The Signaling Role of Accounting Conservatism in Debt Contracting

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Abstract

Empirical studies have documented that firms that report more conservatively are charged a lower interest rate. Following these empirical findings, there has been a debate over the rationale and economic consequences of accounting conservatism. In this paper, we attempt to shed some light on this debate. We argue that the prospect of signaling project return may give rise to the demand for conservative accounting, even though it may not necessarily improve contracting efficiency ex post. This suggests that the negative correlation between lower interest rates and conservative accounting may be explained by the heterogeneity among firms, such as riskiness, leverage ratio and the strength of balance sheet. By incorporating the effort decisions, we show that effort inefficiency may result from the non-contractible efforts and from the asymmetric payoff structures between debtholders and equityholders. Finally, our results indicate that conditional conservatism may either alleviate or amplify the distortion required for the signaling purpose.

Keywords: accounting conservatism, game theory, signaling, real effects

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1 Introduction

Empirical studies have suggested that firms that report more conservatively are charged a lower interest rate, have conservative covenant modifications and are more likely to have smaller bid-ask spreads in the debt markets (see Ahmed and Standford-harris (2002), Armstrong et al. (2009), Zhang (2008), and the references cited therein). Watts (2003) attributes these findings to higher efficiency of debt contracting. He argues that, because of the asymmetric payoffs in a debt contract, debtholders benefit from more timely loss recognition than from timely gain recognition. Thus, accounting conservatism may improve the efficiency of debt contracting, which in turn gives rise to lower interest rates.

In an influential paper, Gigler et al. (2009) analyze the link between accounting conservatism and the efficiency of debt contracting. They illustrate that accounting conservatism may diminish the information content of an accounting system. A more conservative accounting system increases the expected cost of incorrectly liquidating a profitable project, but reduces the expected cost of excessive optimism. When the former effect is stronger than the latter one, the efficiency of debt contracts may be lower as a result of accounting conservatism. Moreover, they show that a lower interest rate and the frequency of passing decision rights to debtholders are substitutes, suggesting that such a negative association does not result from higher efficiency of debt contracting.

This study intends to provide theoretical grounds for such empirical findings. Specifically, we argue that conservative accounting can be a signaling device to convey a firm’s private information in order to raise external capital. This signaling incentive may provide another rationale for why firms that report conservatively are charged a lower interest rate. To elaborate on this, consider a debt covenant that might trigger liquidation when future accounting information reveals bad news before the maturity of debt. Reporting conservatively results in a higher chance of liquidation, which is costly because firms are unlikely to retain any value from it. More importantly, it may be more costly for more risky firms with weaker balance sheet, because they are more vulnerable to the covenant violation and thus cannot afford using conservative reporting to raise a debt. This suggests that in the presence of information asymmetry, less risky firms with stronger financial positions can utilize conservative accounting to distinguish itself from weaker firms. In this aspect, our study complements Gigler et al. (2009) by examining the effect of accounting conservatism when residual claimants have private information about future project return. Our analysis suggests that the negative correlation between lower interest rates and conservative accounting may be explained
by the heterogeneity (riskiness) of firms’ project quality.

To analytically demonstrate this argument, we build on the model by Gigler et al. (2009) and Innes (1990) in which an entrepreneur owns an investment project and seeks for capital funding from an investor. The project is risky and the entrepreneur is privileged with private information about the project return. Facing such an adverse selection problem, the entrepreneur can only rely on an accounting system that generates informative but noisy signals for the project return. The entrepreneur is allowed to choose the degrees of accounting conservatism when contracting with the investor, which determines the correlation between the accounting signal and the project return. If the interim accounting signal is not favorable, the control right of the project will be shifted to the investor who then may write off the project before actual project outcome is realized.

We show that the prospect of signaling project return may give rise to the demand for conservative accounting, even though it may not necessarily improve contracting efficiency ex post. Specifically, the less risky entrepreneur chooses a more conservative accounting system in order to signal her type. In this model, the more conservative accounting system is, the more likely an unfavorable (low) signal will be released. As the investor may choose to liquidate the project upon receiving a low accounting report, it is then more costly for the more risky entrepreneur to commit accounting conservatism than for the less risky one.

