

**Financial Reporting, Regulation and
Information Asymmetry**

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Submitted in partial fulfillment of the
requirements for the degree
of Doctor of Philosophy
in the Graduate School of Arts and Sciences

COLUMBIA UNIVERSITY

2007

UMI Number: 3285065

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ABSTRACT

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Mingcherng Deng

The thesis analyzes how regulators can design financial reporting system in order to mitigate the effect of information asymmetry. First consider an entrepreneur, having private information about the prospect of an investment project, seeks to raise capital from an investor. A noisy accounting signal that is correlated with the prospects of the investment and thus useful for the investor in contracting with the entrepreneur. The inefficiencies in the legal system reduce the investment efficiency and thus the value of the contracting relationship. A regulator may adopt a principles-based system in order to balance the inefficiencies in the legal system against the informativeness of the reporting system. Second, consider an entrepreneur who can exert costly effort to improve the project profitability. An auditor observes an ex ante accounting signal correlated with future unrealized project profitability. A regulator may adopt ex ante conservatism to balance the ex ante incentive of inducing the entrepreneur's effort against the ex post investment efficiency. The higher the value of the project, the less the regulator prefers to conservative reporting. In contrast, when agency costs increase, accounting policy becomes more conservative.

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ACKNOWLEDGMENTS

I wish to thank the members of the dissertation committee: Tim Baldenius, Masako Darrough, Bjorn Jorgensen, Nahum Melumad and Nachum Sicherman for their guidance and support. I am deeply indebted to Tim Baldenius, Nahum Melumad and Stephen Penman for enormously influence on my thinking on accounting research. This dissertation also benefited from the valuable comments of seminar participants at Baruch College, Columbia University, New York University, Ohio State University, University of California at Riverside, University of Minnesota, University of Notre Dame, University of Pittsburgh, University of Toronto, University of Washington at St. Louis, Yale University, Trans-Atlantic Doctoral Conference and the annual meeting of American Accounting Association Conference at Chicago for helpful comments. Finally this dissertation is dedicated to my wife, Wei-yi Sung, and family who have always been supportive. The financial support from NSC TMS-094-1-A-058 is gratefully acknowledged

To my parents and family.

Chapter 1

Introduction

The thesis analyzes how a regulator can design a financial reporting system in order to mitigate the effect of information asymmetry. The objective of a financial reporting system plays two roles in this thesis: It provides useful information to investors to mitigate information asymmetry between investors and managers and for evaluating managerial performance. This alleviates the potential agency costs, such as moral hazard and information asymmetry, and consequently has real economics effects on a firm's investment efficiency. In this thesis, I illustrate how a regulator can improve investors' welfare by designing the characteristics of a financial reporting system, that is, principles-based accounting and ex ante conservative accounting. I identify economic trade-offs under these two accounting reporting systems and the circumstances in which investors may benefit from these two financial reporting systems.

First, I analyze how a principles-based accounting system may alleviate the asymmetric information problem prevalent in project financing decisions. In the model, an entrepreneur, having private information about the prospect of an investment project, seeks to raise capital from an investor. After making the investment decision, the investor observes a noisy accounting signal that is correlated with the prospects of the investment and thus useful for the investor in contracting with the entrepreneur. However, the entrepreneur may be subject to a litigation penalty, resulting from errors in the accounting signal. Due to inefficiencies in the legal system, the investor cannot collect entirely this penalty. The ensuing deadweight loss reduces the investment efficiency and thus the value of the contracting relationship. When the entrepreneur is granted more discretion over the accounting signal, the informativeness of the accounting signal is reduced, but the costs of the penalty indirectly borne by the investor are also lower. I show that weighing the benefits of the accounting signal to the investor against the costs, a regulator may adopt a principles-based system

(characterized by relatively high level of discretion). Contrary to conventional wisdom, I further demonstrate that the entrepreneur may have less incentive to manipulate the accounting signal under a principles-based accounting system and that when the cost of the accounting manipulation is low, the regulator may prefer a rules-based accounting system.

Second, I study the role of ex ante conservative accounting in a contracting setting. While ex post conservatism has attracted much attention in the literature, very little is known about the role of ex ante conservatism in a contracting setting. I develop a principal-agent model in which an investor funds a risky project owned by an entrepreneur who can exert costly effort to improve its prospects. An auditor observes an ex ante accounting signal correlated with future unrealized project profitability. Following an accounting policy mandated by a regulator, the auditor determines when the investment expenditure should be capitalized or expensed. The main finding is that ex ante conservatism may serve as a two-edged sword: it balances the ex ante incentive of inducing the entrepreneur's effort against the ex post investment efficiency. The higher the value of the project, the less the regulator prefers to conservative reporting. In contrast, when agency costs increase, accounting policy becomes more conservative. The relationship is further examined in three different settings. While increasing managerial ownership helps reduce agency costs, it reduces the attainable value of the project, thereby making accounting more conservative. Intuitively, the presence of asymmetric information increases the demand for accounting conservatism, as the agency cost is now higher. The regulator may decrease the degree of accounting conservatism in order to prevent the entrepreneur from colluding with the auditor.

The rest of this thesis is organized as follows. Chapter 2 shows that when the inefficiencies in the legal system is high, a regulator may adopt a principles-based system in order to balance the inefficiencies in the legal system against the informativeness of the reporting system. Chapter 3 demonstrates that although ex ante conservatism may reduce the ex post investment efficiency, it could provide the ex ante incentive of inducing the entrepreneur's effort, thereby mitigating the cost associated with the moral hazard problem.

Chapter 2

Principles-Based Accounting, Legal Liability and Information Asymmetry

2.1 Introduction

Recent corporate scandals have urged the U.S. Securities Exchange Commission (SEC) to step in so as to restore investor confidence in U.S. capital markets. The Sarbanes-Oxley Act of 2002 (hereafter SOX) aims to improve the reliability and usefulness of corporate financial disclosures by mandating stricter regulations. Under such a system, managers will be held responsible for fraud and error prevention, thereby increasing their liability significantly. Given an equal pressure on compliance, managers' discretion over financial reporting, arguably, is seriously eroded. Stringent regulations under SOX have resulted in at least two effects on capital markets. First, partially because of the greater focus on compliance with accounting rules, the number of publicly listed firms restating their financial statements has increased considerably.¹ Second, tough legal regulations have imposed additional costs on investors due to an inefficient legal system.²

To address this problem, many market participants, including U.S. Treasury Secretary Paulson,³ have proposed adopting a principles-based accounting system in order to mitigate the effects of increased liability to managers and to investors, thereby improving investment efficiency. This argument, nevertheless, fails to consider possible agency costs between investors and managers.

¹Glass, Lewis & Co reported that in year 2005, approximately 1,200 publicly listed companies in the U.S restated their financial statements and as of September 20 of year 2006, the number is more than 1,000. See Glass, Lewis & Co. LLC. (2006). "Getting It Wrong the First Time." Also see The U.S. Government Accountability Office. (2006). "Financial Restatements: Update of Public Company Trends, Market Impacts and Regulatory Enforcement Activities."

²In the U.S., class action settlement costs have increased from \$150 million in 1995 to \$3.5 billion in 2005. The consulting firm Towers-Perrin further finds that the U.S. tort system is highly inefficient, with only 42 cents of every tort dollar going to compensate injured plaintiffs. See Towers Perrin. (2006). "2006 Update on U.S. Tort Cost Trends."

³Paulson, H. 2006. Remarks by Treasury Secretary Henry M. Paulson on the Competitiveness of U.S. Capital Markets. <http://www.treas.gov/press/releases/hp174.htm>.

When managers have better information about firms' economic activities, an informative accounting signal may serve as a mechanism to mitigate investors' asymmetric information problem. If managers are granted more discretion in interpreting accounting signals, the effectiveness of such signals could decrease and the asymmetric information problem could get worse. As a result, policy makers might overlook the countervailing effect that accounting discretion might exacerbate the agency problems between investors and managers. In this paper, I characterize a principles-based accounting system by relatively higher level of accounting discretion.

Although the impact of the proposal might be significant, the extant literature provides scant insights into this adoption. (See more discussion in Nelson 2003, Maines et al. 2003 and Schipper 2003.) This paper intends to analyze the conjectured effects of increased accounting discretion on managers' legal liability and on the asymmetric information problems between investors and managers. In particular, I focus on the research questions: How would providing accounting discretion affect the asymmetric information problems between managers and investors? And how do regulators determine an optimal degree of accounting discretion to balance these effects?

To answer these questions, I construct a principal-agent model in which a regulator designs a financial reporting system, which an entrepreneur and an investor are required to follow. The entrepreneur, having private information about the prospect of an investment project, seeks to raise capital from an investor. The investor, however, can access an accounting system that generates a noisy signal of the entrepreneur's private information. The noisy accounting signal, consequently, can be used to mitigate the asymmetric information problem between the investor and the entrepreneur. The responsibility of the regulator is to determine the level of discretion over the accounting signal with the objective of maximizing the expected social welfare, defined as the weighted sum of the investor's and the entrepreneur's utility. If the level of discretion over the accounting signal increases, the accounting system leans towards a principles-based accounting system.

The accounting signal is a double-edged sword. The investor benefits from the presence of the accounting signal, because she can reduce the entrepreneur's information rent and improve investment efficiency. However, the possibility of a penalty, resulting from an error in the accounting signal, imposes a cost on the investor. Given a fixed accounting discretion, the investor needs to

choose the optimal cut-off point for project profitability or the hurdle rate at which she balances the benefit of reducing ex ante information asymmetry and the possible penalty due to accounting errors. The accounting discretion may reduce the investor's burden of possible penalties, but it also reduces the effectiveness of the accounting signal for contracting. Thus, the investor's welfare can be increased or decreased as a result of increased accounting discretion: When the cost of information rent is sufficiently large, the investor prefers an accounting system with less accounting discretion (i.e., closer to a rules-based accounting system), so that he can limit the entrepreneur's information rent more effectively. Otherwise, when the expected penalty imposes a significant cost on the investor, a principles-based accounting system with high accounting discretion may be desirable.

The regulator designs the accounting discretion so as to maximize the expected social welfare. Constrained by institutional or political concerns, the regulator is unlikely to assign extreme weights to either the investor or the entrepreneur. My analysis shows that the regulator may prefer to adopt an accounting system closer to a principles-based regime (i.e., a relatively high level of accounting discretion) when the weight on the entrepreneur's utility increases and one closer to a rules-based regime when the legal system becomes more efficient in the sense that a large portion of the penalty is collected by the investor. If the legal system is very efficient, accounting discretion is unnecessary and the regulator may prefer to adopt a rules-based accounting system in order to maintain the effectiveness of the accounting signal. However, if the legal system is very inefficient, litigation cost constitutes a significant deadweight loss, which consequently lowers the net investment return. In this case, providing more accounting discretion (i.e., close to a principles-based accounting regime) may help mitigate the impact of litigation costs. By the same argument, when the regulator assigns more weight on the entrepreneur's utility, he wants to increase the level of accounting discretion. Consequently the entrepreneur's information rent is higher as the effectiveness of the accounting signal is lower.

I further consider the case where the entrepreneur can manipulate the accounting signal. When disclosing accounting information, the entrepreneur is allowed to apply professional judgments resulting in different interpretations for similar transactions. However, when such judgments are

not made in good faith, they could lead to abuse or manipulation. In this model, the entrepreneur benefits from manipulating the accounting signal in that accounting manipulation reduces the effectiveness of the accounting signal while allowing him to retain more information rent. Hence, if the investor's goal is to minimize the entrepreneur's information rent, he certainly does not want the accounting signal to be manipulated. However, when the entrepreneur manipulates the accounting signal, he is less likely to be investigated by the regulator, thereby resulting in a lower expected penalty indirectly borne by the investor. Consequently, the investor may not be necessarily worse off with a manipulated accounting signal. In fact, the results suggest that when the investor bears a large share of the penalty, the investor may benefit from the accounting manipulation, thereby increasing investment efficiency. Contrary to conventional wisdom, when given high accounting discretion, the entrepreneur has less incentive to manipulate the accounting signal, as the benefit from manipulation is lower. If the cost of accounting manipulation is high, the regulator may choose to grant the entrepreneur more discretion.

The results have a number of implications for regulators. When applying cost-benefit analysis in assessing an accounting system, regulators need to consider the possible effect of the asymmetric information problem. When there is information asymmetry between investors and managers, accounting signals provide useful information to investors, thereby alleviating the cost of asymmetric information problems and reducing the cost of capital for the investment. While it is true that accounting discretion may mitigate the effect of legal liability on investors, regulators should recognize that accounting signals play the dual role of bridging the information asymmetry between investors and managers and of determining expected penalties. Furthermore, to make predictions as to how a change in accounting discretion will affect investment efficiency, regulators must take the efficiency of the legal system into account.

The principal antecedent of this paper is Dye and Verrecchia (1995). The authors consider two types of GAAP: Rigid uniformity and complete discretion. Their results indicate that the internal agency problem between current shareholders and their managers (that is, moral hazard involving the manager's actions) can be improved by expanding discretion, whereas when both internal and external agency problems are present, discretionary GAAP can be inferior to rigid GAAP. Their

results mainly build on the intuition that a discretionary accounting signal is more informative than rigid one, even though a discretionary signal creates opportunities for managerial distortion.

In terms of modelling, my study is closely related to Baron and Besanko (1984), Maggi and Rodriguez-Clare (1995) and Dutta (2003, 2006). Baron and Besanko (1984) consider a procurement situation in which a principal can observe a garbled signal that is correlated with an agent's private information. The agent's only decision variable is the agent's report of his private information, so that there is no moral hazard problem. They show that it is optimal to impose a penalty if the observed signal is low. Maggi and Rodriguez-Clare (1995) analyze the case where a principal can observe a distorted, yet not noisy, signal of an agent's private information. They demonstrate that a principal can reduce the information rent by inducing an agent to manipulate the signal. In contrast, my study shows that the regulator uses accounting discretion to moderate the incentive problems between the investor (principal) and the entrepreneur (agent). In Maggi and Rodriguez-Clare's study, the cost of manipulation is an exogenous function, whereas in my analysis, it is endogenously determined by the regulator and subject to the distribution of the noise term in the accounting signal. In addition, because the entrepreneur's manipulation cannot be verified ex post and the accounting signal is noisy, my study rules out the case of public information as in Maggi and Rodriguez-Clare (1995). Dutta (2003) considers a capital investment setting in which the manager's reservation utility is a function of his private information. Dutta (2006) extends that setting to characterize optimal pay-performance sensitivities of compensation contracts for a risk-averse manager. As in Dutta (2003, 2006), my paper addresses the countervailing incentive of an agent's type-dependent reservation utility, but the source of that incentive in my paper comes from an accounting signal correlated with the agent's private information.

My study also contributes to the literature on earnings management. In my model, a principal can access a noisy signal of an agent's private information, so when applying the Revelation Principle, the principal can reduce the cost of information rent. The agent has an incentive to manipulate the signal in order to reduce its effectiveness, thereby retaining more information rent. However, irrespective of the magnitude of manipulation, the Revelation Principle holds and the agent reports his type truthfully. Most prior studies in the literature, in contrast, have primarily

focused on identifying the situations in which the Revelation Principle fails to hold, so that an agent will not truthfully disclose his private information. Dye (1988), Evans and Sridhar (1996) and Demski (1998) illustrate that when an agent is unable to perfectly communicate his private information, earnings management may be optimal. Arya, Glover and Sunder (1998), Demski and Frimor (1999) and Christensen, Demski and Frimor (2001) examine models in which the Revelation Principle fails because investors cannot commit. Second, earnings management can be induced by other incentives. Bushman and Indjejikian (1993) argue that when managerial compensation contracts are based on an aggregate measure of a manager's actions, it may be desirable to induce accounting distortions to improve the allocation of the manager's incentives across tasks. Liang (2004) shows that when managerial compensation is linear in accounting profits, a principal may reduce agency costs by tolerating earnings management, because such a contract allocates the risk more efficiently. Dutta and Gigler (2002) demonstrate that "window dressing" can be beneficial as it reduces the cost of eliciting truthful forecasts. Mittendorf and Zhang (2005) analyze optimal incentive contracts in which analysts interact with managers, showing that biased earnings guidance is a natural consequence of contract design.

2.2 Model

My model consists of three risk neutral players: a regulator, an entrepreneur and an investor. The regulator is assumed to have the authority to specify a financial reporting system; the entrepreneur and the investor are required to follow the resulting system. The entrepreneur seeks to raise capital from the investor for a new investment. The investor can invest in a project with $I \in \{0, 1\}$ as an indicator variable that denotes whether or not the project is undertaken. If the project is undertaken ($I = 1$), the investor realizes a cash flow

$$\tilde{C} = \theta I + \tilde{\delta},$$

where $\tilde{\delta}$ is a random noise with $E[\tilde{\delta}] = 0$, from the investment with an initial capital cost I .⁴ The gross cash return from investing, $\theta \in [\underline{\theta}, \bar{\theta}]$, is privately observed by the entrepreneur prior to accepting the contract. The investor's and the regulator's belief about θ is reflected by a density function $f(\theta)$, which is differentiable and has strictly positive support for all $\theta \in [\underline{\theta}, \bar{\theta}]$, where $\underline{\theta} > 0$. The corresponding distribution function is denoted as $F(\theta)$ and the term $H(\theta) \equiv [1 - F(\theta)]/f(\theta)$ is an decreasing function of θ .⁵ The entrepreneur is assumed to enjoy private benefits of control when the project is undertaken.⁶ The private benefits are denoted by $B\theta$, which is nondecreasing in the gross cash return θ (that is, $B \geq 0$). In return, the entrepreneur will transfer a payment t to the investor who then will retain the residual rights of the investment.

The model to be considered is one-period. At the beginning of the period, the investor requires the entrepreneur to submit a report $\hat{\theta}$ of his private information θ . This report is used to determine a contract policy $\langle I(\hat{\theta}), t(\hat{\theta}) \rangle$, in which $I(\hat{\theta})$ denotes the investment choice and $t(\hat{\theta})$ is the payment to the investor. Transaction then occurs and at the end of the period, the accounting signal S and the random cash flow \tilde{C} are realized. The entrepreneur pays a net transfer $t(\hat{\theta})$ to the investor. Finally, the entrepreneur may be fined an ex post penalty $P \in \{0, \bar{P}\}$ for misreporting when his report $\hat{\theta}$ significantly deviates from the accounting signal, and the investor can recoup a portion β of penalty from the entrepreneur, which will be specified in detail later. I assume that the penalty \bar{P} cannot be greater than the benefit from the entrepreneur's false announcement (that is, $\bar{P} \leq B$). The respective payoffs are $B\theta I - t - IP$ for the entrepreneur and $\theta I - I + t + \beta IP$ for the investor.

The role of the regulator is to determine the level of discretion $D \in [0, \infty)$ by which the entrepreneur's report $\hat{\theta}$ is appropriate. After contracting with the entrepreneur, the investor observes a garbled accounting signal of the entrepreneur's realized cash flow

$$S = \theta + \epsilon, \tag{2.1}$$

⁴Since all parties are risk neutral and $E[\tilde{\delta}] = 0$, all results are unaffected by the noise term $\tilde{\delta}$ in the cash flow.

⁵The condition is satisfied by most usual distributions-uniform, normal, logistic, chi-square, exponential and Laplace.

