*}\frac{dm^*}{dk}\left(\Delta(1-p)\alpha_E + X_B^N \times z\right) < 0,$$

where we use the fact that $\partial^2 \beta_G(m^*)/\partial D \partial m^* < 0$ (see (16)) and

$$\begin{aligned}\frac{dm^*}{dk} &= -\frac{\partial\psi/\partial k}{\partial\psi/\partial m^*} \\ &= -\frac{m^* \times z}{k \times z + \frac{\partial\beta_G(m^*)}{\partial m^*}\left(\Delta(1-p)\alpha_E + X_B^N \times z\right)} < 0,\end{aligned}$$

where ψ is defined in (11).

On one hand, when $k = \bar{k}$, defined in (8), then $m^* = 1$. For $m^* = 1$ it follows that

$$\Pi = \frac{\left(\Delta(1-p)\alpha_E + X_B^N \times z\right)}{\left(X_B^N + \Delta \times \alpha_I\right)} p(1-\alpha_I)\gamma - (1-\alpha_E)p,$$

which is positive if and only if $\alpha_E > \alpha_E^T(\bar{k}, \gamma)$, where $\alpha_E^T(\bar{k}, \gamma) < 1$ is defined in (17).

On the other hand, when $k \to \infty$, then $m = 0$. For $m = 0$, it follows that

$$\Pi = -\left(1-\alpha_E\right)p < 0.$$

Thus, if $\alpha_E > \alpha_E^T(\bar{k}, \gamma)$ is satisfied, it follows from the intermediate value theorem that there exists a threshold $k^T > \bar{k}$ such that $dm^*/dD > 0$ if and only if $k < k^T$.■

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Figure 1: Time line of events

Stage 1

An entrepreneur requires capital of I to implement a project that generates cash flows of X_G when it is successful and X_B otherwise. The entrepreneur believes $\Pr(X_G) = \alpha_E$ and the investor believes $\Pr(X_G) = \alpha_I$, where $\alpha_E \geq \alpha_I$.

The entrepreneur observes a signal $S \in \{S_G, S_B\}$ about the project's prospects, where $\Pr(S_G|X_G) = \Pr(S_B|X_B) = p$.

Stage2

The entrepreneur chooses a level of costly effort m with which to manipulate the report and then releases a report $R \in \{R_G, R_B\}$ to investors. The entrepreneur's effort to manipulate the report is successful with probability m and the cost of manipulation is $km^2/2$.

Stage 3

The investor decides whether to finance the project given report R_i in return for an equity stake in the firm of β_i, where $i \in \{G,B\}$.

Stage 4

The project outcome is realized. If the entrepreneur misreports and the project is financed but fails, then the entrepreneur faces expected legal penalties D. The investor's share of the expected damages equals γD and her attorney's share equals $(1-\gamma)D$.