Our analysis further demonstrates that entrepreneurs reporting conservative accounting tend to show the following characteristics. When the amount of capital borrowing is higher, entrepreneurs need to commit more conservative accounting, suggesting that conservatism is positively correlated with leverage. An entrepreneur with a less risky project tends to choose more conservative accounting to signal its private information. All else being equal, tangible assets tend to be less risky and have a higher liquidation value. It is shown that investors request a lower repayment when investment projects are funded more by less-risky tangible assets than by risky intangible assets. Thus, our analysis suggests that the degree of accounting conservatism is positively associated with the strength of balance sheet (represented by the level of tangible assets).

We further extend our analysis to incorporate the real effects of accounting conservatism. In pursuit of this goal, we suppose that this effort can be taken either by the entrepreneur before contracting with the investor or by the investor after the project is funded. On top of the existing adverse selection problem, effort inefficiency may result from the non-contractibility (a moral hazard problem) and from the asymmetric payoff structures between the investor (debtholder) and the entrepreneur. On the one hand, since the high-type entrepreneur intends to signal her type via
conservatism, she cannot fully endogenize the benefit of additional effort; as a result, her effort decision is downward distorted. On the other hand, because the investor receives a fixed payment irrespective of the level of realized project return when the project is successful, the investor tends to put more attention on the liquidation value while making her effort decision. Overall, we observe that accounting conservatism may not only have adverse selection effects on the entrepreneur’s payoff, but also have incentive effects on the effort decisions.

We can also articulate the difference between the conditional and unconditional conservatism in this signaling context. Following Gigler et al. (2009), the major difference is that conditional conservatism imposes more stringent verifiability for reporting a good state than for reporting a bad state.\footnote{This notion is consistent with Basu (1997) and Watts (2003) who define accounting conservatism in terms of differential verifiability standards that must be met for measuring and incorporating good and bad news in accounting reports.} This distribution function consequently changes the investor’s required payment and the more risky entrepreneur’s incentive to mimic the less risky one. A rather surprising result is that, as conditional conservatism tilts the accounting signal toward reporting the low signal, the distortion required for the signaling purpose may be either alleviated or exacerbated. In Section 4, we provide detailed conditions under which conditional conservatism helps mitigating the signaling cost.

As we allow the entrepreneur to choose the conservatism level, our model is related to the evidence of conservative choices\footnote{Conservative accounting choices refer to the situation in which firms adopt more conservative options among allowable options when reporting discretion is exercised (Bagnoli and Watts (2005)).} documented in the literature and in practice. Basu and Waymire (2008) posit that the reason General Electric wrote off its intangible assets in 1907, the first company intentionally understating intangibles in history, was to signal its financial position in order to raise external capital. Leftwich (1983) documents that firms typically modify GAAP conservatively in debt contracts. El-Gazzar and Pastena (1990) provide specific examples on how GAAP rules were tailored conservatively for debt contracting (in their Appendix 2). Ahmed and Standford-harris (2002) further find that firms adopting more conservative accounting incur a lower cost of debt (also see Zhang (2008)). In practice, when firms adopt conservative accounting choices, debt rating agencies would explicitly address that in their credit reports and assign them with lower risk premium (Glater (2003) and Ward (2002)). For example, GM, which was known for the most conservative accounting, lost its investment-grade bond rating for adopting liberal accounting rules in 2006 (Norris (2006)). Finally, Bagnoli and Watts (2005) argue that in presence of information
asymmetry, a conservative accounting choice can be used to infer a manager’s private information. In particular, they provide ample evidence of how a manager can communicate its accounting choices to investors and analysts through financial statements and press releases (see the references cited therein).