⁶There is now a sizable theoretical literature that deals with optimal ownership structures of firms depending on the levels of "private benefits of control" See Baldenius (2003) for an application in the problem of capital budgeting and the references therein.

where ϵ is an ex post unobservable error in the accounting signal. To simplify the exposition, I assume that the distribution of the accounting error $g(\epsilon)$ is of normal distribution with mean 0 and variance 1. The discretion D determines the extent to which the entrepreneur's report $\hat{\theta}$ can be deviated from the accounting signal. In other words, when the difference between the accounting signal $S(\theta)$ and the entrepreneur's report $\hat{\theta}$ is smaller than the level of the discretion D , the regulator will accept the entrepreneur's report. Otherwise, it suggests that the entrepreneur might have misreported his private information. Under that circumstance, the regulator may investigate the entrepreneur's report and has the authority to fine the entrepreneur the ex post penalty \bar{P} for misreporting.⁷ When the regulator increases the upper bound D , the entrepreneur would have more leeway to interpret the accounting signal, the spirit of which is closer to a principles-based accounting system. Thus, the accounting discretion D represents the extent to which the accounting signal leans towards a principles-based accounting system.⁸

The incentive problem arising under asymmetric information is the preference of the entrepreneur to misreport his type $\hat{\theta}$. The entrepreneur may have incentive to overreport his type, since it might trigger the investment decision ($I(\hat{\theta}) = 1$), leading to private benefits. In the meantime, the entrepreneur may want to underreport private information so as to reduce possible penalty. An accounting signal significant deviating from the entrepreneur's report indicates that the entrepreneur might have overstated the true θ . Therefore, when the difference between the entrepreneur's report $\hat{\theta}$ and the accounting signal $S(\theta)$ is greater than the discretion D (i.e., $|\hat{\theta} - S(\theta)| \geq D$), the entrepreneur may be subject to the ex post penalty imposed by the regulator. This suggests the entrepreneur's expected penalty, given her report $\hat{\theta}$, is

$$E[\bar{P}|\theta, \hat{\theta}, D] = \int_{-\infty}^{\hat{\theta} - \theta - D} \bar{P}g(\epsilon)d\epsilon + \int_{\theta - \hat{\theta} + D}^{\infty} \bar{P}g(\epsilon)d\epsilon. \quad (2.2)$$

Eq. (2.2) clearly reflects that the expected penalty decreases as more discretion D is allowed, but

⁷By the Revelation Principle, the entrepreneur always reports truthfully. However, it is possible that the regulator may falsely reject the entrepreneur's report due to the accounting errors, thereby penalizing the entrepreneur.

⁸Maines et al. (2003) illustrates the distinction between rules-based and principles-based accounting by characterizing the accounting standard-setting process as a continuum ranging from right standards on one end to general definition of economics-based concepts on the other end.

increases when the entrepreneur misreports his true type θ . Because of the inefficiency of a legal system, the investor will be reimbursed only a portion of the expected penalty $\beta \in [0, 1)$ paid by the entrepreneur, and the remaining penalty is assumed to be a transaction cost or a deadweight loss to the society. I hereafter refer to β as the penalty reimbursement rate.⁹

The timing of the events is summarized as follows.

- (1) The regulator announces the discretion over the accounting standard D ¹⁰.
- (2) The entrepreneur learns his type θ .
- (3) The investor specifies a contract policy $\langle t(\hat{\theta}), I(\hat{\theta}) \rangle$ for all $\hat{\theta}$.
- (4) The entrepreneur selects a specific contract by submitting a report $\hat{\theta}$.
- (5) The random cash flow \tilde{C} is realized.
- (6) The accounting signal S is observed by the investor and the regulator may investigate the entrepreneur's report.

The entrepreneur is assumed to be risk neutral. Given the level of discretion D allowed by the regulator and the penalty \bar{P} , the entrepreneur's expected utility with a cash return θ who reports his return as $\hat{\theta}$ is

$$U_E(\theta, \hat{\theta}) = B\theta I(\hat{\theta}) - t(\hat{\theta}) - I(\hat{\theta})E[\bar{P}|\theta, \hat{\theta}, D], \quad (2.3)$$

where the first term of (2.3) represents the private benefits that will be realized, the $t(\hat{\theta})$ is the transfer to the investor and the third term $E[\bar{P}|\theta, \hat{\theta}, D]$ denotes the expected penalty as in (2.2). The Revelation Principle implies that for any feasible policy, there exists an incentive compatible policy which is at least as good as the original policy. Thus, I can derive the optimal allocations that can be restricted to the class of contract policies satisfying the individual compatibility constraint

$$U_E(\theta) \geq U_E(\theta, \hat{\theta}) \quad \forall \theta, \hat{\theta} \in [\underline{\theta}, \bar{\theta}], \quad (IC)$$

⁹The reimbursement ratio β can be interpreted a proxy for the efficiency of a legal system. A high penalty reimbursement rate β suggests that the legal system is efficient, in the sense that most of tort dollar will go back to plaintiffs' pockets.

¹⁰The results in this paper would be qualitatively unaffected if the regulator would choose \bar{P} for given D , instead of setting D for a given \bar{P} .

where $U_E(\theta) \equiv U_E(\theta, \theta)$. Given a contract policy, the entrepreneur will choose his report to maximize the utility function (2.3). The entrepreneur is assumed to have a constant reservation utility, which is normalized to zero. This implies that the contract policy must also satisfy the individual rationality condition

$$U_E(\theta) \geq 0 \quad \forall \theta, \hat{\theta} \in [\underline{\theta}, \bar{\theta}]. \quad (\text{IR})$$

The investor's utility is given by

$$U_I(\theta, \hat{\theta}) = \theta I(\hat{\theta}) - I(\hat{\theta}) + t(\hat{\theta}) + \beta I(\hat{\theta}) E[\bar{P} | \theta, \hat{\theta}, D], \quad (2.4)$$

in which $t(\hat{\theta})$ denotes the payment from the entrepreneur, the third term is the penalty reimbursement received from the entrepreneur and $I(\hat{\theta})$ represents the cost of capital investment. Because the entrepreneur's individual rationality constraint must be satisfied at the optimality, the investor's utility can be rewritten as

$$U_I(\theta, \hat{\theta}) = \theta I(\hat{\theta}) + B\theta I(\hat{\theta}) - I(\hat{\theta}) - (1 - \beta)I(\hat{\theta})E[\bar{P} | \theta, \hat{\theta}, D] - U_E(\theta, \hat{\theta}), \quad (2.5)$$

which indicates that in order to induce the entrepreneur's participation, the investor will partially bear the costs of the penalty, which is the fourth term in (2.5). And the burden of the penalty decreases in the penalty reimbursement β that the investor can collect from the entrepreneur. That is, when the penalty reimbursement β increases, the investor's utility is less affected by the penalty. Given the investor's belief about the cost parameter $f(\theta)$, the investor's maximization problem [P] is

$$\underset{\{t(\cdot), I(\cdot)\}}{\text{Max}} \int_{\underline{\theta}}^{\bar{\theta}} U_I(\theta) dF(\theta) \quad (2.6)$$

subject to:

$$U_E(\theta) \geq U_E(\theta, \hat{\theta}), \quad (\text{IC})$$

$$U_E(\theta) \geq 0. \quad (\text{IR})$$

The optimal solution to the maximization problem is characterized as follows. To develop the local representation, consider any incentive compatible contract policy. Give that policy, a report $\hat{\theta}(\theta)$ maximize the entrepreneur's utility and thus satisfies the necessary condition, $\partial U_E / \partial \hat{\theta} |_{\hat{\theta}(\theta)=\theta} = 0$. Then the total derivative of the entrepreneur's utility function $U_E(\theta) \equiv U_E(\theta, \theta)$ evaluated at $\hat{\theta}(\theta) = \theta$ is denoted by¹¹

$$\frac{dU_E(\theta)}{d\theta} = I(\theta) [B - 2\bar{P}g(-D)], \quad (2.7)$$

which denotes the necessary and sufficient condition to the local incentive compatibility constraint to hold.¹² Equation (2.7) illustrates how the entrepreneur's local incentive compatibility constraint is affected by the entrepreneur's report $\hat{\theta}$ and by the penalty: The entrepreneur benefits from misreporting the cash return parameter θ by retaining more private benefits. The gain from overstating the cash return θ increases with the level of private benefits, provided that the investment project is undertaken, which is the first term of (2.7). On the other hand, to misreport his true type, the entrepreneur expects to be charged with higher the penalty, which is the second term of (2.7). Because the entrepreneur's incentive is to misreport his true cost parameter θ , the investor must design the contract policy in order to induce the entrepreneur to truthfully report his private information. After integrating by parts, the entrepreneur's expected utility is

$$E[U_E(\theta)] = \int_{\underline{\theta}}^{\bar{\theta}} I(\theta) [B - 2\bar{P}g(-D)] H(\theta) dF(\theta). \quad (2.8)$$

Eq. (2.8) represents the information rent that the investor has to give up to the entrepreneur. This information rent depends on the investment decision $I(\theta)$ chosen by the investor, the entrepreneur's private benefits B and the cost of penalty. Ideally the investor would like to invest in the project as long as its rate of return is positive. However, a higher level of the cash return leads to higher information rent. Thus the investor faces a trade-off between the investment efficiency and rent

¹¹Since $B \geq \bar{P}$, which also implies $B \geq \bar{P}g(-D)$, the monotonicity condition is always satisfied; otherwise when the penalty \bar{P} is too large, pooling results may occur. See Dutta (2003) for a capital investment setting in which the manager's reservation utility is a function of his private information.

¹²Equations (2.7) is the necessary, but not sufficient, condition for global incentive compatibility. The sufficient conditions satisfying global incentive compatibility are developed in the Appendix.

extraction, which is standard in the literature. Meanwhile, the possibility of being penalized \bar{P} may reduce the entrepreneur's information rent. Although the entrepreneur truthfully reports his type, he is still subject to possible penalty due to type I errors in the investigation technology. Namely, the regulator might falsely reject the entrepreneur's report. Thus, in terms of reducing the entrepreneur's information rent, the investor would like to have the penalty as severe as possible. Nevertheless, as shown in (2.5), because the investor must also bear a portion of the penalty (i.e., $\beta < 1$), he may not always prefer to a high penalty. The analysis of this economic trade-off is provided in the next section.

2.3 Characterization of the optimal contract

I first characterize the first-best solution against which the second-best contract will be compared. The first-best solution is the contract policy of $\langle I(\hat{\theta}), t(\hat{\theta}) \rangle$ that maximizes the investor's utility for each θ subject to the individual rationality constraint. In the first-best setting, the private information θ is observable, so the investor can design a contract to determine the investment decision without giving up any information rent. In addition, because the investor can perfectly observe the private information θ , the accounting signal plays no role in contracting, and hence neither the penalty nor the accounting discretion is relevant in the first-best world. To be specific, the first-best solution to the problem [P] is

$$I = \begin{cases} 1 & \text{if } \theta \geq \theta^{FB} \\ 0 & \text{if } \theta < \theta^{FB} \end{cases}, \quad (2.9)$$

where $\theta^{FB}(1+B) - 1 = 0$. In the first-best world, the investor can fully extract the entrepreneur's private benefit, so that the rate of return from the investment is equal to $\theta^{FB}(1+B)$. The first-best solution simply shows that when there is no asymmetric information, the investor accepts the investment opportunity whenever the rate of return from the investment is larger than the marginal cost of investment capital.

In the second-best world, the investor must consider the incentive compatibility constraint (2.7).

Substituting the entrepreneur's information rent into the investor's utility, I can simplify the optimization problem as

$$\underset{\{t(\cdot), I(\cdot)\}}{Max} \int_{\underline{\theta}}^{\bar{\theta}} \left\{ \begin{array}{l} \theta I(\theta) + B\theta I(\theta) - I(\theta) - (1 - \beta)I(\theta) \int_{-\infty}^{-D} 2\bar{P}g(\epsilon)d\epsilon \\ -I(\theta)[B - 2\bar{P}g(-D)]H(\theta) \end{array} \right\} dF(\theta)$$

The simplified problem depicts the investor's utility incorporating the cost of the expected penalty and the information rent. Because the investor must reimburse the expected penalty for the entrepreneur to induce the entrepreneur's participation, the investor's utility is negatively affected by the expected penalty as $\beta < 1$. Meanwhile, the penalty may have a countervailing effect on the investor's utility, for the entrepreneur's information rent can be reduced by the presence of the expected penalty. The investor's objective is to determine a hurdle rate of θ^* , such that these two effects will be balanced against each other and that for all $\theta \in [\theta^*, \bar{\theta}]$ the investment project shall be undertaken. The optimization problem is linear in the investor's investment decision so its solution can be easily characterized as in Proposition 1.

Proposition 1 *Under asymmetric information, there exists a hurdle rate θ^* such that investor will accept the investment opportunity if and only if*

$$I = \begin{cases} 1 & \text{if } \theta \geq \theta^* \\ 0 & \text{if } \theta < \theta^* \end{cases}, \quad (2.10)$$

where θ^* is endogenously determined by

$$\theta^*(1 + B) - 1 - (1 - \beta) \int_{-\infty}^{-D} 2\bar{P}g(\epsilon)d\epsilon - H(\theta^*)[B - 2\bar{P}g(-D)] = 0. \quad (2.11)$$

Proof. *All proofs of are in the Appendix 1. ■*

Eq. (2.11) indicates the extent to which the investor's incentive to invest is affected by the information rent. With asymmetric information, the investor faces with a trade-off between investment efficiency, rent extraction and out-of-pocket penalty. The investor distorts the investment cut-off rate θ^* upward so as to extract a part of the entrepreneur's rent (that is, $\theta^* > \theta^{FB}$). Compared with the hurdle rate under complete information in (2.9), the hurdle rate θ^* under incomplete

information is higher. Rearranging (2.11) yields

$$f(\theta^*) \underbrace{[\theta^*(1+B) - 1]}_{\text{Gross Return}} - \underbrace{2(1-\beta)G(-D)\bar{P}}_{\text{Out-of-pocket penalty}} = \underbrace{(1 - F(\theta^*)) [B - 2\bar{P}g(-D)]}_{\text{Information rent}}. \quad (2.12)$$

The left-hand side of (2.12) is the gross return from the investment given a hurdle rate θ^* minus the out-of-pocket penalty to the investor, whereas the right-hand side of (2.12) is the cost of the information rent for the more efficient types.

The optimal hurdle rate θ^* will be affected by the accounting discretion D . The accounting discretion alleviates the investor's burden of the out-of-pocket penalty, but it also reduces the effectiveness of the accounting signal. Consider an extreme case where the accounting discretion D approaches to infinity, the investor's expected out-of-pocket penalty is zero, but the entrepreneur's information rent increases to the full extent. For any given the level of the discretion D , the optimal solution for the hurdle rate θ^* balances the gross return from the project with these two effects.

There exists an optimal level of accounting discretion from the investor's perspective. First, the economic cost of the accounting signal is due to the fact that the investor will be reimbursed only a portion β of the penalty the entrepreneur is expected to pay. When the investor can fully recover the loss of the expected penalty from the entrepreneur (i.e., $\beta = 1$), he may prefer to minimize the entrepreneur's information rent by having the accounting discretion as low as possible, which may result in the first-best solution if the fixed penalty \bar{P} is sufficiently large. Suppose that by contrast, the investor does not recoup any portion of the penalty paid by the entrepreneur (i.e., $\beta = 0$). In this case, the investor may benefit from high accounting discretion, because the marginal cost of penalty to the investor dominates the marginal benefit of reducing the information rent. Thus the optimal hurdle rate θ^* is positively associated with the penalty reimbursement rate β .

It is worth briefly discussing the impact of the entrepreneur's private benefit B on the hurdle rate θ^* . The economic tension for the entrepreneur's private benefit is developed from the trade-off between a higher cash return, the first term in (2.12), and the information rent. Since the individual rationality constraint (IR) must be satisfied, when the private benefit increases, the investor receives a higher total cash return, but also incurs higher information rent as well. Because the marginal

benefit of having higher private benefit is always greater than the marginal cost of information rent ($H(\theta)$), the investor always prefers to have an entrepreneur with high private benefits. Baldenius (2003) finds a similar result in the setting of capital budgeting.

The results are summarized in Corollary 2.

Corollary 2 *The optimal hurdle rate θ^* (1) decreases in the in the entrepreneur's private benefit ($d\theta^*/dB < 0$) (2) decreases in the penalty reimbursement rate ($d\theta^*/d\beta < 0$) and (3) can be increasing or decreasing in the accounting discretion, specifically,*

$$\frac{d\theta^*}{dD} \begin{cases} \geq 0 & \text{if } H(\theta^*)D \geq (1 - \beta) \\ < 0 & \text{if } H(\theta^*)D < (1 - \beta) \end{cases}$$

2.4 Regulator's Problem

In this section, I study the regulator's maximization problem. The regulator establishes the accounting policy, namely the accounting discretion D , to maximize expected social welfare. Following the literature on regulation, I define the expected social welfare as a weighted sum of the investor's and the entrepreneur's utility:¹³

$$W = E[U_I(\theta)] + \alpha E[U_E(\theta)], \quad (2.13)$$

where $U_I(\theta) \equiv U_I(\theta, \theta)$ denotes the investor's utility, $U_E(\theta)$ denotes the entrepreneur's utility, and $\alpha \in [0, 1]$ is the weight assigned to the entrepreneur's utility by the regulator.

The game investigated involves three parties' decision making: (1) the regulator first chooses the accounting discretion D ; (2) the investor then chooses a contract policy $\langle t(\hat{\theta}), I(\hat{\theta}) \rangle$; and (3) the entrepreneur then chooses a response $\hat{\theta}$. The equilibrium concept employed is subgame perfection in that the regulator chooses its policy on the basis of the response functions $\langle t(\hat{\theta}), I(\hat{\theta}) \rangle$. Given the regulator's and the investor's policies, the entrepreneur chooses a report $\hat{\theta}$ to maximize his utility and as per the Revelation Principle, the equilibrium has $\hat{\theta} = \theta$. Thus the regulator's

¹³A similar setup has been applied frequently in the regulation literature. See Baron (1988), Besanko and Spulber (1992), Laffont (2000), and Faure-Grimaud and Martimort (2003).

problem can be written as

$$\underset{\{D(\cdot)\}}{\text{Max}} \quad E[U_I(\theta)] + \alpha E[U_E(\theta)] \quad (2.14)$$

subject to that $\langle t(\theta), I(\theta) \rangle$ is the solution to the investor's problem [P] in (2.6) for any D .

The investor's problem is to determine the hurdle rate θ^* at which the investment project is undertaken. The regulator's optimization problem can be rewritten as

$$W = \int_{\theta^*(D)}^{\bar{\theta}} \left\{ \left[\theta(1+B) - 1 - (1-\beta) \int_{-\infty}^{-D} 2\bar{P}g(\epsilon) d\epsilon \right] - (1-\alpha)H(\theta)[B - 2\bar{P}g(-D)] \right\} dF(\theta), \quad (2.15)$$

where the hurdle rate $\theta^*(D)$ is characterized by (2.11). When the regulator changes the level of the discretion, the investor determines the optimal choice of the hurdle rate $\theta^*(D)$, which consequently affects the entrepreneur's utility U_E . The optimal accounting discretion for the regulator's problem satisfies the necessary condition:

$$\frac{dW}{dD} = \underbrace{\frac{\partial U_I}{\partial \theta^*} \frac{d\theta^*}{dD}}_{\substack{\text{Indirect effect} \\ \text{on the investor's utility}}} + \underbrace{\alpha \frac{\partial U_E}{\partial \theta^*} \frac{d\theta^*}{dD}}_{\substack{\text{Indirect effect} \\ \text{on the entrepreneur's utility}}} + \underbrace{\left[\frac{\partial U_I}{\partial D} + \alpha \frac{\partial U_E}{\partial D} \right]}_{\substack{\text{Direct effect on} \\ \text{social welfare}}} = 0. \quad (2.16)$$

The first term in (2.16) indicates the indirect effect of the accounting discretion on the investor's utility. As the regulator changes the level of the accounting discretion, the investor consequently will choose the hurdle rate $\theta^*(D)$ optimally, so as per the Envelope Theorem, the first term in (2.16) is zero. The second term in (2.16) denotes the indirect effect of the accounting discretion on the entrepreneur's information rent. When the investor increases the hurdle rate, the entrepreneur's expected utility decreases ($\partial U_E / \partial \theta^* < 0$). However, the hurdle rate $\theta^*(D)$ can be decreased or increased by the level of the discretion D as shown in Corollary 2. As a result the net indirect effect of the accounting discretion on the entrepreneur's utility will depend on the level of the penalty reimbursement β . The last term in (2.16) represents the direct effect of the accounting discretion D on the regulator's social welfare, the sign of which will jointly depend on the weight

on the entrepreneur's utility α and on β .

To characterize the optimal level of the accounting discretion, suppose that the regulator assigns a zero weight to the entrepreneur's utility (i.e., $\alpha = 0$). As shown in (2.16), the regulator's problem in this case is equivalent to the investor's problem: the optimal accounting discretion is determined by

$$\frac{dW}{dD} = \frac{\partial U_I}{\partial D} = (1 - \beta) - H(\theta^*(D))D^* = 0. \quad (2.17)$$

Now suppose that the regulator assigns equal weights to the entrepreneur's and investor's utility (i.e., $\alpha = 1$). Under this scenario, the regulator chooses the discretion to maximize the social welfare as if she fully reimburses the investor for the entrepreneur's information rent fully. As a result, the entrepreneur will be given complete discretion to interpret the accounting signal; in other words, the accounting signal will not be utilized for contracting purposes.

The regulator, however, is unlikely to assign extreme weights to individual's payoffs as he is constrained by institutional or political concerns. As such, according to the preference of the society, the regulator may balance the investor's investment efficiency against the entrepreneur's information rent by imposing different level of discretion over the accounting signal. Under this circumstance, the optimal accounting discretion for the regulator's problem satisfies the necessary condition (2.16).

I now characterize the optimal solution to the regulator's problem in more detail. The practitioners' press generally views accounting discretion in corporate reporting negatively as it tends to exacerbate asymmetric information problems. That argument applies most forcefully when the regulator does not value the entrepreneur's welfare highly (i.e., low α). However, as in (2.16), inefficiencies in the legal system give rise to a countervailing effect, which in general results in a strictly positive optimal level of accounting discretion. As shown in the Appendix, the regulator's problem may not always be well-defined. To understand the intuition, note that the direct effect of accounting discretion D on the entrepreneur's utility is always positive ($\partial U_E / \partial D > 0$). The direct effect on the investor's utility is positive for low β because of the reduced out-of-pocket penalty ($\partial U_I / \partial D > 0$). Lastly, the indirect effect on the entrepreneur's utility via the change in

the optimal hurdle rate is also positive ($\partial U_E / \partial \theta^* \times d\theta^* / dD > 0$) for small β , because, in that case, the optimal hurdle θ^* rate decreases in accounting discretion ($d\theta^* / dD < 0$). Those three effects combined show that, by (2.16), there does not exist an interior optimum for the regulator's problem if β is too small. The following analysis addresses the values of β sufficiently high, such that the regulator's problem is well-defined.

Now consider the comparative statics of the optimal level of discretion with regard to changes in the exogenous parameters α and β . As the regulator assigns more weight to the entrepreneur's utility (i.e., α goes up), the direct effect in (2.16) due to $dU_E / dD > 0$ calls for more discretion. However, for any (α, β) -combination such that the regulator's problem is well-defined, I show in the Appendix that $d\theta^* / dD > 0$, which, by (2.16), leads to a countervailing indirect effect because $\partial U_E / \partial \theta^* < 0$. Yet, as the next result demonstrates, the first effect always dominates the second, with the result that the regulator will choose a higher discretion level as α goes up. On the other hand, as the penalty reimbursement rate β goes up, Proposition 3 demonstrates that the regulator will choose a lower level of discretion. This holds because the dominant effect of an increase in β is that the associated reduction in the out-of-penalty to the investor makes him weigh rent extraction more heavily. This in turn leads the regulator, who tends to internalize the investor's objective more than that of the entrepreneur, to reduce the level of discretion. Proposition 3 summarizes these results.

Proposition 3 *If the penalty reimbursement ratio β is sufficiently large, a unique optimal level of accounting discretion $D^* > 0$ exists, for all $\alpha \in [0, 1)$. The optimal interior solution D^* decreases in the penalty reimbursement rate β ($dD^* / d\beta < 0$) and increases in the weight α ($dD^* / d\alpha > 0$).*

Proposition (3) has implication for policy makers. It implies that the accounting system will tend more towards a principles-based regime if the weight on the entrepreneur's utility increases and more toward a rules-based regime if the penalty reimbursement β increases. Recently the U.S. Treasury Secretary Henry Paulson and the Committee of Capital Markets Regulation have proposed adopting a principles-based accounting system in order to mitigate the effects of increased liability of managers and investors. When applying cost-benefit analysis in assessing the choice of an accounting system, regulators must take into account the underlying asymmetric informa-

tion problems and the inefficiency of the legal system in the USA. If the legal system is efficient, accounting discretion is unnecessary and regulators may prefer to adopt a rules-based accounting system. However, if the legal system is very inefficient, litigation cost constitutes a deadweight loss, which consequently lowers the net investment return. Consequently, a principles-based accounting system may help mitigate the impact of litigation costs. In sum, regulators should recognize that accounting signals play an essential role in bridging the information asymmetry between investors and managers and that increasing accounting discretion may reduce their effectiveness and the investment efficiency.

2.5 Accounting Manipulation

In this section, I consider the case where the entrepreneur is allowed to apply professional judgements to interpret the accounting signal. When the judgement is not made in good faith, it may lead to manipulation. When the investor cannot verify the entrepreneur's manipulation of the accounting signal, but the same incentive scheme, as characterized in the preceding section, is kept, the entrepreneur may not have the incentive to disclose his type truthfully. This begs the question of how the entrepreneur's incentives and the investor's utility would be affected by such nonverifiable manipulation.

Suppose that the investor observes a garbled, and possibly manipulated, accounting signal of the entrepreneur's cash return,

$$S = \theta + m + \epsilon, \tag{2.18}$$

where m stands for the entrepreneur's manipulation of the accounting signal chosen before the accounting signal is realized. I assume that for simplicity, there is a cost $v(m) = \phi m^2/2$ associated with manipulation.¹⁴ Following the same argument outlined in the previous section, the regulator would investigate the entrepreneur's report if the difference between the accounting signal S and

¹⁴If there is no personal cost associated with the accounting manipulation, the insider would like to manipulate the accounting signal to the greatest extent as possible, so as to increase information rent. To avoid this uninteresting result, I assume that the agent must incur a convex cost of manipulation $v(m)$.

the entrepreneur's report $\hat{\theta}$ is larger than the discretion D . As a result, when the entrepreneur has an opportunity to manipulate the accounting signal S , he would like to manipulate it upward. The entrepreneur chooses the announcement of his type $\hat{\theta}$ and the level of the accounting manipulation m without knowing ϵ . (Recall that the accounting noise ϵ is purely random, not observable by either party.) As shown in the previous section, when the difference is greater than the accounting discretion ($|\hat{\theta} - S(\theta)| \geq D$), the regulator will investigate the entrepreneur's report and the entrepreneur will be fined by \bar{P} for misreporting. The entrepreneur's expected penalty is

$$E[\bar{P}|\theta, \hat{\theta}, D, m] = \int_{-\infty}^{\hat{\theta}-\theta-D-m} \bar{P}g(\epsilon)d\epsilon + \int_{\theta-\hat{\theta}+D+m}^{\infty} \bar{P}g(\epsilon)d\epsilon. \quad (2.19)$$

The expected penalty decreases in the manipulation of the accounting signal, as the entrepreneur's report is less likely to be investigated.

Given the accounting discretion D , the expected utility function of the entrepreneur with a cost parameter θ who reports his cost as $\hat{\theta}$ is

$$U_E(\theta, \hat{\theta}, m) = \left[B\theta - \int_{-\infty}^{\hat{\theta}-\theta-D-m} 2\bar{P}g(\epsilon)d\epsilon - v(m) \right] I(\hat{\theta}) - t(\hat{\theta}). \quad (2.20)$$

Since the accounting manipulation is not verifiable, the investor must also consider the moral hazard constraint:

$$2\bar{P}g(-D - m) - v'(m) = 0, \quad (2.21)$$

which is the first-order condition with respect to m associated with (2.20).¹⁵ It shows that the entrepreneur chooses the optimal level of the manipulation in order to equate the marginal benefit of increasing information rent to the marginal cost of the manipulation. Note that if the investment is not realized ($I = 0$), the entrepreneur has no incentive to manipulate the accounting signal. Accordingly, the investor's utility can be rewritten as

$$U_I(\theta, \hat{\theta}, m) = \left[\theta + B\theta - 1 - (1 - \beta) \int_{-\infty}^{\hat{\theta}-\theta-D-m} 2\bar{P}g(\epsilon)d\epsilon - v(m) \right] I(\hat{\theta}) - U_E(\theta, \hat{\theta}, m).$$

¹⁵I assume ϕ is sufficiently high so that the second-order condition is satisfied.

(2.22)

Given the moral hazard constraint and the incentive compatibility constraint, the investor's problem [P_M] is:

$$\underset{\{t(\cdot), I(\cdot)\}}{\text{Max}} \int_{\underline{\theta}}^{\bar{\theta}} U_I(\theta, \theta, m) dF(\theta) \quad (2.23)$$

subject to:

$$(\theta, m) \in \underset{\hat{\theta}, \hat{m}}{\arg \max} U_E(\hat{\theta}, \hat{m}; \theta) \quad (2.24)$$

$$U_E(\theta, m) \geq 0, \quad (2.25)$$

where $U_E(\theta, m) \equiv U_E(\theta, \theta, m)$.

Before characterizing the optimal solution to this problem, I first reexamine the entrepreneur's information rent. As in (2.7), when accounting manipulation is possible, the total derivative of the entrepreneur's utility function, for any given m , is denoted by

$$\frac{dU_E(\theta)}{d\theta} = I(\theta) [B - 2\bar{P}g(-D - m)], \quad (2.26)$$

which represents the necessary and sufficient condition to the local incentive compatibility constraint held. The entrepreneur's expected utility then is given by

$$E[U_E(\theta, m)] = \int_{\underline{\theta}}^{\bar{\theta}} I(\theta) [B - 2\bar{P}g(-D - m)] H(\theta) dF(\theta), \quad (2.27)$$

which is weakly larger than (2.8) as long as D and m are positive. On the one hand, the accounting manipulation may lower the effectiveness of the accounting signal, thereby increasing the entrepreneur's information rent. If the investor's goal were to minimize the information rent, he certainly would not want the accounting signal to be manipulated. On the other hand, the accounting manipulation may help relieve the expected penalty as in (2.22). Hence, the investor may not necessarily be worse off with a manipulated accounting signal. From the investor's point of view, an "optimal" level of manipulation may exist, which balances these two countervailing effects. Nevertheless,

since the accounting manipulation is not observable, the entrepreneur will manipulate the accounting signal according to his personal interests, as shown by the moral hazard constraint (2.21). As such, the investor's utility can be either positively or negatively affected by the accounting manipulation. The goal of the analysis is to determine the net effect of the signal manipulation on the investment efficiency, the investor's payoff and ultimately the optimal accounting discretion as chosen by the regulator.

Substituting the entrepreneur's information rent into the investor's utility, I can simplify the optimization problem and characterize the optimal investment decision is given by the following cutoff θ^{**} :

$$\left[\theta^{**}(1+B) - 1 - (1-\beta) \int_{-\infty}^{-D-m^{**}} 2\bar{P}g(\epsilon) d\epsilon - v(m^{**}) \right] - H(\theta^{**})[B - 2\bar{P}g(-D - m^{**})] \quad (2.28)$$

$$+\mu(\theta) [2\bar{P}g(-m^{**} - D) - v'(m^{**})] = 0,$$

where $\mu(\theta)$ is the multiplier associated with the moral hazard constraint (2.21), m^{**} is the solution to (2.21) and θ^{**} is the hurdle rate. The investor will accept the investment opportunity if and only if

$$I = \begin{cases} 1 & \text{if } \theta \geq \theta^{**} \\ 0 & \text{if } \theta < \theta^{**} \end{cases}, \quad (2.29)$$

Eq. (2.28) indicates that the accounting manipulation indeed affects the investor's incentive to participate in the project. When the marginal cost of the manipulation $v'(m)$ is large, the entrepreneur may not manipulate the accounting signal to the extent the investor desires. In this case, the benefit of saving ex post penalty is greater than the cost of additional information rent. On the other hand, consider an extreme case where the marginal cost of manipulation is relatively small subject to the requirement that the second-order condition for (2.20) be satisfied. In this case, the entrepreneur can easily manipulate the accounting signal to the largest extent, so that the investor

can no longer benefit from the accounting signal. Thus, impacted by accounting manipulation in a non-monotonic way, the investor's incentive to invest can be higher (lower) depending on the economic trade-offs between the magnitude of manipulation and the cost of asymmetric information problem.

The analysis shows that when the penalty reimbursement β is relative small, the investor benefits from the accounting manipulation and the optimal hurdle θ^{**} can be lower than that θ^* when the accounting manipulation is not possible. In comparison, when the legal system is relatively efficient (that is, β is relatively large), the investor cares less about the cost of the penalty, but more about the benefit of lowering information rent, so that manipulation is harmful. From the entrepreneur's standpoint, the incentive to manipulate is *lower* when he is provided higher accounting discretion. In other words, the accounting discretion and the accounting manipulation are substitutes for the entrepreneur. Because the accounting manipulation is costly, as the benefit from manipulating the accounting signal is lower under high accounting discretion, the entrepreneur has less incentive to manipulate the accounting signal.

Proposition 4 *There exists a cut-off point β_0 such that for all $\beta < \beta_0$, the optimal hurdle rate θ^{**} with manipulation is smaller than θ^* without manipulation.*

The equilibrium is also affected by the regulator's choice of accounting discretion. While it is true that the regulator can reduce the cost of the expected penalty by granting more accounting discretion, yet this will increase the entrepreneur's information rent. When the accounting discretion increases, the expected penalty decreases, so the entrepreneur will reduce the level of manipulation (i.e., $dm/dD < 0$). In an extreme case where the accounting discretion is close to infinity, the manipulation would be zero, for there is no benefit from manipulating the accounting signal at all. Holding the accounting discretion constant, when the entrepreneur increases the manipulation, the investor's burden of the expected penalty is lower, but the cost of information rent also rises. Thus, the optimal hurdle rate can be increased or decreased by higher manipulation, depending on the accounting discretion. Depending on the regulator's choice of accounting discretion, I show how the optimal hurdle rate θ^{**} would changed as in Corollary 5.

Corollary 5 For all $\beta < \beta_0$, if the accounting discretion increases, the optimal hurdle rate θ^{**} will be lower ($d\theta^{**}/dD < 0$). However, the accounting manipulation always decreases in the accounting discretion ($dm^{**}/dD < 0$).

Next, I characterize the regulator's problem under the assumption that the entrepreneur may manipulate the accounting signal. The regulator's objective is, again, to maximize a weighted sum of the investor's and the entrepreneur's utility by choosing the level of the accounting discretion:

$$\begin{aligned} & \underset{\{D(\cdot)\}}{\text{Max}} \quad E[U_I(\theta, m)] + \alpha E[U_E(\theta, m)] \\ & \underset{\{D(\cdot)\}}{\text{Max}} \quad E[U_I(\theta, m)] + \alpha E[U_E(\theta, m)] \end{aligned} \quad (2.30)$$

subject to for any level of discretion D , the contract policy $\langle t(\hat{\theta}), I(\hat{\theta}) \rangle$ is the solution to the investor's problem [P_M] in (2.23) and m^{**} is the solution to (2.21). The analysis for the regulator's problem (2.30) is similar to that as described in the Section 2.4. The first-order condition with respect to the discretion is given by

$$\frac{dW}{dD} = \left[\frac{\partial U_I}{\partial \theta^{**}} \frac{d\theta^{**}}{dD} + \frac{\partial U_I}{\partial m^{**}} \frac{dm^{**}}{dD} \right] + \alpha \left[\frac{\partial U_E}{\partial \theta^{**}} \frac{d\theta^{**}}{dD} + \frac{\partial U_E}{\partial m^{**}} \frac{dm^{**}}{dD} \right] + \frac{\partial W}{\partial D} = 0, \quad (2.31)$$

where D^{**} is the solution to (2.31). The analysis can be simplified further as the first term in (2.31) is zero by the Envelope Theorem.

I now characterize the effect of the accounting manipulation on the regulator's choice of the accounting discretion. Recall that given a level of the accounting discretion, the entrepreneur chooses the level of accounting manipulation following (2.21) and when the marginal cost of accounting manipulation ($v'(m) = \phi m$) increases, the magnitude of accounting manipulation decreases. To better understand the effect of accounting manipulation, first suppose that the marginal cost of the accounting manipulation is extremely large (i.e., large ϕ). Under this scenario, the entrepreneur has little incentive to manipulate the accounting signal and the accounting manipulation is close to zero. Thus, the solution to the investor's problem [P_M] is the same as the solution to the problem [P] shown in Proposition (3). That is, the optimal level of D^{**} is close to D^* when the accounting manipulation m^{**} is close to zero. Second, when the cost of manipulation is sufficiently small, the entrepreneur always manipulates the accounting signal upward in order to reduce the possibility of being investigated. Thus to characterize the impact of the accounting manipulation, it suffices

to show the sign of the partial derivative of D^{**} with respect to the marginal cost of manipulation ϕ ($\partial D^{**}/\partial\phi$). If the cost of accounting manipulation is higher, the manager has less incentive to manipulate the accounting signal, which gives rise to lower information rent. Holding the level of the entrepreneur's utility constant, the regulator wants to increase the level of accounting discretion to mitigate that incentive. Indeed, the analysis in the Appendix shows that when the cost of manipulation goes down, the entrepreneur manipulates the accounting signal upward to a greater extent and the regulator in response reduces the level of accounting discretion ($\partial D^{**}/\partial\phi > 0$). Put differently, the optimal level of accounting discretion will be lower with accounting manipulation than that without (i.e., $D^{**} < D^*$). That is, if the accounting signal can be manipulated, the regulator will prefer an accounting system closer to a rules-based regime.

Proposition 6 *Given that the penalty reimbursement rate β is sufficiently large, the optimal degree of accounting discretion D^{**} increases in the cost of accounting manipulation ($\partial D^{**}/\partial\phi > 0$).*

The results provide some insights into recent comments made by regulators. Many market regulators, including FASB, conjecture that a rules-based accounting system is necessary to prevent managers from manipulating accounting information, because a greater focus on compliance under such a system may result in higher cost of accounting manipulation. Their argument implies that the cost of accounting manipulation is negatively associated with the level of accounting discretion. However, Proposition 6 shows that when there exists asymmetric information problems, such conjecture may not hold. While it is true that the level of accounting manipulation decreases in the cost of manipulation, providing lower accounting discretion to managers may lead to higher accounting manipulation, as shown in Corollary 5. This countervailing incentive may further lead to higher information rent and lower investment efficiency. Thus if the regulator expects that the cost of accounting manipulation is high (e.g., characterized by stricter certification requirement or more efficient audit technology), adopting a rules-based accounting system may not necessary be the optimal solution. In other words, failure to understand this economic trade-off may exacerbate the existing asymmetric information problems between investors and managers.

2.6 Conclusion

This paper analyzes how a principles-based accounting system may alleviate the asymmetric information problem between privately informed entrepreneurs and investors. I consider an agency model where an entrepreneur has private information about an investment project and seeks to raise capital from an investor. My results show a delicate economic trade-off among the level of accounting discretion, the efficiency of a legal system and the cost of the asymmetric information problem. A noisy accounting signal correlated with the entrepreneur's private information is useful to mitigate asymmetric information problems. However, the entrepreneur may be subject to a litigation penalty, resulting from the errors in the accounting signal. Due to inefficiencies in the legal system, the investor cannot totally collect the penalty paid by the entrepreneur. This dead-weight loss reduces the investment efficiency and thus the value of the contracting relationship. When the entrepreneur is granted more discretion over the accounting signal, the informativeness of the accounting signal is reduced, but the costs of the penalty indirectly borne by the investor are also lower. I show that weighing the benefits of the accounting signal to the investor against the costs, a regulator may adopt a principles-based system (characterized by a relatively high level of discretion). Contrary to conventional wisdom, I further demonstrate that the entrepreneur has less incentive to manipulate the accounting signal under a principles-based accounting system and that when the legal system is very inefficient, accounting manipulation may improve investment efficiency.