Our work adds to the recent debate on accounting conservatism and efficiency of debt contract, including Armstrong et al. (2009), Gigler et al. (2009), Guay and Verrecchia (2006), Li (2009), Watts (2003), and Zhang (2008). Our results complement theirs by showing that accounting conservatism can be a signaling device in debt contracting and can subsequently give rise to distortions on capital investment; thus, our results indicate that when the cost of information asymmetry is high, accounting conservatism can improve social welfare. This paper is also related to the accounting literature on signaling games. Fan (2007) and Baldenius and Meng (2009) consider a model in which an entrepreneur intends to signal her private information by offering shares to investors or by reporting earnings. Allowing the investors to exert costly effort, they elaborate on how its contractibility affects the investors’ effort and mitigate or exacerbate the cost of signaling. Hughes and Schwartz (1988) argue that a FIFO accounting choice can be a credible signal of favorable private information, which leads to an increase in the market value of the entrepreneur. Bagnoli and Watts (2005) consider a market setting in which a manager trades off between the market value of a firm and beating earnings expectation. They show that a separating equilibrium can occur when the cost of missing earnings expectations is high. In contrast, we demonstrate that in debt contracting setting, conservative accounting choices can be a signaling mechanism, but the signaling cost is resulted from the different payoff structures between equityholders and debtholders.

This work is related to various studies in the literature in which accounting conservatism may play a stewardship role in order to mitigate agency costs. Gigler and Hemmer (2001) consider a principal-agent setting in which the agent can make a voluntary disclosure prior to an ex post, noisy earnings report. They find that the value of communication strictly decreases 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

\[ \text{Li (2009) allows for renegotiation and finds that when debt covenants are not renegotiable or when renegotiation cost is sufficiently high, more conservative accounting actually reduces the efficiency of debt contracts. In other words, conservatism accounting can be suboptimal for debt holders’ perspective.} \]

\[ \text{Zhang (2008) empirically finds that conservatism to benefit lenders ex post through the timely signaling of default risk, as manifested by accelerated covenant violations, and to benefit borrowers ex ante through lower initial interest rates.} \]
correlated with the agent’s private information. The analysis shows that if the transfer payments are unbounded, the degree of conservatism in the accounting system is inconsequential and the first-best investment can be implemented. Chen et al. (2007) show that when accounting information serves both valuation and stewardship purposes, accounting conservatism may effectively reduce a manager’s incentive to conduct earnings management. While conservatism makes accounting numbers less valuable for stewardship in their model, our model suggests that conservatism may play an essential role in mitigating agency problems. Kwon et al. (2001) argue that, in the context of moral hazard problem, accounting conservatism may emerge as an optimal solution in the presence of limited liability because it increases the likelihood ratios for higher ex post outcome reports. Raith (2009) studies a two-period moral hazard problem in which a manager can be compensated based on an early signal of a future outcome of his action, or (later) based on the outcome itself. He shows that conservative accrual accounting can be optimal when the manager cannot commit to a long-term contract.

The article is organized as follows. Section 2 describes the formal model. Section 3 provides the equilibrium analysis. In Section 4, we extend our analysis to incorporate the real effects and the conditional conservatism. Section 5 concludes. All the proofs are in the appendix.

2 The Model

We consider a model in which a risk-neutral entrepreneur owns an asset $A$ and seeks additional funding from a risk-neutral investor to finance an investment project. The project requires cash inflow $I > A$; thus, if the investor agrees to finance the project, her capital funding is $D = I - A$. The project is risky and its outcome depends on the state of the world. The entrepreneur can be of two types. A less risky entrepreneur has a probability of success or “Good” state equal to $p^h$, and the project yields return $R^h$ in the case of success and zero in the case of failure or “Bad” state. A risky entrepreneur has a probability of success equal to $p^l$ with project return $R^l$, where $0 < p^l < p^h < 1$. We conveniently label the entrepreneur who observes $p^h$ as a high type, and the entrepreneur who observes $p^l$ as a low type. The investor has no access to the entrepreneur’s type; from her perspective, the high type and low type arise with the prior probabilities $\theta$ and $1 - \theta$, respectively ($0 < \theta < 1$). The capital market is assumed to be competitive in the sense that the investor demands an expected rate of return normalized to zero. Facing such an adverse selection problem, the entrepreneur should rely on other sources of information in order to determine whether
to finance the project.