The results have some implications to the U.S. Treasury Secretary Henry Paulson and the Committee of Capital Markets Regulation, who have proposed adopting a principles-based accounting system in order to mitigate the effects of increased liability to managers and to investors, thereby improving investment efficiency. My results suggest that when applying cost-benefit analysis in assessing an accounting system, regulators need to consider the possible effect of asymmetric information problems. When there is information asymmetry between investors and managers, accounting signals provide useful information to investors. As a result, the cost of the asymmetric information problem is alleviated, thereby increasing investment efficiency and reducing the cost

of capital. When the legal system of capital markets is efficient, accounting discretion is unnecessary and regulators may prefer to adopt a rules-based accounting system. However, when the legal system is very inefficient, managers are subject to potential significant litigation penalties, which consequently lower the value of investors' investment. Thus, a principles-based accounting system may be necessary to balance the impact of litigation costs and asymmetric information problems. That said, regulators should recognize that accounting signals play an essential role in bridging the information asymmetry between investors and managers and that increasing accounting discretion may reduce that effect and thus the competitiveness of the capital markets.

The result hinges on the fact that the possible penalty creates a countervailing incentive to the entrepreneur. Prior studies, including Guesnerie and Laffont (1984), Lewis and Sappington (1989), Maggi and Rodriguez-Clare (1995), and Dutta (2005, 2006), show that the optimal contract involves a pooling equilibrium in the presence of such countervailing incentives. My analysis implicitly assumes that the penalty for misreporting cannot be greater than its benefit. That is, the countervailing incentive is always smaller than the entrepreneur's information. This suggests that the monotonicity condition can always be maintained and pooling does not occur. An interesting extension of my study is to study how the possibility of a pooling equilibrium may affect my results.

Another simplifying assumption is that an auditor does not play a role in verifying the entrepreneur's report. In the literature, for example, Antle (1982), Baiman, Evans and Noel (1987), Melumad and Thoman (1990), and Baiman, Evans and Nagarajan (1991), an auditor will not truthfully report unless she is offered appropriate incentives. One possible extension is that the regulator must hire a self-interested auditor to audit the entrepreneur's report and compensate the auditor by the penalty paid by the entrepreneur. As long as the penalty can cover the auditor's disutility, the auditor's moral hazard problem can be solved. Another issue would be the collusion between the entrepreneur and the auditor. By colluding with the auditor, the entrepreneur can mitigate the impact of the misreporting on the entrepreneur's information rent. To avoid such collusion, the auditor must be rewarded more than possible bribes from the entrepreneur, so that honest reporting is preferable (along the lines of Kofman and Lawarree (1993) for example)

It remains to be determined whether my conclusions persist in a more general setting. A regula-

tor may be concerned about the comparability of accounting standards. Given fixed discretion, the entrepreneur may manipulate the accounting signal to various extents depending on his information rent; as a result, the comparability of accounting standards is sacrificed. The external agency problem can be another issue. The discretion may weaken the verifiability of an accounting signal, so shareholders' value can be damaged (for example, Sankar and Subramanyam (2001)).

Chapter 3

Ex Ante Conservatism: A Mechanism to Balance Agency Costs and Investment Efficiency

3.1 Introduction

The impact of conservative accounting has been examined extensively in the literature. Two types of accounting conservatism are recognized in the literature (Beaver and Ryan (2005)): *ex post* and *ex ante* conservatism. *Ex post* (or conditional or news dependent) conservatism refers to the situation in which book values are written down under sufficiently adverse circumstances but not written up under favorable circumstances, such as impairment accounting for long-lived tangible and intangible assets. *Ex ante* (or unconditional or news independent) conservatism means that an accounting policy yields expected unrecorded goodwill at the inception of assets and liability, such as immediate expensing of the costs of most internally developed intangibles and recognizing allowance for bad-debt expense. Researchers have found that financial reporting can play a stewardship role, yielding a demand for *ex post* conservatism (e.g., Gigler and Hemmer (2001), Kwon, Newman and Suh (2001), Venugopalan (2006) and Chen, Hemmer, and Zhang (2007)). However, very little is known about the role of *ex ante* conservatism in a contracting setting.

Ex ante conservatism attracts most of its attention from the literature of valuation studies. Absent agency problems, the effect of *ex ante* conservatism, from valuation perspective, is to generate systematic bias in book value. Feltham and Ohlson (1996) argue that *ex ante* conservatism distorts the relationship between reported earnings and book value, but does not affect stock prices or investment allocation. Zhang (2000) finds that, given book value, conservatism increases the marginal impact of earnings on stock prices for firms that are expanding their asset base, while conservatism has little effect on the marginal impact of earnings on stock prices for firms that in-

vest only to maintain their asset base. Penman and Zhang (2002) show that ex ante conservative accounting interacts with changes in investment to produce temporary distortions in earnings.

This paper explores the demand for ex ante conservatism in the presence of agency costs (e.g., asymmetric information, moral hazard, and collusion). In contrast to ex post conservatism, ex ante conservatism is emphasized in the context where an accounting signal *ex ante* (or news independent) reflects possible losses before an actual outcome is realized and is traditionally followed by the adage “*anticipate* no profit, but *anticipate* all losses” (Bliss, 1924). It requires charging an item to expense or loss sooner rather than later with the rule reversed for revenue recognition and asset recognition. Certainly, such a notion is meaningless unless auditors and researchers supplement it with further guidelines. For example, if this adage were taken literally, auditors would have been required to write down, or to liquidate, all of prospects for assets or revenues to zero unless their value is fully anticipated and warranted. With this caveat in mind, this paper intends to answer the following research questions: When and to what extent is it desirable for auditors to recognize losses? What would be the economic consequences of ex ante conservatism?

To answer these research questions, I develop a principal-agent model in which an investor intends to fund a risky project owned by an entrepreneur. The entrepreneur can exert costly effort to improve the prospects of the project. Before the outcome of the project is realized, an auditor observes an ex ante nonverifiable accounting signal that is correlated with the future unrealized value of the project. The regulator’s objective is to determine a threshold ex ante; when it is not possible to estimate the future profitability with reasonable certainty, the regulator suggests that the auditor expense or capitalize the investment expenditure. If the investment expenditure is expensed, the investor will receive a fixed payment by liquidating the project; if the expenditure is capitalized, he will continue funding the project and the outcome, either success or failure, will be realized at the end. In essence, this practice reflects accounting conservatism, for it limits the recognition of assets. When the threshold equals the book value of the investment, the accounting policy is comparable to the lower-of-cost-or-market rules. Thus, when the regulator requires a higher degree of verification, the auditor is more likely to expense the investment, suggesting that accounting is more conservative ex ante.

The main finding is that ex ante conservatism may serve as a two-edged sword: it balances the ex ante incentive of inducing the entrepreneur's effort against the ex post efficiency of forgoing an unprofitable project. Since there is always a possibility that the project will succeed at the end, the regulator would like to set the threshold as low as possible. However, given a lower threshold, the entrepreneur would have less incentive to exert effort, thereby reducing the expected value of the project and resulting in the higher costs of a moral hazard problem. Thus the regulator could use the accounting signal as a mechanism to mitigate the agency problem between the investor and the entrepreneur. Intuitively, when the project value is higher, the regulator prefers to set the threshold lower, making the accounting less conservative. In contrast, when it is more costly to induce the entrepreneur's effort (i.e., agency costs are higher), the accounting policy becomes more conservative. This result stipulates the spirit of Bliss's adage: accounting conservatism reflects the demand for recognizing possible costs (losses) so as to mitigate agency costs.

I further consider the relationship between accounting conservatism and agency costs in three different settings. First, I assume that the entrepreneur is required to endow some assets into the investment and in return, is entitled to retain a portion of the project value. Watt (2003) hypothesizes that accounting conservatism could be a mechanism to facilitate contracting between the separation of ownership and control. Indeed, the separation of ownership may result in the entrepreneur's interests being potentially more aligned with the investor's. However, under such an ownership structure, the investor will retain less realized project value, thereby making the project more likely to be expensed and reducing his incentive to continue the project. I demonstrate that when the agency cost is relatively large, higher managerial ownership may lead to higher accounting conservatism. Second, the entrepreneur frequently has more information than the investor. For example, the entrepreneur may have better information about the future value of the project and the private benefit that can potentially be gained from it. The investor is thus unaware of the exact opportunity cost of the project. Accounting conservatism is higher under asymmetric information and decreases in the entrepreneur's private benefit. In general, the presence of asymmetric information increases the demand for accounting conservatism, as the agency cost is now higher.

Third, I study the impact of ex ante conservatism on the problem of collusion between the au-

ditor and the entrepreneur. The auditor is assumed to have a certain level of discretion to interpret the accounting signal. The incentive of collusion arises because the auditor might exercise discretion over the accounting signal in the entrepreneur's favor, so that the entrepreneur might save the disutility for exerting effort. In response to this possibility, the investor must reward the auditor no less than the amount of the benefit from collusion. The auditor would collude with the entrepreneur if and only if the bribe is larger than the transaction cost of collusion. The regulator now needs to consider an economic trade-off among three factors: the ex ante incentive to induce the entrepreneur's effort, the ex post investment efficiency, and the cost of deterring collusion. When the accounting signal is more conservative, the entrepreneur is less likely to gain private benefit, so he has a stronger incentive to collude with the auditor. In other words, the cost of collusion decreases in accounting conservatism. As such, the regulator may decrease the level of accounting conservatism in order to deter such collusion. Consequently, the investor may need to take a project that is less profitable, and the ex post investment efficiency is suffered.

Ex post conservatism has been the focal point for addressing agency problems in the role of financial reporting. In this literature, researchers model a financial system that reports an ex post accounting signal correlated with an agent's effort. The accounting signal is informative about an agent's personally costly effort and thus is useful for mitigating agency costs in a contracting setting. For instance, Antle and Lambert (1988) find that when a risk-averse auditor is hired to generate accounting information, conservative accounting is needed in the sense that the auditor will be penalized differently for types of errors in the ex post reports. Kwon, Newman and Suh (2001) study a limited-liability moral hazard setting. When the limited liability precludes large negative penalties, the conservative accounting system is optimal, because it increases likelihood ratios for higher ex post outcome reports. Gigler and Hemmer (2001) model a principal-agent setting in which the agent can make a voluntary disclosure prior to an ex post, noisy, earnings report. The authors focus on the implications of conservative accounting rather than the choice of the optimal accounting policy. They find that the value of communication is strictly decreasing in the degree of conservatism in the reporting system. Venugopalan (2006) studies a contractual setting in which after an agent has invested, the accounting system generates *ex post* verifiable

signals that are correlated with an agent's private information. The analysis shows that if the transfer payments from the buyer to the seller are unbounded, then the degree of conservatism in the accounting system is of no consequence and the first best investment and first best expected transfer payments can be implemented. Chen, Hemmer, and Zhang (2007) show that when accounting information serves both valuation and stewardship purposes (in which current shareholders rely on the same ex post reports to monitor their risk-averse manager), conservatism in the accounting standard may effectively reduce incentive to conduct earnings management. While conservatism makes accounting numbers *less* valuable for stewardship in their model, my model suggests that conservatism may play an essential role in mitigating agency problems.

Other possible explanations for conservatism are explored in the literature. Antle and Nalebuff (1991) focus on the "auditor's curse" in the auditing process in which management has private information about the firm and is trying to present as favorable a picture as possible. Under this assumption, understatements of income by the auditor will be protested, while overstatements will go unchallenged. To correct for this "auditor's curse," the auditor reports conservatively in equilibrium. Bachar, Melumad, and Weyns (1997) identify an economic trade-off among three accounting regimes—the historical cost, lower-of-cost-or-market, and market value—and the conditions under which the social welfare of one regime dominates others. Fan and Zhang (2007) study the relation between aggregation and conservatism. They argue that conservatism may lead to an inefficient information process ex post, but it can improve information quality ex ante. They show that the desirability of conservative accounting depends on the degree of uncertainty associated with the underlying information.

My results add insights into some empirical studies. First, the FASB argues in its Concepts Statement 2 (1980, paragraphs 91-97) that conservatism violates accounting principles such as neutrality and representational faithfulness. Ball and Shivakumar (2005) further state that "an unconditional bias of unknown magnitude introduces randomness in decisions based on financial information and can only reduce contracting efficiency." My model suggests that such distortion may be desirable to mitigate managers' opportunistic action associated with risky economic transactions. Second, LaFond and Roychowdhury (2006) hypothesize and find that as managerial own-

ership declines, the severity of the agency problem increases, thereby *increasing* the demand for conservatism. My analysis provides additional evidence for their results, arguing that accounting conservatism may positively relate to managerial ownership only when the agency cost is relatively small. Third, my analysis justifies the results of LaFond and Watts (2006), who find that conservatism is the result of an asymmetric information problem rather than producing asymmetric information. Fourth, my model further characterizes an interesting relation between the quality of a financial reporting system (that is, the precision of an accounting signal) and the magnitude of conservatism when agency costs are present under various settings.

3.2 Model

My model consists of four players: a regulator, an auditor, an investor (a principal) and an entrepreneur (an agent). The regulator has the authority to specify an accounting policy; the investor and the entrepreneur are required to follow the resulting reporting system. I consider the situation in which the investor wants to fund an investment project owned by the entrepreneur. The model has two periods, $t = 0, 1$. The outcome of the project can either be successful with probability p or unsuccessful otherwise; this will be revealed at the end of period 1. In period 0, the entrepreneur can exert personal costly effort to increase the probability p with a disutility function $\psi(p)$ with $\psi' > 0$, $\psi'' > 0$, and $\psi(1/2) = 0$. To ensure interior solutions, I further assume $\psi'(p = 1/2) = 0$ and $\psi'(1) = \infty$. Thus when the entrepreneur does not exert any effort $\psi(1/2) = 0$, the investor's prior belief about whether or the project will be successful is $p = 1/2$. The entrepreneur freely chooses his level of effort at his will; the investor cannot observe it. At the end of period 0, the investor hires an auditor, who can access a noisy accounting signal of the entrepreneur's effort,

$$S = p + \epsilon,$$

where ϵ is an ex post unobservable error in the accounting signal. I assume that the accounting error ϵ has symmetric distribution $G(\epsilon)$ on $(-\infty, +\infty)$ around 0 with differentiable density $g(\epsilon)$ with $G'(\epsilon) \geq 0$ and that g is of normal distribution $N(0, \sigma)$, so that $g'(\epsilon) = -\epsilon g(\epsilon)/\sigma$. I hereafter denote by the variance σ the quality of the accounting signal: the higher the variance, the lower the

precision of the accounting signal.

The regulator's role is to determine an accounting policy that the auditor needs to follow. Specifically, having observed the accounting signal S , the auditor must issue an accounting report to the investor—either capitalizing or expensing. The accounting policy is characterized by a threshold $b \in (-\infty, \infty)$, such that the auditor will report

$$R = \begin{cases} \text{Capitalizing} & \text{if } S \geq b \\ \text{Expensing} & \text{if } S < b \end{cases},$$

respectively.¹ This accounting policy reflects a common notion that reasonably certain estimates of future profitability are required for asset recognition. When the estimates of future profitability are sufficiently large, the accounting reporting system recognizes the project as assets for the investor; otherwise, the project expenditure should be expensed. Given the auditor's report R at the end of period 0, the investor determines whether or not he wants to continue the project. When the auditor issues an expensing report, the investor will choose to liquidate the project and collect a cash payment C at the end of period 0. When the auditor indicates a capitalizing report, the investor will continue the project and if the project is successful at the end of period 0, the investor receives a lump sum of V , where $V > C$; however, if the project fails, he receives nothing.² In other words, with a probability $\Pr(S \geq b) = \int_b^\infty g(S|p)dS = \int_{b-p}^\infty g(\epsilon)d\epsilon$,³ the auditor will issue a capitalizing report, with the result that the investor continues the project. With a probability $\Pr(S < b)$, an expensing report will be issued and the investor liquidates the project. Furthermore, I assume that $C = V/2 > I$, so that without the agency problem, the investor a priori is indifferent between quitting and continuing the project. The investor decision affects how the entrepreneur is compensated. If the investor chooses to continue, the entrepreneur will gain a private benefit B

¹This assumption, not uncommon in the auditing literature, reflects that the nature of an auditor's opinion tends to be qualified versus unqualified or clean opinions versus going concerns. (See Statement on Auditing Standards No. 58 (AICPA 1988): Reports on Audited Financial Statements.)

²Alternatively, I can assume that given a Pass signal, the investor, with a certain probability, will choose to invest. The results are not affected under this assumption.

³ $\Pr(S \geq b) = \int_b^\infty g(S|p)dS = \Pr(p + \epsilon \geq b) = \Pr(\epsilon \geq b - p) = \int_{b-p}^\infty g(\epsilon)d\epsilon$

(such as social status) at the end of period 1, whereas if the investor quits at the end of period 0, the entrepreneur will not be compensated.⁴

The timing of the events is summarized as follows:

- (1) The regulator announces the accounting policy b .
- (2) The investor invests I and the entrepreneur exerts his effort p .
- (3) The auditor observes the accounting signal S and issues an accounting report R following the accounting policy b .
- (4) The investor decides to continue or to liquidate the project.
- (5) The cash payment C is realized if the investor chooses to liquidate and the game stops.
- (6) The value of the project V is realized and the entrepreneur receives his private benefit B .

The entrepreneur is assumed to be risk neutral with limited liability. Given the threshold b , his expected utility can be specified as

$$E[U_E(p; b)] = \int_{b-p}^{\infty} Bg(\epsilon)d\epsilon - \psi(p), \quad (3.1)$$

which is equal to the expected private benefit minus the cost of disutility. I assume that the private benefit B is sufficiently large such that the entrepreneur expects to receive a positive payoff and the individual rationality constraint is satisfied:⁵

$$E[U_E(p; b)] \geq 0.$$

Since the entrepreneur's effort is not observable, I need to consider the moral hazard constraint for the entrepreneur's effort. That is, the entrepreneur chooses his effort so as to maximize his utility.

Taking a derivative of the entrepreneur's utility with respect to p yields

$$\frac{dU_E}{dp} = Bg(b-p) - \psi'(p) = 0. \quad (3.2)$$

⁴This private benefit may capture the opportunity managers have for making investment in negative NPVs, such as "pet" projects and "trophy" acquisition. See Baldenius (2003) for an application in capital budgeting.

⁵I assume that the private benefits are sufficiently large that the entrepreneur's individual rationality constraint is always satisfied.

The investor's utility is specified as

$$E[U_I(b)] = \int_{-\infty}^{b-p} Cg(\epsilon)d\epsilon + \int_{b-p}^{\infty} Vpg(\epsilon)d\epsilon - I. \quad (3.3)$$

In equation (3.3), the first term denotes the cash payment that the investor can collect at the end of period 0, while the second term denotes the expected value of the project realized in the period 1., which is an increasing function of the entrepreneur's effort.⁶ Note that ex ante the investor's expected utility must be positive as well:

$$E[U_I(p; b)] \geq 0.$$

The regulator's role is to design an accounting policy b to balance ex ante incentive against ex post efficiency. As the entrepreneur's effort cannot be verified, the entrepreneur may not choose the appropriate level of effort, because he does not internalize the share of ex post loss due to the project failure borne by the investor. Indeed, as shown by (3.2), the entrepreneur will choose the optimal level of effort to maximize only his utility. It is obvious that the accounting policy will affect the entrepreneur's incentive to exert effort. Recall that the probability that the entrepreneur will receive the private benefit is $\Pr(S \geq b)$, or $\int_{b-p}^{\infty} g(\epsilon)d\epsilon$. When the regulator increases the threshold b , the entrepreneur's incentive to exert effort is reduced, and to some extent, may be so low that he may choose not to participate in the project. On the other hand, holding the level of entrepreneur's effort constant, if the regulator increases the threshold b , the auditor is more likely to issue an expensing report, and thereby reduce the investor's incentive to continue funding. From the regulator's perspective, this results in a loss of social welfare, because the investment project, worth Vp , is discarded. In contrast, when the threshold b is reduced, the probability that the investor will continue the project rises. However, the entrepreneur would have less incentive to exert effort, so the investor may undertake a project that is more likely to fail. The economic trade-off also demonstrates the extent to which the investor inclines to have a safe fixed payment C rather than an uncertain, and yet larger, value V . Hence, the optimal accounting policy is to equate the benefit

⁶That is, $\frac{d}{dp} \left[\int_{b-p}^{\infty} Vpg(\epsilon)d\epsilon \right] > 0$.

of providing ex ante incentive to induce the entrepreneur's effort with the cost of ex post investment efficiency (that is, wrongly rejecting a valuable project).

The objective function of the regulator is taken to the maximization of the investor surplus subject to the entrepreneur's incentive constraint.⁷ The maximization problem [P1] is given by

$$\underset{\{b(\cdot), p(\cdot)\}}{\text{Max}} E[U_I(b; p)] = \int_{-\infty}^{b-p} Cg(\epsilon)d\epsilon + \int_{b-p}^{\infty} Vpg(\epsilon)d\epsilon - I, \quad (3.4)$$

subject to:

$$p^*(b) \in \arg \max U_E(p; b); \quad (\text{IC})$$

$$E[U_E(p; b)] \geq 0; \quad (\text{MIR})$$

$$E[U_I(b)] \geq 0. \quad (3.5)$$

3.3 Characterization of the optimal contract

I first characterize the first-best solution against which the second-best contract will be compared. The first-best solution is the contract policy of $\langle p, b \rangle$ that maximizes the investor's utility for each b subject to the individual-rationality constraint. Taking the first order condition of the investor's utility (3.3) with respect to p yields

$$\frac{\partial U_I}{\partial p} = -Cg(b-p) + \left[Vpg(b-p) + \int_{b-p}^{\infty} Vg(\epsilon)d\epsilon \right] = 0. \quad (3.6)$$

Equation (3.6) indicates the economic trade-off for exerting effort. The first term in equation (3.6) indicates the marginal cost of inducing the entrepreneur's effort. As the entrepreneur's effort increases, the investor's incentive to continue the project increases, because the expected value of the project at the end of period 1 is higher. The term in square brackets is the marginal benefit of the entrepreneur's effort: the marginal benefit of realizing the project value (the first term) and the

⁷This is consistent with the objective of the Securities Exchange Committee: "The mission of the U.S. Securities and Exchange Commission is to protect investors, maintain fair, orderly, and efficient markets, and facilitate capital formation." An alternative setting is that the regulator maximizes a weighted sum of the investor's and the entrepreneur's utility. The results are not sensitive to this setting.

marginal benefit of increasing the expected project value (the second term). The first-best solution balances these two economic effects. To examine the role of the accounting policy, I take the first-order condition for b :

$$\frac{\partial U_I}{\partial b} = g(b - p^{FB}) [C - Vp^{FB}] = 0, \quad (3.7)$$

where p^{FB} is the solution for (3.6). Equation (3.7) is a linear function in the accounting policy b , suggesting that the optimal choice for b is bang-bang: If the cash payment C is greater than the expected value Vp , the regulator sets the threshold at the maximum value (that is, b is close to its maximum value $b^{\max} = \infty$), and the investor chooses to stop the project. Otherwise, when the value of the project is sufficiently large, the investor continues investing in the project resulting in the minimum threshold.

In this model, when the entrepreneur exerts effort, the probability that the project will succeed is always greater than 1/2, suggesting that $C < Vp$ and that the regulator will set the threshold at the minimum level. In other words, the auditor will always capitalize the investment in the first-best world. The intuition can be understood as follows. In the first best world, the investor does not need to provide any incentive to motivate the entrepreneur; the entrepreneur always exerts the first-best effort, so that the expected payoff Vp is always greater than the payment C at the end of period 0. In addition, the entrepreneur is still willing to participate in the contract, because the auditor always capitalizes the investment in the first best world so that he knows ex ante he will earn a private benefit. This result is not surprising. As argued by Watts (2003b), a financial reporting system is desirable partly because of existing agency costs. If information is free and no agency cost is associated with an economic transaction, there is no role for auditors or financial reporting. The results are summarized in Lemma 7.

Lemma 7 *In the first-best world, there is no demand for ex ante conservatism, in the sense that the regulator sets the threshold at the minimum level. The project is always capitalized and the entrepreneur exerts the first-best effort p^{FB} satisfying (3.6).*

Proof. All proofs of Chapter 3 are in the Appendix 2. ■

In the second-best world, the regulator must consider agency costs, that is, the moral hazard

constraint (3.2). Maximizing the investor's expected utility is equivalent to

$$\text{Max}_{\{p(\cdot), b(\cdot)\}} \int_{-\infty}^{b-p} Cg(\epsilon)d\epsilon + \int_{b-p}^{\infty} Vpg(\epsilon)d\epsilon + \lambda [Bg(b-p) - \psi'(p)],$$

where λ is the shadow price of the moral hazard constraint for the entrepreneur's effort. As shown in the Appendix, this yields the first order conditions for b and p :

$$\frac{\partial \mathcal{L}}{\partial p} = -Cg(b-p) + Vpg(b-p) + \int_{b-p}^{\infty} Vg(\epsilon)d\epsilon + \lambda \{ [B(b-p)/\sigma]g(b-p) - \psi''(p) \} = 0, \quad (3.8)$$

and

$$\frac{\partial \mathcal{L}}{\partial b} = g(b-p) [C - Vp - \lambda B(b-p)/\sigma] = 0. \quad (3.9)$$

Equation (3.8) illustrates the extent to which the investor's utility is affected by the presence of the moral hazard problem. The optimal solution to the investor's problem is jointly determined by (3.2), (3.8), and (3.9). First, equation (3.8) characterizes the second-best solution for the entrepreneur's effort. In the second-best world, the entrepreneur now determines the level of effort by equating the marginal benefit of private benefits and the marginal disutility. The last term of (3.8) demonstrates that an unit increase in effort p results in higher a expected value of private benefit and a higher disutility. Meanwhile, the regulator can adjust the accounting policy b to induce the entrepreneur's effort. Compared with (3.6), the last term in (3.8) reflects the regulator's desire to balance the investment efficiency and the agency cost, evidenced by the shadow price λ . When the threshold is higher, the entrepreneur has a stronger incentive to exert effort, but it reduces the probability that the project will continue, thereby lowering investment efficiency. On the other hand, if the regulator sets the threshold lower, the auditor is more likely to capitalize the investment, which further encourages the investor to continue funding the project. But it reduces the entrepreneur's incentive to exert effort, so that the investor will undertake a project that is less likely to succeed, lowering ex post investment efficiency. Equation (3.9) thus shows that the optimal accounting policy equates the marginal benefit of inducing the entrepreneur's effort with the marginal cost of

lower investment efficiency. Further, substituting (3.9) into (3.8) yields

$$\frac{\partial \mathcal{L}}{\partial p} = \int_{b-p}^{\infty} Vg(\epsilon) d\epsilon - \lambda \psi''(p) = 0. \quad (3.10)$$

Equation (3.10) demonstrates that holding the accounting policy constant (that is, the cumulated probability that the project will continue), the regulator simply equates the marginal benefit of higher expected value and the marginal cost of inducing an additional unit of effort. The shadow price is apparently positive and is the marginal benefit of inducing effort measured in the units of its social welfare; a unit increase in the marginal disutility $\psi'(p)$ results in a λ - units decreases in the social welfare. The result is highlighted in Lemma (8).

Lemma 8 *The entrepreneur's effort p^* is lower relative to the first-best level ($p^{FB} > p^*$) as the shadow price λ is positive and from (3.9) the optimal accounting policy is given by*

$$b^* = \frac{\sigma(C - Vp^*)}{B\lambda} + p^*,$$

where p^* is the solution for (3.8).

The regulator here determines the optimal accounting policy by trading off between ex post investment efficiency and ex ante incentive. Since it is always possible that the project will succeed in the end, the regulator would like to set the threshold as low as possible. However, a lower threshold would lower the entrepreneur's incentive to exert effort, resulting in lower a expected project value and higher moral hazard. To be more specific, note that given the optimal b^* , the unconditional cumulative probability of continuing the project can be written as $\int_{\sigma(C - Vp^*)/B\lambda}^{\infty} dG(\epsilon)$. When the project value is large enough, such that $C < Vp^*$, the cumulative probability is strictly greater than 1/2. As the project value decreases, it is intuitive that the optimal threshold will be higher, resulting in a more conservative accounting policy. On the other hand, the regulator could use the accounting signal as a mechanism to mitigate the agency problem between the investor and the entrepreneur. Equation (3.9) indicates that the accounting policy b^* decreases in the agency cost indicated by the entrepreneur's private benefit B and the shadow price λ . When the entrepreneur's private benefit increases, the entrepreneur has stronger incentive to exert effort, so that the agency cost of the moral hazard problem is lower, thereby resulting in a lower b^* or less conservative ac-

counting. Further, when the marginal cost of disutility is higher, it is more costly to induce the entrepreneur's effort, suggesting that the agency cost is higher (and λ is smaller); the regulator, as a result, increases the threshold, making the accounting signal more conservative.

The threshold b has an implication to accounting conservatism. Generally speaking, accounting conservatism stands for the notion that assets should be reported at the lowest of a range of possible values. The lower-of-cost-or-market rule for valuing inventories is an example of accounting conservatism: a write-off is required if the market value of inventory is below its original cost. Here b represents the minimum threshold at which the auditor would write off an investment. Given the book value (or the cost) of the investment I , the auditor determines this threshold by comparing the minimum expected project value (that is, $b^* \times V$) and the book value of the investment I . First, when the minimum project value equals the book value, this policy closely resembles lower-of-cost-or-market reporting. When the market value of the project, or the expected project value ($S \times V$), is above the book value of the investment, there is no need for a write-off; otherwise, the auditor will issue an expensing report and the investor will liquidate the asset. Second, when the threshold project value is below the book value, the accounting policy then is comparable to market value accounting under which an asset write-off is not necessary even though its market value is well below its book value. Thus, when the regulator requires a higher degree of verification, he increases the threshold level and thus the auditor is more likely to issue an expensing report, implying that accounting is more conservative *ex ante*.

Proposition 9 *When the future value of project V decreases, the accounting policy b^* increases, so that the auditor is more likely to expense the project, the spirit of which is closer to conservative accounting.*

The key distinction between *ex ante* conservatism and *ex post* conservatism is that the former utilizes only information known at the beginning of the contract. Here the regulator relies on expected distribution of the project profitability and thereby announces the threshold or the accounting policy before an economic transaction is realized. In contrast to *ex post* conservatism, *ex ante* conservatism is emphasized when an accounting signal *ex ante* (or news independent) reflects possible losses before an actual outcome is realized and is traditionally followed by the adage

“*anticipate* no profit, but *anticipate* all losses” (Bliss, 1924). In the FASB’s Concepts Statement 2 (1980, paragraph 95), conservatism is further defined as “a prudent reaction to uncertainty... If two estimates of amounts to be received or paid in the future are about equally likely, conservatism dictates using the less optimistic estimate.” Proposition 9 identifies the economic trade-offs affecting accounting conservatism and establishes to what extent the auditor should recognize losses. My results thus offer researchers rationale behind an economic cause of ex ante conservatism, such as writing off bad-debt expense and expensing the costs of internally developed intangibles, and are in marked contrast to Chen, Hemmer, and Zhang (2007) in which conservatism makes accounting numbers *less* valuable for stewardship.

The FASB argues in Concepts Statement 2 (1980, paragraphs 91-97) that conservatism violates accounting principles such as neutrality and representational faithfulness. Ball and Shivakumar (2005) further state that “an unconditional bias of unknown magnitude introduces randomness in decisions based on financial information and can only reduce contracting efficiency. In contrast, the conditional form of conservatism (timely loss recognition) can improve contracting efficiency.” My model provides a new perspective on this debate. It is true that conservative accounting signals surely distort the faithfulness of the accounting signal as argued by the FASB. However, such distortion may be desirable to mitigate managers’ opportunistic action associated with risky economic transactions. The regulator here makes a trade-off between mitigating agency costs from the moral hazard problem and improving investment efficiency. Watts (2003b) states that because of conservatism’s constraint on opportunistic payments to managers, it may be necessary components of efficient financial reporting. My results are consistent with his notion.

Corollary 10 *The optimal degree of accounting conservatism increases in the agency costs (that is, $\partial b^*/\partial B > 0$) and in the precision of the accounting signal (i.e., $\partial b^*/\partial \sigma < 0$)*

First, Corollary 10 provides an implication on the relation between accounting conservatism and the agency cost. Here, the agency cost, as shown by (3.10), is determined by two main factors: private benefit B and the marginal cost of disutility $\psi''(p)$. Although not directly modeled, private benefit can be a proxy for the legal, regulatory and corporate environment in which the firm is operated. Private benefit arguably is likely to be limited in countries with stronger investor

protection, which thereby reduces the agency costs and the demand for accounting conservatism. Thus, Corollary 10 predicts that since legal enforcement is stronger in code-law countries, the demand for accounting conservatism is also lower. This prediction is consistent with the results shown by Ball, Kothari and Robin (2000). However, their results are motivated by the hypothesis that the demand for accounting conservatism is due to the presence of information asymmetry which is less prevalent among code-law countries than among common-law countries. Section 3.5 provides a detailed analysis of the relation between conservatism and information asymmetry.

Second, Corollary 10 demonstrates an interesting economic trade-off between accounting conservatism and the quality of the accounting signal (as measured by the variance of the signal). As shown in equation (3.2), the entrepreneur determines the level of effort by equating the marginal benefit of increasing the cumulative probability of retaining private benefit with the marginal cost of disutility. When the signal is extreme noisy (that is, the precision approaches to zero), the realized signal would be less correlated with entrepreneur's effort; as a result, he has less incentive to exert effort. In other words, given a fixed level of conservatism b , as the precision of the signal decreases, the entrepreneur's marginal benefit of exerting effort becomes lower. In response to the countervailing effect of low precision signal, the regulator decreases the threshold to induce the entrepreneur's effort, thereby making the accounting system more conservative.

3.4 Managerial ownership

In this section, I consider the situation in which the investor is an equity holder. Agency problems between the investor and the entrepreneur arise from the separation of ownership and control. Watt (2003a) hypothesizes that accounting conservatism could be a mechanism to facilitate contracting between managers and investors. When the entrepreneur can fund some assets into the investment, the separation of ownership becomes less significant and the interests of the entrepreneur are potentially more aligned with those of the investor. Thus the severity of the moral hazard problem may decrease, resulting in less demand for accounting conservatism. My model nevertheless argues that argument may hold only when the agency cost is relatively large.

I now assume that the entrepreneur is entitled to share the resulting value from the project

according to a predetermined rule, which will be specified later. This could be a case where the entrepreneur initially is funded with assets worth $A < I$ out of the total investment I and the entrepreneur must raise only $E = I - A$ from the investor. As a result, the profits of the project are now shared by the investor and the entrepreneur. The entrepreneur will collect a predetermined dividend payment D if the project is successful at the end of period 1. It is reasonable to assume that the dividend increases in the amount of assets, i.e., $dD/dA > 0$. Thus I can denote the magnitude of D as a proxy for managerial ownership: the larger the assets A with which the entrepreneur funds the project, the higher the managerial ownership. Following the same argument, if the investor decides to discontinue the project, then he can collect a fixed amount C at the end of period one. However, if the investor continues funding the project at the end of period 0 and the project is successful, the investor can collect only $(V - D)$ by the end of period 1 and the entrepreneur will share D . Given the threshold b , the investor's expected utility can be specified as

$$E[U_E(p; b)] = \int_{b-p}^{\infty} Bg(\epsilon)d\epsilon + \int_{b-p}^{\infty} Dpg(\epsilon)d\epsilon - \psi(p) - A. \quad (3.11)$$

The first two terms of equation (3.11) indicate the entrepreneur's benefit from exerting effort. On the one hand, because of his personal endowment, the entrepreneur is expected to receive a portion of realized payoff, which is the second term of (3.11). On the other hand, the entrepreneur needs to exert two costs associated with this investment: the disutility of effort $\psi(p)$ and the cost of assets A . I assume that the private benefit B is sufficiently large that the entrepreneur expects to receive a positive payoff and satisfies the individual rationality constraint

$$E[U_E(p; b)] \geq 0.$$

The investor's utility is specified as

$$E[U_I(p, b)] = \int_{-\infty}^{b-p} Cg(\epsilon)d\epsilon + \int_{b-p}^{\infty} (V - D)pg(\epsilon)d\epsilon - E. \quad (3.12)$$

Since the entrepreneur's effort is not observable, I need to consider the moral hazard constraint for the entrepreneur's effort. That is, the entrepreneur must choose his effort so as to maximize his

utility. Taking a derivative of the entrepreneur's utility with respect to p ,

$$\frac{dU_E}{dp} = Bg(b-p) + \int_{b-p}^{\infty} Dg(\epsilon)d\epsilon + Dpg(b-p) - \psi'(p) = 0. \quad (3.13)$$

Intuitively, (3.13) demonstrates that when the entrepreneur is entitled to receive a dividend on a successful project, his incentive to exert effort gets stronger.

The regulator's problem [P2] is to maximize the investor's utility (3.12) subject to the individual rationality constraints for the investor and the entrepreneur and the moral hazard constraint (3.13). As shown in the Appendix, the optimal accounting policy is determined by the first order condition:

$$\frac{\partial \mathcal{L}}{\partial b} = g(b-p) \{C - Vp - \lambda B(b-p)/\sigma + Dp[1 - \lambda(b-p)/\sigma]\} = 0. \quad (3.14)$$

Rearranging (3.14) yields

$$b = \frac{(C - Vp + Dp)\sigma}{\lambda(B + Dp)} + p. \quad (3.15)$$

Equation (3.14) illustrates whether the investor would benefit from higher managerial ownership is ambiguous. Compared with (3.8), equation (3.14) shows that allowing the entrepreneur to participate in the project results in two additional effects on social welfare. Given the optimal choice of p^M and b^M satisfying (A-29), (A-30) and (A-28), the investor's welfare under managerial ownership can be written as

$$W^M = \left[\int_{-\infty}^{b^M - p^M} Cg(\epsilon)d\epsilon + \int_{b^M - p^M}^{\infty} (V - D)p^M g(\epsilon)d\epsilon - E \right] + \lambda^M [(B + p^M D)g(b^M - p^M) - \psi'(p^M)].$$

Using the envelope theorem and the first order conditions in (3.13) and (3.14), the effect of managerial ownership on social welfare can be shown as

$$\frac{dW^M}{dD} = \left[- \int_{b^M - p^M}^{\infty} p^M g(\epsilon)d\epsilon + \lambda^M p^M g(b^M - p^M) \right], \quad (3.16)$$

where b^M and p^M are the solutions for the optimization problem. On the one hand, the expected value of the project is directly reduced by Dp , the first term in square brackets in equation (3.14),

thereby reducing the investor's incentive to continue the project. The first term in (3.16) denotes the marginal cost of lower social welfare by increasing a unit of ownership D . On the other hand, such dividend distribution provides the entrepreneur a stronger incentive to exert effort evidenced by (3.13). This reduces the marginal agency cost, shown by the second term in square brackets in (3.14). In other words, the investor benefits from a stronger incentive to exert effort as shown in the second term of (3.16). The magnitude of these two economic costs, therefore, jointly determines the optimal level of accounting conservatism. When the entrepreneur's marginal disutility is small, the direct marginal cost of lowering expected value dominates the indirect marginal benefit of inducing more effort, so that higher managerial ownership leads to more conservative accounting. However, this relationship may reverse when it is extremely costly to induce the entrepreneur's effort (reflected by a smaller shadow price λ).

Proposition 11 *When the agency cost is relatively small (that is, $Vg(b^M - p^M) > \psi''$), the expected investor's welfare increases in the manager ownership D , and accounting conservatism is negatively related to the managerial ownership ($\partial b^M / \partial D < 0$).*

This analytical result provides additional insights into the empirical study by LaFond and Roychowdhury (2006). They hypothesize and find that as managerial ownership declines, the severity of the agency problem increases, thereby *increasing* the demand for conservatism. Proposition 11 argues that this observation may not hold when the agency cost is relatively large. Under these circumstance, my analysis demonstrates that accounting conservatism may positively relate to managerial ownership. An empirical study further controlling for the degree of agency costs may help reconcile this qualification.

3.5 Information asymmetry

In this section, I analyze the impact of an asymmetric information problem on the accounting policy. I focus on analyzing the relation between information asymmetry and the degree of accounting conservatism. The entrepreneur frequently has more information than does the investor. For example, the entrepreneur may have better information about the future value of the project and the private benefit gained from the project. The exact opportunity cost for the project thus is unknown

to the investor. My results provide a theoretical analysis to support the argument by Ball, Kothari and Robin (2000).

To study the effect of information asymmetry, I assume that the entrepreneur's private benefit B is private information and is known to the entrepreneur before the investor contacts with him. The private benefit may arguably correlate with the entrepreneur's qualities or skills in executing the project and thus can be considered as the entrepreneur's type. The investor benefits more from the entrepreneur with high private benefit than the one with low benefit. The investor's belief about B is reflected in the density function, $f(B)$, which is differentiable and has strictly positive support for all $B \in [\underline{B}, \overline{B}]$. The corresponding distribution function is denoted as $F(B)$ and the term $\frac{1-F(B)}{f(B)}$ is a decreasing function of B .⁸

The entrepreneur is assumed to be risk neutral. First, the regulator decides the accounting policy $b(\hat{B})$ and then the entrepreneur announces his private benefit. Given the threshold b , the entrepreneur's expected utility can be specified as

$$U_E(b(\hat{B})\hat{B}; B) = \int_{b(\hat{B})-p}^{\infty} Bg(\epsilon)d\epsilon - \psi(p), \quad (3.17)$$

which is equal to the expected private benefit minus the cost of disutility. The revelation principle implies that for any feasible policy, there exists an incentive compatible policy which is at least as good as the original policy. Thus, I can derive the optimal allocations that can be restricted to the class of contract policies satisfying the incentive compatibility constraint,

$$U_E(B) \geq U_E(B, \hat{B}) \quad \forall B, \hat{B} \in [\underline{B}, \overline{B}],$$

where $U_E(B) \equiv U_E(B, B)$. The necessary condition for local incentive compatibility constraint to hold is

$$\frac{dU_E(B)}{dB} = \int_{b-p}^{\infty} g(\epsilon)d\epsilon, \quad (3.18)$$

which reflects the information rent that the investor must give up so that the entrepreneur will

⁸The condition is satisfied by most usual distributions-uniform, normal, logistic, chi-square, exponential and Laplace.

truthfully report his private benefit B . Given a contract policy, the entrepreneur will choose his report of the private information B to maximize the utility function (3.17). The entrepreneur is assumed to have a constant reservation utility, normalized to zero, which I assume is satisfied as the private benefit B is sufficiently large. In addition, the timing of the game is similar to that aforementioned, except that now the regulator will design a contract policy depending on the entrepreneur's announcement of his private information.

Given the investor's belief about B is represented by a density function of $f(B)$, which is positive on the support $[\underline{\theta}, \bar{\theta}]$ and zero otherwise, I can specify the investor's maximization problem [P3]:

$$\underset{\{b(\cdot), p(\cdot)\}}{\text{Max}} \int_{\underline{B}}^{\bar{B}} \left[\int_{-\infty}^{b-p} Cg(\epsilon)d\epsilon + \int_{b-p}^{\infty} Vpg(\epsilon)d\epsilon \right] dF(B) - I.$$

subject to

$$(B, p(B)) \in \arg \max_{\hat{B}, p(\hat{B})} U_E(\hat{B}, p(\hat{B}); B, b)$$

$$U_E(B, p(B); b) \geq 0.$$

and

$$E[U_I(b)] \geq 0.$$

Except for the self-selection contract (3.18), the maximization problem [P3] is identical to the problem [P1]. Ignoring the second-order condition for now, the problem can be maximized point-wise, yielding the first order conditions for b (see the Appendix for details):

$$\frac{\partial \mathcal{L}}{\partial b} = g(b-p) \left\{ C - Vp - \lambda B(b-p)/\sigma + \frac{1-F(B)}{f(B)} \right\} = 0. \quad (3.19)$$

where $\lambda f(B)$ is the shadow price of the moral hazard constraint (3.2).

The impact of possible adverse selection is obvious. Compared with (3.9), equation (3.19) reflects how the investor should adjust the accounting policy b in the presence of information asym-

metry. The inverse hazard rate $[1 - F(B)]/f(B)$ is always positive, suggesting that all else being equal, the regulator must increase the threshold, thereby making the accounting policy more conservative.

Proposition 12 *When private benefit B is private information, accounting conservatism is higher under information asymmetry.*

The main message of the Proposition 12 is that conservatism may result from asymmetric information problems rather than producing asymmetric information (See LaFond and Watts (2006) for a similar argument in an empirical study). This may have an important implication for the FASB, which has consistently opposed conservatism. It argues that the understatement of net assets will cause the users of financial statements, such as investors, to make incorrect inferences, presumably because of uncertainty about the bias. That also implies that conservatism increases information asymmetry, so an increase in conservatism worsens information asymmetry between investors and managers.

The difference can be reconciled as follows. In my study, the entrepreneur always observes private information before contracting with the investor. In order to reflect the cost of inducing truthful reporting, the regulator makes the accounting signal more conservative so as to re-balance the trade-off between ex ante incentive and ex post efficiency. When there is no agency cost associated with the entrepreneur's behavior, the FASB's argument applies to my model as well; the accounting signal, under that assumption, need not to be conservative and the investor is better off with un-biased accounting signals.

3.6 Collusion

The analysis thus far has hinged on the assumption that the auditor always reports truthfully. In this section, I analyze the case where the auditor is assumed to be self-interested and may collude with the entrepreneur. When collusion is possible, the entrepreneur may have an incentive to side-contract with the auditor, so that the auditor may deviate from the accounting policy mandated by the regulator and issue a capitalize signal to the investor.

I consider a simple two-tier model. The auditor is viewed as an informed supervisor who privately observes a noisy signal of the entrepreneur's effort. The auditor's utility function is $U_A(s) = s \geq 0$, that is, risk neutrality with a limited liability constraint, and he receives a transfer Z from the investor. To study the impact of collusion, I assume the auditor has discretion over the accounting signal by m .⁹ If the auditor accepts a bribe P from the entrepreneur, the auditor will issue an accounting report to the investor when

$$R = \begin{cases} \text{Capitalizing} & \text{if } S \geq b - m \\ \text{Expensing} & \text{if } S < b - m \end{cases}$$

Note that the entrepreneur benefits from possible discretion, for now the auditor is more likely to capitalize the asset, thereby reducing the entrepreneur's cost of exerting effort. When the auditor accepts a bribe and exercises accounting discretion, he will be charged a fixed transaction cost k_c , which reflects a potential fine if the auditor later is caught for colluding by the regulator. The larger the transaction cost, the more costly the collusion is to the auditor. To encourage an honest accounting report, the investor needs to consider the auditor's incentive compatibility constraint when compensating the auditor with Z :

$$U_A(s; a = 0) \geq U_A(s; a = 1) \quad (3.20)$$

where $\hat{a} = 1$ indicates that the auditor colludes with the entrepreneur or $\hat{a} = 0$ otherwise. Specifically, the auditor compares the possible payments he may receive under two situations.

$$a \in \arg \max_{\hat{a} \in \{0,1\}} (1 - \hat{a}) \cdot Z + \hat{a} \cdot [P - k_c], \quad (3.21)$$

Equation (3.20) illustrates that the auditor will report honestly if and only if the investor's payment Z is not smaller than the side payment subject to the transaction cost $(P - k_c)$.

The entrepreneur's utility now needs to reflect the impact of the side-payment to the auditor,

⁹The accounting discretion will be disclosed by the financial reporting system, but is not verifiable by the regulator.

which is given by

$$U_E(p; b, \hat{a}) = (1-a) \left[\int_{b-p}^{\infty} Bg(\epsilon) d\epsilon - \psi(p) \right] + a \left[\int_{b-p-m}^{\infty} Bg(\epsilon) d\epsilon - \psi(p) - P \right]. \quad (3.22)$$

The entrepreneur's benefit from collusion is the differential of the entrepreneur's surpluses under two scenarios

$$\Delta U_E = \int_{b-p-m}^{b-p} Bg(\epsilon) d\epsilon - P, \quad (3.23)$$

which is strictly positive and increases in discretion m . The side payment certainly cannot exceed the benefit of collusion with the auditor, that is,

$$\int_{b-p-m}^{b-p} Bg(\epsilon) d\epsilon \geq P, \quad (3.24)$$

which is binding at the optimum. Consequently in order to prevent the auditor from colluding (that is, $\hat{a} = 0$), the investor must compensate him at least

$$Z \geq \int_{b-p-m}^{b-p} Bg(\epsilon) d\epsilon - k_c. \quad (3.25)$$

I assume that the transaction cost is relatively small, so that the inequality (3.25) binds at the equilibrium.¹⁰

Assuming the auditor's discretion m and the transaction cost k_c are common knowledge, the regulator's problem is to maximize the investor's utility.

$$\text{Max}_{\{p(\cdot), b(\cdot)\}} \left[\int_{-\infty}^{b-p} Cg(\epsilon) d\epsilon + \int_{b-p}^{\infty} Vpg(\epsilon) d\epsilon \right] - I - Z,$$

subject to

$$p^*(b) \in \arg \max U_E(p, b; B),$$

¹⁰I assume that once the auditor is compensated, he prefers to not commit to collusion and the accounting discretion is not exercised. See Laffont (1999, 2001) and Faure-Grimaud, Laffont and Martimort (2003) for more general discussion about the relation between collusion and soft information.

$$U_A(s; a = 0) \geq U_A(s; a = 1),$$

$$E[U_E(p; b)] \geq 0,$$

$$E[U_I(b)] \geq 0,$$

$$E[U_A(s; a)] \geq 0.$$

The research question is how the regulator ought to adjust the accounting policy reflecting the possibility of collusion or how the accounting policy affects the incentive of collusion. The Lagrangian of the problem shown in the Appendix can be simplified as

$$\mathcal{L} = \left[\int_{-\infty}^{b-p} Cg(\epsilon)d\epsilon + \int_{b-p}^{\infty} Vpg(\epsilon)d\epsilon - I - \left(\int_{b-p-m}^{b-p} Bg(\epsilon)d\epsilon - k_c \right) \right] + \lambda[Bg(b-p) - \psi'(p)]. \quad (3.26)$$

Equation (3.26) clearly depicts that the social welfare is lower, as now the investor needs to incur additional compensation Z so as to prevent the auditor from colluding with the entrepreneur. The larger the discretion, the higher the collusion cost shown by (3.25). The first order conditions for b is

$$\frac{\partial \mathcal{L}}{\partial b} = g(b-p) \left[C - Vp - \lambda B(b-p)/\sigma - B \left(1 - \frac{g(b-p-m)}{g(b-p)} \right) \right] = 0. \quad (3.27)$$

Compared with the optimal solution (3.9), equation (3.27) demonstrates how the regulator should change the accounting policy in order to reflect the cost of collusion exemplified by the expression in round brackets in (3.27). Obviously when the discretion m is equal to zero, the accounting policy b is identical to that of (3.9). When the auditor has discretion over the accounting signal, the regulator must adjust the accounting policy b accordingly so as to deter potential collusion.

The regulator now needs to consider the economic trade-off among three factors: the ex ante incentive to induce the entrepreneur's effort, the ex post investment efficiency, and the cost of deterring collusion. First, to understand how the accounting policy affects the equilibrium, note that when the investor decides to deter the auditor from colluding, the entrepreneur's incentive to exert effort is not affected, as it is characterized by (3.2). Second, given a fixed p , as the accounting

policy becomes less conservative (that is, the threshold b is lower), the investor is more likely to continue the project. Consequently, the entrepreneur has less incentive to bribe the auditor, since he feels more certain about gaining a private benefit, translating to a lower cost of collusion. Third, nevertheless, a less conservative accounting provides the entrepreneur less incentive to exert effort, thereby leading to lower expected project value and a higher agency cost. Thus, the regulator trades off between the marginal benefit of reducing collusion cost and the marginal cost of investing in a less profitable project. As a result, when the project value is reasonably large, the regulator may sacrifice the ex post investment efficiency so as to discourage collusion.

This collusion effect can be further demonstrated by the first order condition (3.27). When the expected value of the project Vp is reasonably large, the regulator designs a less conservative accounting policy ($b < p$) in order to induce the entrepreneur's effort, which is characterized by the third term in (3.27). The marginal cost of potential collusion, shown by the fourth term in (3.27), increases in the auditor's discretion m and decreases in the accounting policy b . By reducing a unit of the threshold b , the regulator increases the chance of continuing the project, but decreases the entrepreneur's incentive to exert effort, evidenced by the third term in (3.27). Meanwhile, the marginal cost of collusion, shown by the fourth term in (3.27), decreases in the threshold b .¹¹ In equilibrium, the regulator equates the marginal benefits of inducing efforts with the marginal cost of collusion.

Proposition 13 *When the auditor has discretion over the accounting signal and may collude with the entrepreneur, the regulator reduces accounting conservatism ($db/dm < 0$).*

Proposition 13 contributes to the literature of conservatism by identifying the link between accounting conservatism and collusion. The literature on conservatism tends to ignore agency costs associated with a financial reporting system. The potential collusion between auditors and managers adds complexity to the design of a reporting system. The literature on collusion (e.g., Tirole 1992, Kofman and Lawarree 1993 and Laffont and Tirole 1993) found that absent contracting frictions (such as costly communication), collusion, both actual and potential, is harmful to the

¹¹That is, provided that g is of normal distribution, $\frac{d}{db} \left[\frac{g(b-p-m)}{g(b-p)} \right] > 0$.

principal. The general results are that a threat of collusion may reduce, but does not eliminate, the benefits of supervision (Kofman and Lawarree, 1993) and that a better supervision technology increases welfare (Laffont, 2001, Proposition 2.3). My paper demonstrates that under the circumstances specified above, the cost of collusion may depend on the distribution of supervision technology (i.e., the precision of the accounting signal) and on the characteristics of the signal (i.e., the accounting policy) determined by the regulator. In order to deter potential collusion between the auditor and the entrepreneur, the regulator may make the accounting policy less conservative, which further affects the efficiency of the investment.

3.7 Conclusion

Conservative accounting can serve as a mechanism to mitigate agency costs. Accounting conservatism is recognized in two distinct ways in the literature: *ex ante* and *ex post* conservatism. While *ex post* conservatism has attracted much attention in the literature, very little is known about the role of *ex ante* conservatism in a contracting setting. My paper explores the demand for *ex ante* conservatism in the presence of agency costs. The main finding is that *ex ante* conservatism may serve as a two-edged sword, balancing the *ex ante* incentive of inducing the entrepreneur's effort against the *ex post* efficiency of forgoing unprofitable project. When the value of an economic transaction is higher, the regulator prefers a less conservative accounting reporting system. In contrast, when it is more costly to induce the entrepreneur's effort (i.e., when agency cost is higher), the accounting policy becomes more conservative.

I further consider the relationship between accounting conservatism and agency costs in three different settings: managerial ownership, information asymmetry and collusion. First, contrary to common belief, although increasing managerial ownership helps reduce agency costs, it also reduces the attainable value of a transaction, thereby rendering accounting less conservative. Second, the entrepreneur frequently has more information than the investor. The presence of asymmetric information increases the demand for accounting conservatism, as the agency cost is now higher. Third, the auditor is assumed to have a certain amount of discretion in interpreting the accounting signal and may collude with the entrepreneur. Under this setting, the regulator needs to consider an

economic trade-off among three factors: the ex ante incentive to induce the entrepreneur's effort, the ex post investment efficiency, and the cost of deterring collusion. When the accounting signal is more conservative, the entrepreneur is less likely to gain private benefit, so he has a stronger incentive to collude with the auditor. As such, surprisingly, the regulator may decrease the level of accounting conservatism in order to deter such collusion. The downside is that the investor may need to take on a less profitable project, reducing the ex post investment efficiency.

The study can be extended in several directions. One unexplored area is the relationship between accounting conservatism and agency problems in a multi-period model. In a dynamic setting, the past history of an agent's type or performance offers an endogenous signal to a principal. A principal can offer a history-dependent contract that takes the information about an agent's earlier performance into consideration. It is intuitive that such long-term contracts may reduce the demand for conservatism because of lower agency costs. However, the exact mechanism is still unclear in the literature. Second, future researches may incorporate a utility function for the auditor into the model. The auditor's decision for example may depend on the characteristics of financial reporting and be subject to more severe liability (punishment) for misreporting. The auditor will not truthfully report unless she is offered appropriate incentives, as in Melumad and Thoman (1990) and the references cited therein. Third, the regulator's behavior may not be confined to maximizing the investor's utility, but be concerned more about other characteristics of a reporting system. In addition, other political interest groups, such as Congress, media and independent boards, are ignored in my model; in reality, they may play a significant role in a regulator's decision process.

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APPENDIX

Proof of Proposition 1. I begin with the entrepreneur's utility:

$$\begin{aligned} U_E(\theta, \hat{\theta}) &= B\theta I(\hat{\theta}) - t(\hat{\theta}) - \int_{-\infty}^{\hat{\theta}-\theta-D} \bar{P}I(\hat{\theta})g(\epsilon)d\epsilon - \int_{\theta-\hat{\theta}+D}^{\infty} \bar{P}I(\hat{\theta})g(\epsilon)d\epsilon \\ &= B\theta I(\hat{\theta}) - t(\hat{\theta}) - \bar{P}I(\hat{\theta}) + \int_{\hat{\theta}-\theta-D}^{\theta-\hat{\theta}+D} \bar{P}I(\hat{\theta})g(\epsilon)d\epsilon \end{aligned}$$

The incentive compatibility constraint implies that the first order condition for the optimal response $\hat{\theta}$ chosen by type θ is satisfied:

$$\begin{aligned} \frac{\partial U_E}{\partial \hat{\theta}} &= B\theta I'(\hat{\theta}) - t'(\hat{\theta}) - \bar{P}I'(\hat{\theta}) + \int_{\hat{\theta}-\theta-D}^{\theta-\hat{\theta}+D} \bar{P}I'(\hat{\theta})g(\epsilon)d\epsilon - \bar{P}I(\hat{\theta})g(\theta - \hat{\theta} + D) \\ &\quad - \bar{P}I(\hat{\theta})g(\hat{\theta} - \theta - D) = 0. \end{aligned}$$

For the truth to be an optimal response for all θ , it must be the case that

$$\left. \frac{\partial U_E}{\partial \hat{\theta}} \right|_{\hat{\theta}=\theta} = B\theta I'(\theta) - t'(\theta) - \bar{P}I'(\theta) + \int_{-D}^{+D} \bar{P}I'(\theta)g(\epsilon)d\epsilon - \bar{P}I(\theta)g(D) - \bar{P}I(\theta)g(-D) = 0, \quad (\text{A-1})$$

and this equation must hold for all θ , since θ is unknown to the investor. Let the rent variable be

$$U_E(\theta, \theta) = B\theta I(\theta) - t(\theta) - \bar{P}I(\theta) + \int_{-D}^{+D} \bar{P}I(\theta)g(\epsilon)d\epsilon.$$

The local incentive constraint constraint is now written as (by substituting in (A-1)) is

$$\begin{aligned} \frac{dU_E}{d\theta} &= BI(\theta) + B\theta I'(\theta) - t'(\theta) - \bar{P}I'(\theta) + \int_{-D}^{+D} \bar{P}I'(\theta)g(\epsilon)d\epsilon \\ &= I(\theta)[B - \bar{P}g(D) - \bar{P}g(-D)]. \end{aligned}$$

Note that ϵ is of normal distribution, so that $g(D) = g(-D)$ and

$$\frac{dU_E}{d\theta} = I(\theta)[B - 2\bar{P}g(-D)]. \quad (\text{A-2})$$

The penalty \bar{P} is assumed to be not greater than the rent of misrepresenting, which implying that the sign of $\frac{dU_E}{d\theta}$ does not change irrespective of θ . I then apply the optimal control theory to solve this optimization problem. Letting I the control variables and U_E the state variable, the Lagrangian for this optimization problem is

$$L(I, \lambda; \theta, D) = [\theta I + B\theta I - I - (1 - \beta)\bar{P}I \left[\int_{-\infty}^{-D} g(\epsilon)d\epsilon + \int_{+D}^{+\infty} g(\epsilon)d\epsilon \right] - U_E \{A(\theta)\} \\ + \lambda \{I[B - 2\bar{P}g(-D)]\},$$

where λ is the shadow price for the incentive compatibility constraint. The necessary conditions include

$$\frac{\partial L}{\partial I} = [\theta + B\theta - 1 - (1 - \beta) \int_{-\infty}^{-D} 2\bar{P}g(\epsilon)d\epsilon]f(\theta) + \lambda \{[B - 2\bar{P}g(-D)]\}, \\ -\frac{\partial L}{\partial U_E} = \dot{\lambda}(\theta) = f(\theta),$$

which suggests that $\lambda(\theta) = F(\theta) + c$, where c is a constant. The boundary $\theta = \bar{\theta}$ is unconstrained, so that the transversality condition at $\theta = \bar{\theta}$ is

$$\lambda(\theta) = c + F(\bar{\theta}) = 0,$$

so $c = -1$ and $\lambda(\theta) = F(\theta) - 1$. Note that the Lagrangian is linear in $I(\theta)$ as shown by (A-3), suggesting that the solution is bang-bang. That is, the control variable $I(\theta)$ is at its minimum level if its coefficient in the Lagrangian is negative, and at its maximum level if its coefficient is positive. In other words, there exists a cut-off rate θ^* such that (A-4) is zero:

$$L(I = 1; \theta^*, D) = \theta^*(1 + B) - 1 - (1 - \beta) \int_{-\infty}^{-D} 2\bar{P}g(\epsilon)d\epsilon - H(\theta^*)[B - 2\bar{P}g(-D)] = 0. \quad (\text{A-4})$$

where $H(\theta) \equiv \frac{1-F(\theta)}{f(\theta)}$ is defined as the inverse hazard rate. When the sign of (A-3) is positive or $\theta \geq \theta^*$, the investor accepts the investment opportunity, or

$$I = \begin{cases} 1 & \text{if } \theta \geq \theta^* \\ 0 & \text{if } \theta < \theta^* \end{cases}$$

■

Proof of Corollary 2. I first analyze the impact of the accounting policy D and the private benefit B on the choice of cut-off point θ^* . Recall that (A-4) must be held at optimality. Taking a second order derivative with respect to θ^* and D yields

$$\left[(1 + B) - \frac{dH(\theta^*)}{d\theta^*} [B - 2\bar{P}g(-D)] \right] d\theta^* + 2\bar{P}g(-D) [(1 - \beta) - H(\theta^*)D] dD = 0.$$

Rearranging, I have

$$\frac{d\theta^*}{dD} = - \frac{2\bar{P}g(-D) [(1 - \beta) - H(\theta^*)D]}{1 + B - \frac{dH(\theta^*)}{d\theta^*} [B - 2\bar{P}g(-D)]}.$$

Since $dH(\theta^*)/d\theta^* \leq 0$

$$\text{sign} \left(\frac{d\theta^*}{dD} \right) = \text{sign} [H(\theta^*)D - (1 - \beta)].$$

Second, I can take partial derivatives with respect to private benefit B :

$$\frac{d\theta^*}{dB} = - \frac{1 - H(\theta^*)}{1 + B - \frac{dH(\theta^*)}{d\theta^*} [B - 2\bar{P}g(-D)]} < 0.$$

Thirdly, the impact of the penalty reimbursement is straightforward:

$$\frac{d\theta^*}{d\beta} = - \frac{2\bar{P}G(-D)}{1 + B - \frac{dH(\theta^*)}{d\theta^*} [B - 2\bar{P}g(-D)]} < 0.$$

■

Proof of Proposition 3: Given the hurdle rate is θ^* , the regulator's welfare function is

$$\begin{aligned} W &= E[U_I] + \alpha E[U_E] \\ &= \int_{\theta^*}^{\bar{\theta}} \left\{ \left[\theta(1+B) - 1 - (1-\beta) \int_{-\infty}^{-D} 2\bar{P}g(\epsilon) d\epsilon \right] - (1-\alpha)H(\theta)[B - 2\bar{P}g(-D)] \right\} dF(\theta) \end{aligned}$$

The optimal accounting discretion for the regulator's problem satisfies the necessary condition:

$$\frac{dW}{dD} = \frac{\partial U_I}{\partial \theta^*} \frac{d\theta^*}{dD} + \alpha \frac{\partial U_E}{\partial \theta^*} \frac{d\theta^*}{dD} + \frac{\partial W}{\partial D} = 0, \quad (\text{A-5})$$

where $\partial W/\partial D = \partial U_I/\partial D + \alpha(\partial U_E/\partial D)$. Per the Envelope Theorem, the first term in (??) is zero. The entrepreneur's utility is a strictly decreasing function of θ^* , that is,

$$\frac{\partial U_E}{\partial \theta^*} = -[1 - F(\theta^*)][B - 2\bar{P}g(-D)] < 0.$$

Similarly, taking a derivative with respect to D for the regulator's welfare yields

$$\frac{\partial W}{\partial D} = \int_{\theta^*}^{\bar{\theta}} 2\bar{P}g(-D) [(1-\beta) - (1-\alpha)H(\theta)D] dF(\theta).$$

Collectively, the optimal accounting discretion D^* must satisfies

$$\begin{aligned} \frac{dW}{dD} &= -\alpha H(\theta^*)[B - 2\bar{P}g(-D^*)]f(\theta^*) \frac{d\theta^*}{dD} \\ &\quad + \int_{\theta^*}^{\bar{\theta}} 2\bar{P}g(-D^*) [(1-\beta) - (1-\alpha)H(\theta)D^*] dF(\theta) = 0, \end{aligned}$$

where

$$\frac{d\theta^*}{dD} = -\frac{2\bar{P}g(-D^*) [(1-\beta) - H(\theta^*)D^*]}{1 + B - \frac{dH(\theta^*)}{d\theta^*}[B - 2\bar{P}g(-D^*)]}. \quad (\text{A-6})$$

The first term represents the indirect effect of the accounting discretion on the entrepreneur's information rent. The hurdle rate can be increasing or decreasing in the accounting discretion as shown by Proposition 2.

$$\text{sign} \left(\frac{d\theta^*}{dD} \right) = \text{sign} [H(\theta^*)D^* - (1-\beta)]. \quad (\text{A-7})$$

Hence the first term in (??) can be positive or negative depending on the sign of $d\theta^*/dD$. The last term represents the direct effect of the accounting discretion on the welfare. Note that when the weight $\alpha = 0$, the regulator's problem is equivalent to the case where the investor determines the optimal discretion. Denote that D_0^* is the optimal accounting discretion when $\alpha = 0$. It is obvious that $D_0^* = (1 - \beta)/H(\theta^*)$ so that $d\theta^*/dD = 0$. And the first order condition (??) is also satisfied by D_0^* . The second-order condition is denoted by

$$\frac{d^2W}{dD^2} = \alpha \frac{\partial^2 U_E}{\partial \theta^* \partial D} \left(\frac{d\theta^*}{dD} \right)^2 + \alpha \frac{\partial U_E}{\partial \theta^*} \frac{d^2\theta^*}{dD^2} + \frac{\partial^2 W}{\partial D^2}. \quad (\text{A-8})$$

Straightforward derivations shows that the first term and the third term in (A-8) are strictly negative. That is, given $\partial U_E/\partial \theta^* < 0$, if $d^2\theta^*/dD^2 \geq 0$, then the second order condition is satisfied. It can be shown that the condition $(1 - \beta) < H(\theta^*)D^*$ will lead to $d^2\theta^*/dD^2 \geq 0$ and satisfy the second order condition. Therefore, $d\theta^*/dD > 0$. Another condition to ensure (??) satisfied is that $\partial W/\partial D > 0$. Since $d\theta^*/dD > 0$ and $\partial U_I/\partial \theta^* < 0$, implying that the first term in (??) negative, $\partial W/\partial D$ must be positive to balance that negative effect. Provided these two conditions, the regular's problem is concave in the accounting discretion D .

Let D^* be the solution for all $\alpha > 0$. Now suppose that $D^* < D_0^*$, which implies that $D^* < (1 - \beta)/H(\theta^*)$ and that $d\theta^*/dD > 0$, which contradicts to the requirement of the second order condition. Thus, $dD^*/d\alpha > 0$. It is straightforward to show that as long as $\partial^2 W/\partial D \partial \alpha =$ is small,

$$\frac{dD^*}{d\alpha} = - \frac{\frac{\partial U_E}{\partial \theta^*} \frac{d\theta^*}{dD} + \frac{\partial^2 W}{\partial D \partial \alpha}}{s.o.c} > 0, \quad (\text{A-9})$$

where *s.o.c* denotes the second order condition (A-8). Further the comparative statics for the penalty reimbursement β is

$$\frac{dD^*}{d\beta} = - \left\{ \alpha \left[\frac{\partial^2 U_E}{\partial \theta^* \partial \beta} \frac{d\theta^*}{dD} + \frac{\partial U_E}{\partial \theta^*} \frac{d^2\theta^*}{dD d\beta} \right] + \frac{\partial^2 W}{\partial D \partial \beta} \right\} / s.o.c. \quad (\text{A-10})$$

The first term in (A-10) is zero, as the entrepreneur's utility is not affected by the penalty reim-

bursement. From (A-6),

$$\frac{d^2\theta^*}{dDd\beta} = \frac{2\bar{P}g(-D)}{1 + B - \frac{dH(\theta^*)}{d\theta^*}[B - 2\bar{P}g(-D)]} > 0$$

and $\partial U_E/\partial\theta^*$ is negative, so the second term is negative. And

$$\frac{\partial^2 W}{\partial D \partial \beta} = \int_{\theta^*}^{\hat{\theta}} \int_{-\infty}^{-D} \bar{P}g(\epsilon) d\epsilon dF(\theta) > 0,$$

Thus, $dD^*/d\beta < 0$. ■

Proof of Proposition 4: Now I consider the case where the entrepreneur can manipulate the accounting signal. The entrepreneur's utility function is

$$U_E(\theta, \hat{\theta}) = B\theta I(\hat{\theta}) - t(\hat{\theta}) - \int_{-\infty}^{\hat{\theta}-D-m} 2\bar{P}I(\hat{\theta})g(S - \theta - m)dS - v(m)I(\hat{\theta}).$$

Applying the same approach, Denote the entrepreneur's utility as the rent variable $U_E(\theta, \theta)$. After substituting in the first order condition for the optimal choice of $\hat{\theta}$, the local inventive constraint is

$$\frac{\partial U_E}{\partial \theta} = I[1 - 2\bar{P}g(-m - D)],$$

and the moral hazard constraint is

$$\frac{\partial U_E}{\partial m} = I [2\bar{P}g(-m - D) - v'(m)].$$

The Lagrangian is

$$\begin{aligned} L(I, \lambda, \mu; \theta, D) &= [\theta I + B\theta I - I - (1 - \beta) \int_{-\infty}^{-D-m} 2\bar{P}I g(\epsilon) d\epsilon - v(m)I - U_E]f \\ &+ \lambda \{I[B - 2\bar{P}g(-m - D)]\} + \mu f I [2\bar{P}g(-m - D) - v'(m)], \end{aligned}$$

where $\lambda(\theta)$ and $\mu(\theta)$ are the shadow price for the incentive compatibility constraint and the moral hazard constraint, respectively. The necessary conditions include

$$\frac{\partial L}{\partial I} = [\theta + B\theta - 1 - (1 - \beta) \int_{-\infty}^{-D-m} 2\bar{P}g(\epsilon) d\epsilon - v(m)]f + \lambda[B - 2\bar{P}g(-m - D)] \quad (\text{A-11})$$

$$-\frac{\partial L}{\partial U_E} = \dot{\lambda}(\theta) = f(\theta), \quad (\text{A-12})$$

$$\frac{\partial L}{\partial m} = \bar{P}g(-m-D) \{2(1-\beta)f - v'(m)f + 2[\lambda - \mu f](m+D)\} - \mu f v''(m) = 0, \quad (\text{A-13})$$

and

$$\frac{\partial L}{\partial \mu} = 2\bar{P}g(-m-D) - v'(m) = 0. \quad (\text{A-14})$$

Similarly, the boundary $\theta = \bar{\theta}$ is unconstrained so that the transversality condition at $\theta = \bar{\theta}$ is

$$\lambda(\theta) = c + F(\bar{\theta}) = 0,$$

so $c = -1$ and $\lambda(\theta) = F(\theta) - 1$, which suggests

$$\begin{aligned} \frac{\partial L}{\partial m} &= \bar{P}g(-m-D) \{2(1-\beta) - v'(m) - 2[H(\theta) + \mu](m+D)\} - \mu v''(m) = 0 \\ &= (1-\beta) - v'(m)/2 - [H(\theta) + \mu](m+D) - \mu \frac{v''(m)}{v'(m)} = 0, \end{aligned} \quad (\text{A-15})$$

Again, since the Lagrangian is linear in I , its solution is bang-bang. Let θ^{**} denote the optimal cut-off at which the investor decides to undertake the project, and must satisfy the following condition

$$L(\theta^{**}) = [\theta^{**}(1+B) - 1 - 2(1-\beta)G(-D - m^{**})\bar{P} - v(m^{**})] - H(\theta^{**})[B - 2\bar{P}g(-m^{**} - D)] = 0 \quad (\text{A-16})$$

where m^{**} solves (A-14) and the moral hazard constraint drops out. In other words, when the sign of (A-16) is positive or $\theta \geq \theta^{**}$, the investor undertakes the investment opportunity.

$$I = \begin{cases} 1 & \text{if } \theta \geq \theta^{**} \\ 0 & \text{if } \theta < \theta^{**} \end{cases}$$

To determine the impact of manipulation on the cut-off point θ^{**} , it is critical to determine the sign of the shadow price of the moral hazard constraint. Next I need to determine the sign of $\mu(\theta)$.

Substituting (A-14) into (A-13) and simplifying it yields

$$\mu = \frac{1 - \beta - v'(m)/2 - H(\theta)(D + m)}{m + D + \frac{v''(m)}{v'(m)}}. \quad (\text{A-17})$$

The sign of $\mu(\theta)$ depends on the magnitude of manipulation m , the accounting discretion D and the liability share β . Provided a fixed level of m and D , it is obvious that there exists a cut-off point β_0 such that for all $\beta < \beta_0$, the shadow price is positive.

The second order condition is quite complex. Differentiating (A-11), (A-13) and (A-14) totally and using (A-14) yields

$$\left\{ 1 + B - \frac{dH(\theta)}{d\theta} [B - 2\bar{P}g(-m - D)] \right\} d\theta + v'(m) [(1 - \beta) - 1/2 - H(\theta^{**})(m + D)] dm + 2v'(m) [(1 - \beta) - H(\theta)(m + D)] dD = 0,$$

$$- \left[(m + D) \frac{dH(\theta)}{d\theta} \right] d\theta - \left\{ v''(m)/2 + H(\theta) + \mu \left[1 + \frac{d}{dm} \frac{v''(m)}{v'(m)} \right] \right\} dm - \left[(m + D) + \frac{v''(m)}{v'(m)} \right] d\mu - (H(\theta) + \mu) dD = 0,$$

$$- [v'(m)(m + D) + v''(m)] dm - v'(m)(m + D) dD = 0.$$

The determinant of this matrix is

$$\Delta = - \left[1 + B - \frac{dH(\theta)}{d\theta} [B - 2\bar{P}g(D)] \right] \left[m + D + \frac{v''(m)}{v'(m)} \right] [v'(m)(m + D) + v''(m)] < 0.$$

Applying the Cramer's rule leads to

$$\frac{\partial \theta^{**}}{\partial D} = \frac{v'(m)}{\Delta} \left[m + D + \frac{v''(m)}{v'(m)} \right] v'(m)(m + D) + 2v''(m) [(1 - \beta) - H(\theta)(m + D)].$$

This shows that when the magnitude of $[(1 - \beta) - H(\theta)(m + D)]$ is positive, the sign of $\partial \theta^{**} / \partial D$ is negative. Similarly, it is straightforward to show that

$$\frac{\partial m}{\partial D} = - \frac{2\bar{P}g(-m - D)(m + D)}{[2\bar{P}g(-m - D)(m + D) + v''(m)]} < 0.$$

■
Proof of Proposition 6: When the accounting signal can be manipulated, the regulator's welfare function is

$$W = \int_{\theta^{**}}^{\bar{\theta}} \left\{ \begin{array}{l} \left[\theta(1+B) - 1 - (1-\beta) \int_{-\infty}^{-D-m^{**}} 2\bar{P}g(\epsilon) d\epsilon - v(m^{**}) \right] \\ -(1-\alpha)H(\theta)[B - 2\bar{P}g(-D - m^{**})] \end{array} \right\} dF(\theta).$$

I consider the case where the accounting manipulation is possible.

$$\frac{dW}{dD} = \left[\frac{\partial U_I}{\partial \theta^{**}} \frac{d\theta^{**}}{dD} + \frac{\partial U_I}{\partial m^{**}} \frac{dm^{**}}{dD} \right] + \alpha \left[\frac{\partial U_E}{\partial \theta^{**}} \frac{d\theta^{**}}{dD} + \frac{\partial U_E}{\partial m^{**}} \frac{dm^{**}}{dD} \right] + \frac{\partial W}{\partial D} = 0. \quad (\text{A-18})$$

Again per the Envelop Theorem, the first bracket in (A-18) is zero for the hurdle rate θ^{**} and the manipulation m^{**} are chosen to maximize the investor's utility. The second bracket is negative if $[(1-\beta) - H(\theta^{**})(m^{**} + D^{**})]$ is positive. To understand this, first note that

$$\frac{\partial U_E}{\partial \theta^{**}} = -(1 - F(\theta^{**}))[B - 2\bar{P}g(-D - m^{**})] < 0.$$

From Proposition (4), when the term $[(1-\beta) - H(\theta)(m + D)]$ is positive, then $d\theta^{**}/dD < 0$. Second, the insider's utility strictly increases in the manipulation as

$$\frac{\partial U_E}{\partial m^{**}} = \int_{\theta^{**}}^{\bar{\theta}} H(\theta)\bar{P}(D + m^{**})g(-D - m^{**})dF(\theta) > 0,$$

and because $dm^{**}/db < 0$, the insider's utility is decreasing function of the discretion. As such, both terms in the second bracket is negative if $[(1-\beta) - H(\theta)(m^{**} + D)]$ is positive. Thirdly, the regulator's welfare is

$$\frac{\partial W}{\partial D} = \int_{\theta^{**}}^{\bar{\theta}} \bar{P}g(-D - m^{**}) [(1-\beta) - (1-\alpha)H(\theta)(D + m^{**})] dF(\theta),$$

which is positive following the same argument in Proposition 3. Collectively, the optimal discretion

D^{**} must satisfy the first order condition:

$$\begin{aligned} \frac{dW}{dD} &= -\alpha H(\theta^{**})[B - \bar{P}g(-D^{**} - m^{**})]f(\theta^{**})\frac{d\theta^{**}}{dD} \\ &+ \int_{\theta^{**}}^{\bar{\theta}} \bar{P}g(-D^{**} - m^{**}) [(1 - \beta) - (1 - \alpha)H(\theta)(D^{**} + m^{**})] dF(\theta) = 0. \end{aligned} \quad (\text{A-19})$$

Comparing with (??), (A-19) clearly demonstrates the effect of the accounting manipulation. When the accounting manipulation is possible, the impact of the accounting discretion on the rent extraction is weaker as shown by the first term in (A-19). In contrast, the second in (A-19) indicates that the subsidy effect when the accounting manipulation is possible, as m^{**} is strictly positive. To maintain the investor's incentive as same as that without the manipulation, the regulator must further adjust the level of the accounting discretion. By applying the same method as in Proposition 3, I can show that when $[(1 - \beta) - H(\theta)(D^{**} + m^{**})]$ is negative, the second order condition

$$\frac{d^2W}{dD^2} = \alpha \left[\frac{\partial^2 U_E}{\partial \theta^{**} \partial D} \frac{d\theta^{**}}{dD} + \frac{\partial U_E}{\partial \theta^{**}} \frac{d^2 \theta^{**}}{dD^2} + \frac{\partial^2 U_E}{\partial m^{**} \partial D} \frac{dm^{**}}{dD} + \frac{\partial U_E}{\partial m^{**}} \frac{d^2 m^{**}}{dD^2} \right] + \frac{\partial^2 W}{\partial D^2}. \quad (\text{A-20})$$

is satisfied and thus the regulator's problem is concave (detailed proof available upon request). In addition, given that condition, $\partial W / \partial D$ is positive so as to satisfy the first order condition.

Next I characterize the effect of the accounting manipulation on the optimal accounting discretion. Note that the entrepreneur chooses the level of the accounting manipulation by (2.21), that is,

$$\bar{P}g(-D - m^{**}) - v'(m^{**}) = 0.$$

To characterize the effect of the accounting manipulation, assume that $v(m) = \phi m^2 / 2$, where ϕ represents the coefficient for the cost of manipulation. First, when ϕ is close to infinity, implying that the accounting manipulation is very costly, the entrepreneur will lower the magnitude of the accounting manipulation close to zero for $\partial m^{**} / \partial \phi < 0$. Given such high cost of accounting manipulation, the regulator's problem [P_M] is identical to [P] with no manipulation, and the optimal discretion D^{**} is equal to D^* . Second, when ϕ is reasonably small, the accounting manipulation m^{**} is strictly positive. Since the manipulation is strictly positive, it suffices to show that the sign

of $\partial^2 W / \partial D \partial \phi$ so as to compare the magnitude of D^{**} . Taking the second order derivative of dW/dD respect to ϕ yields,

$$\begin{aligned} \frac{\partial^2 W}{\partial D \partial \phi} &= \frac{\partial^2 W}{\partial D \partial m^{**}} \frac{\partial m^{**}}{\partial \phi} = -\frac{1}{s.o.c} \frac{\partial m^{**}}{\partial \phi} \left\{ [-\alpha H(\theta^{**}) \bar{P}g(-D^{**} - m^{**})(D^{**} + m^{**})] f(\theta^{**}) \frac{d\theta^{**}}{dD} \right. \\ &\quad \left. + \int_{\theta^{**}}^{\bar{\theta}} -(D^{**} + m^{**}) \bar{P}g(-D^{**} - m^{**}) [(1 - \beta) - (1 - \alpha)H(\theta)(D^{**} + m^{**})] dF(\theta) \right. \\ &\quad \left. + \int_{\theta^{**}}^{\bar{\theta}} -\bar{P}g(-D^{**} - m^{**})(1 - \alpha)H(\theta) dF(\theta) \right\} > 0 \end{aligned} \quad (A-21)$$

where *s.o.c* denotes the second order condition in (A-20). (A-21) indicates that the level of the accounting discretion increases in the cost of the accounting manipulation and thereby decreases in the optimal level of the accounting manipulation. In other words, when the cost of manipulation is extremely large, m^{**} is close to zero and $D^{**} = D^*$; however, when the cost of manipulation is recently small, the entrepreneur manipulates the accounting signal upward and the regulator must set the optimal level of the accounting discretion lower (that is, $D^{**} < D^*$), which is closer to a rule-based accounting system. ■

Proof of Proposition 9: Assume the entrepreneur gains a private benefit B for the second period. The project will be success in the period 1 with probability p . Recall that the entrepreneur's utility is

$$U_E(p; b) = \int_{b-p}^{\infty} Bg(\epsilon) d\epsilon - \psi(p).$$

The investor's utility is

$$U_I(b, p) = \int_{-\infty}^{b-p} Cg(\epsilon) d\epsilon + \int_{b-p}^{\infty} Vpg(\epsilon) d\epsilon - I$$

Note that the entrepreneur's incentive compatibility must be satisfied

$$U_E(p; b) \geq 0,$$

which suggests that

$$\int_{b-p}^{\infty} Bg(\epsilon)d\epsilon = \psi(p),$$

The moral hazard constraint is

$$\frac{dU_E}{dp} = Bg(b-p) - \psi'(p) = Bg(b-p) - \psi'(p) = 0. \quad (\text{A-22})$$

Substituting it into the investor's utility, I have the Lagrangian of this problem is

$$\mathcal{L}(p, b, \lambda) = \left[\int_{-\infty}^{b-p} Cg(\epsilon)d\epsilon + \int_{b-p}^{\infty} Vpg(\epsilon)d\epsilon - I \right] + \lambda [Bg(b-p) - \psi'(p)],$$

where λ is the shadow price of the moral hazard constraint in the entrepreneur's effort. Taking a first order condition of the Lagrangian with respective p and b yields:

$$\frac{\partial \mathcal{L}}{\partial b} = g(b-p) [C - Vp - \lambda B(b-p)/\sigma] = 0. \quad (\text{A-23})$$

$$\frac{\partial \mathcal{L}}{\partial p} = -Cg(b-p) + Vpg(b-p) + \int_{b-p}^{\infty} Vg(\epsilon)d\epsilon + \lambda \{ [B(b-p)/\sigma]g(b-p) - \psi''(p) \} = 0 \quad (\text{A-24})$$

Substituting (A-23) into (A-24) yields

$$\frac{\partial \mathcal{L}}{\partial p} = \int_{b-p}^{\infty} Vg(\epsilon)d\epsilon - \lambda \psi''(p) = 0. \quad (\text{A-25})$$

Equation (A-25) implies

$$\lambda = \frac{\int_{b-p}^{\infty} Vg(\epsilon)d\epsilon}{\psi''(p)},$$

which is strictly positive. From (A-23), the solution to b is straightforward

$$b^* = \frac{[C - Vp]\sigma}{B\lambda} + p^*,$$

where p^* is the solution to (A-25). ■

Proof of Corollary 10: The second order condition is quite complex. Differentiating (A-25)

and (A-23) totally yields the Hessian matrix of the Lagrangian:

$$\begin{bmatrix} -\lambda B/\sigma & -V + \lambda B/\sigma \\ Vg(b-p) & -Vg(b-p) \end{bmatrix}$$

which is nonsingular since its determinant

$$\Delta = g(b-p)V^2 > 0. \quad (\text{A-26})$$

Applying the Crammer's rule, I can show

$$\frac{\partial b}{\partial V} = \int_{b-p}^{\infty} [V - \lambda B/\sigma]g(\epsilon)d\epsilon - g(b-p)Vp < 0,$$

which is negative when the expected value V is reasonable large and

$$\frac{\partial b}{\partial \sigma} = \frac{\partial p}{\partial \sigma} = \frac{1}{\Delta} [B(b-p)g(b-p)V\lambda] < 0.$$

Similarly, given $b < p$,

$$\frac{\partial b}{\partial B} = -\frac{1}{\Delta} g(b-p)(b-p)V\lambda > 0.$$

■

Proof of Proposition 11: The entrepreneur's expected utility function is

$$E[U_E(p; b)] = \int_{b-p}^{\infty} Bg(\epsilon)d\epsilon + \int_{b-p}^{\infty} pDg(\epsilon)d\epsilon - \psi(p) - A. \quad (\text{A-27})$$

That is, the entrepreneur must choose his effort so as to maximize his utility. Taking a derivative of the entrepreneur's utility with respect to p

$$\frac{dU_E}{dp} = (B + pD)g(b-p) - \psi'(p) = 0. \quad (\text{A-28})$$

The investor's utility is specified as

$$E[U_I(p, b)] = \int_{-\infty}^{b-p} Cg(\epsilon)d\epsilon + \int_{b-p}^{\infty} (V - D)pg(\epsilon)d\epsilon - E.$$

The Lagrangian can be written as

$$\mathcal{L}(p, b, \lambda) = \left[\int_{-\infty}^{b-p} Cg(\epsilon)d\epsilon + \int_{b-p}^{\infty} (V-D)pg(\epsilon)d\epsilon - E \right] + \lambda [(B+pD)g(b-p) - \psi'(p)].$$

$$\frac{\partial \mathcal{L}}{\partial p} = -Cg(b-p) + (V-D)pg(b-p) + \int_{b-p}^{\infty} (V-D)g(\epsilon)d\epsilon \quad (\text{A-29})$$

$$+ \lambda \{ Dg(b-p) + [B+pD][(b-p)/\sigma]g(b-p) - \psi''(p) \} = 0$$

$$\frac{\partial \mathcal{L}}{\partial b} = g(b-p) [C - (V-D)p - \lambda[(B+pD)(b-p)/\sigma]] = 0. \quad (\text{A-30})$$

From (A-30), the optimal level of the threshold is given by

$$b = \frac{[C - (V-D)p]\sigma}{\lambda[B+Dp]} + p, \quad (\text{A-31})$$

where p is the solution to (A-29). Equation (A-29) can be written as

$$\frac{\partial \mathcal{L}}{\partial p} = \int_{b-p}^{\infty} (V-D)g(\epsilon)d\epsilon - \lambda [\psi''(p) - Dg(b-p)] = 0,$$

which implies

$$\lambda = \frac{\int_{b-p}^{\infty} (V-D)g(\epsilon)d\epsilon}{\psi''(p) - Dg(b-p)}. \quad (\text{A-32})$$

Given the optimal choice of p^M and b^M satisfying (A-29), (A-30) and (A-28), the investor's welfare under managerial ownership can be written as

$$W = \left[\int_{-\infty}^{b^M-p^M} Cg(\epsilon)d\epsilon + \int_{b^M-p^M}^{\infty} (V-D)p^Mg(\epsilon)d\epsilon - E \right] + \lambda [(B+p^MD)g(b^M-p^M) - \psi'(p^M)].$$

Given a fixed level of assets A , I can take a derivate with respect to D

$$\frac{dW}{dD} = \frac{\partial W}{\partial b} \frac{\partial b}{\partial p} \frac{dp}{dD} + \frac{\partial W}{\partial D}.$$

From the envelop theorem, it can be shown

$$\frac{dW}{dD} = p^M g(b^M - p^M) \left[\lambda^M - \frac{1 - G(b^M - p^M)}{g(b^M - p^M)} \right].$$

Note that $dW/dD = 0$ at

$$\lambda^M = \frac{1 - G(b^M - p^M)}{g(b^M - p^M)} = \frac{\int_{b^M - p^M}^{\infty} (V - D)g(\epsilon)d\epsilon}{\psi''(p^M) - Dg(b^M - p^M)}. \quad (\text{A-33})$$

Simplifying (A-33), I note that the sign of dW/dD is the sign of $(Vg(b^M - p^M) - \psi'')$. In other words, when the cost of disutility ψ'' is small, the expected social welfare W increases in the dividend payment. Next, following the similar approach as in Proof of Corollary 10, the determinant of the Hessian matrix is $\Delta^M = [D(b - p)\lambda + \sigma(V - D)]^2 / \sigma^2 > 0$. Applying the Cramer's rule, I obtain

$$\frac{\partial b}{\partial D} = \frac{1}{\Delta^M} \begin{bmatrix} -p[1 - \lambda(b - p)/\sigma] & -(V - D) - \lambda[D(b - p)/\sigma - (B + pD)/\sigma] \\ -[1 - G(b - p)]/g(b - p) - \lambda & -(V - D) - \lambda D(b - p)/\sigma \end{bmatrix}. \quad (\text{A-34})$$

Substituting in (A-31) into (A-34), I obtain that $p[1 - \lambda(b - p)/\sigma] > 0$ and $-(V - D) - \lambda D(b - p)/\sigma < 0$. Then it is clear that the sign of $\partial b/\partial D$ is strictly positive, at $Vg(b^M - p^M) = \psi''$. Similarly, it can shown that $\partial p/\partial D < 0$. Thirdly, I examine the second order condition, evaluated at $Vg(b^M - p^M) = \psi''$:

$$\left. \frac{d^2W}{dD^2} \right|_{Vg(b^M - p^M) = \psi''} = p^M g(b^M - p^M) \left[\frac{d\lambda^M}{dD} - \frac{d}{dD} \frac{1 - G(b^M - p^M)}{g(b^M - p^M)} \right],$$

which is positive. Thus, in the neighborhood of $Vg(b^M - p^M) = \psi''$, the impact of managerial ownership D is driven by the second derivative, which is always positive. Managerial ownership dominates. ■

Proof of Proposition 12. The entrepreneur's utility is

$$U_E(b(\hat{B}), p(B), \hat{B}; B) = \int_{b(\hat{B}) - p}^{\infty} Bg(\epsilon)d\epsilon - \psi(p).$$

The first order condition of incentive compatibility is

$$-Bg(b(B) - p)\dot{b}(B) = 0, \quad (\text{A-35})$$

and the second order condition is

$$g(b(B) - p)\dot{b}(B) \leq 0. \quad (\text{A-36})$$

Equations (A-35) and (A-36) constitute necessary and sufficient conditions for incentive compatibility. I need to check that the entrepreneur does not want to lie globally either. Therefore the following conditions must also be held:

$$U_E(B; B) \geq U_E(\hat{B}; B),$$

which implies

$$U_E(B; B) - U_E(\hat{B}; \hat{B}) \geq U_E(\hat{B}; B) - U_E(\hat{B}; \hat{B}).$$

In other words,

$$\int_{\hat{B}}^B \left[\frac{dU_E}{dB}(t; t) - \frac{dU_E}{dB}(\hat{B}; t) \right] dt \geq 0.$$

Substituting for dU_E/dB yields

$$\int_{\hat{B}}^B \left[\int_{b(B)-p}^{\infty} dG(\epsilon) - \int_{b(\hat{B})-p}^{\infty} dG(\epsilon) \right] dt \geq 0$$

Given $\dot{b}(B) \leq 0$, the condition is held for all $B > \hat{B}$, that is, the global incentive compatibility must be satisfied as well.

Taking a first order condition with respect to B , I have

$$\frac{dU_E}{dB} = \frac{\partial U_E}{\partial \hat{B}} \frac{d\hat{B}}{dB} + \frac{dU_E}{dB} = \int_{b-p}^{\infty} g(\epsilon) d\epsilon. \quad (\text{A-37})$$

The moral hazard constraint is given by

$$\frac{dU_E}{dp} = Bg(b-p) - \psi'(p) = 0.$$

The investor's utility is

$$U_I = \int_{-\infty}^{b-p} Cg(\epsilon)d\epsilon + \int_{b-p}^{\infty} Vpg(\epsilon)d\epsilon.$$

I then apply the optimal control theory to solve this optimization problem. Letting p and b the control variables and U_E the state variable, the Lagrangian for this optimization problem is

$$\begin{aligned} \mathcal{L}(p, b, \lambda; B) = & \left[\int_{-\infty}^{b-p} Cg(\epsilon)d\epsilon + \int_{b-p}^{\infty} Vpg(\epsilon)d\epsilon - I \right] f(B) + \lambda f(B) [Bg(b-p) - \psi'(p)] \\ & + \rho \int_{b-p}^{\infty} g(\epsilon)d\epsilon, \end{aligned}$$

where $\lambda f(B)$ is the shadow price of the moral hazard constraint in the entrepreneur's effort and ρ is the shadow price for the self-selection constraint. Taking a first order condition of the Lagrangian with respective p and b yields

$$\begin{aligned} \frac{\partial \mathcal{L}}{\partial p} = & \left[-Cg(b-p) + Vpg(b-p) + \int_{b-p}^{\infty} Vg(\epsilon)d\epsilon \right] f(B) \\ & + \lambda f(B) [B(b-p)g(b-p)/\sigma - \psi''(p)] + \rho g(b-p) = 0 \end{aligned}$$

and

$$\frac{\partial \mathcal{L}}{\partial b} = g(b-p) \{ [C - Vp] f(B) - \lambda f(B) B(b-p)/\sigma - \rho \} = 0 \quad (\text{A-38})$$

And taking a derivative with respect to the state variable, I have

$$-\frac{\partial \mathcal{L}}{\partial U_E} = \dot{\rho}(\theta) = f(B).$$

which suggests that

$$\rho(B) = F(B) + c,$$

where c is a constant. Note that the state U_E is unconstrained at \bar{B} , that is,

$$\rho(\bar{B}) = c + F(\bar{B}) = 0,$$

which suggests that $c = -1$. Substituting it back to (??) and (A-38) yields

$$\int_{b-p}^{\infty} Vg(\epsilon)d\epsilon - \lambda\psi''(p) = 0,$$

and

$$[C - Vp] - \lambda B(b - p)/\sigma + [1 - F(B)]/f(B) = 0.$$

This suggests

$$b = \frac{\{C - Vp + [1 - F(B)]/f(B)\}\sigma}{B\lambda} + p.$$

It can be shown that as the second order condition is satisfied,

$$\frac{\partial b}{\partial B} = \frac{1}{\Delta} g(b - p)V \left[-(b - p)\lambda/\sigma + \frac{d}{dB} \left[\frac{1 - F(B)}{f(B)} \right] \right].$$

where Δ is the determinant of the Lagrangian and is positive. The sign of $\partial b/\partial B$ is positive if the information rent $(1 - F(B))/f(B)$ is small. ■

Proof of Proposition 13: The entrepreneur's utility now needs reflect the impact of the side-payment to the auditor, which is given by

$$U_E(p; b, a) = (1 - \hat{a}) \left[\int_{b-p}^{\infty} Bg(\epsilon)d\epsilon - \psi(p) \right] + \hat{a} \left[\int_{b-p-m}^{\infty} Bg(\epsilon)d\epsilon - \psi(p) - P \right]. \quad (\text{A-39})$$

When the constraint (3.25) is satisfied, the auditor has no incentive to conclude with the entrepreneur, so that $\hat{a} = 0$. Thus I can simplify the investor's utility as

$$U_I(p; b, \hat{a} = 0) = \int_{-\infty}^{b-p} Cg(\epsilon)d\epsilon + \int_{b-p}^{\infty} Vpg(\epsilon)d\epsilon - I - \left[\int_{b-p-m}^{b-p} Bg(\epsilon)d\epsilon - k_c \right]. \quad (\text{A-40})$$

Equation (A-40) clearly demonstrates that the investor's utility decreases in the discretion d , but

increases in the transaction cost k_c . The Lagrangian for this problem is

$$\mathcal{L} = \left[\int_{-\infty}^{b-p} Cg(\epsilon)d\epsilon + \int_{b-p}^{\infty} Vpg(\epsilon)d\epsilon - I - \left(\int_{b-p-m}^{b-p} Bg(\epsilon)d\epsilon - k_c \right) \right] + \lambda[Bg(b-p) - \psi'(p)] \quad (\text{A-41})$$

Taking first order conditions with respect to the Lagrangian yields

$$\begin{aligned} \frac{\partial \mathcal{L}}{\partial p} &= -Cg(b-p) + Vpg(b-p) + \int_{b-p}^{\infty} Vg(\epsilon)d\epsilon - B[g(b-p) - g(b-p-m)] \\ &\quad + \lambda[B(b-p)g(b-p)/\sigma - \psi''(p)] = 0, \\ \frac{\partial \mathcal{L}}{\partial b} &= g(b-p)[C - Vp - \lambda B(b-p)/\sigma - B[1 - g(b-p-m)/g(b-p)]] = 0. \quad (\text{A-42}) \end{aligned}$$

which suggests that

$$b = \frac{\left[C - Vp - B \left(1 - \frac{g(b-p-m)}{g(b-p)} \right) \right] \sigma}{\lambda B} + p.$$

After substituting (??) for (A-42), the optimal solution for entrepreneur's effort is

$$\frac{\partial \mathcal{L}}{\partial p} = \int_{b-p}^{\infty} Vg(\epsilon)d\epsilon - \psi''(p) = 0.$$

To characterize the impact of the discretion on the accounting policy, I can show the Hessian matrix of the Lagrangian (A-41) is

$$\begin{bmatrix} -\lambda B/\sigma + \frac{d}{db} \frac{g(b-p-m)}{g(b-p)} & -V + \lambda B/\sigma + \frac{d}{dp} \frac{g(b-p-m)}{g(b-p)} \\ Vg(b-p) & -Vg(b-p) \end{bmatrix}.$$

which is nonsingular since its determinant is positive. Applying Crammer's rule, I can show

$$\frac{\partial b}{\partial m} = \frac{\partial b}{\partial p} = \frac{1}{\Delta} \left[\frac{d}{dm} \frac{g(b-p-m)}{g(b-p)} BVg(b-p) \right].$$

Note that the sign of $\frac{d}{dm} \frac{g(b-p-m)}{g(b-p)}$ is the same as the sign of $(b-p-m)$. When the value of the project is reasonably large, $b < p$ and therefore $\partial b/\partial m < 0$. ■