In our model, there exists an accounting system that can generate, after the project is funded, one of two possible signals: $S_H$ or $S_L$. These signals are informative about the state of project return; thus, the investor may rely on the accounting system to mitigate the information asymmetry problem. Given the states of the world, the accounting system generates the signals with the following conditional probabilities:

\[
\begin{align*}
P(S_H | G) &= \lambda + \delta, \text{ and } P(S_L | G) = 1 - \lambda - \delta, \\
P(S_H | B) &= \delta, \text{ and } P(S_L | B) = 1 - \delta,
\end{align*}
\]

where $0 \leq \lambda \leq 1$ and $0 \leq \delta \leq 1 - \lambda$ to ensure that the conditional probabilities are well-behaved. The above specification is consistent with the strict monotone likelihood ratio property (MLRP).\(^5\)

The informativeness of the signals crucially depends on the two parameters $\delta$ and $\lambda$. First, the posterior probabilities are given by $P(G | S_H) = [(\lambda + \delta)\theta]/(\lambda \theta + \delta)$ and $P(B | S_L) = [(1 - \delta)(1 - \theta)]/(1 - \lambda \theta - \delta)$. The parameter $\delta$ represents an index of unconditional conservatism in the manner of Venugopalan (2006) and Gigler et al. (2009). When $\delta$ is lower, the accounting system is more likely to report $S_L$, irrespective of the state of nature. Thus a decrease in $\delta$ makes the accounting system more conservative unconditionally.\(^6\) This suggests that unconditional conservatism makes the accounting system more informative at the top end (signal $S_H$) and less informative at the bottom end (signal $S_L$). In contrast, the parameter $\lambda$ captures the degree of informativeness in the accounting system. This is because an increase in $\lambda$ decreases the “error” associated with signal $S_H$ when the state is $G$, but leaves the “error” associated with signal $S_L$ unchanged when the state is $B$.\(^7\) A graphic illustration of these probabilities (for an exogenously given conservatism level $\delta$) is provided in Figure 1.

\(^5\)Given the binary nature of the accounting signal, MLRP is equivalent to the condition that the likelihood of obtaining the signal $S_H$ is higher when the state is $G$ than when the state is $B$, i.e., $P(S_H | G) > P(S_H | B)$.

\(^6\)One can verify that the parameter $\delta$ satisfies those four conditions in Gigler et al. (2009) under which unconditional conservatism can be represented statistically. The condition (A1) is satisfied: $P(S_H | G, \delta)/P(S_H | B, \delta) = (\lambda + \delta)/\delta > 1$ and $P(S_L | G, \delta)/P(S_L | B, \delta) = (1 - \lambda - \delta)/(1 - \delta) < 1$. The condition (A3) is satisfied because $d[P(S_H | G, \delta)/P(S_H | B, \delta)]/d\delta < 0$ and $d[P(S_L | G, \delta)/P(S_L | B, \delta)]/d\delta < 0$. Finally, the conditions (A2) and (A4) are satisfied as $d[P(S_H | G, \delta)]/d\delta = d[P(S_H | B, \delta)]/d\delta = 1 > 0$.

\(^7\)This property can be verified by the following derivatives: $dP(G | S_H)/d\lambda = [\delta \theta (1 - \theta)]/(\delta + \theta \lambda)^2 > 0$ and $dP(B | S_H)/d\lambda = [\theta (1 - \delta)(1 - \theta)]/(1 - \delta - \lambda \theta)^2 > 0$.

\(^8\)The characterization of the accounting system is consistent with prior accounting literature. See the discussion in Venugopalan (2006) and Gigler et al. (2009) and the references therein.
We make three more assumptions to facilitate the analysis. First, a risky project yields higher return $R_l$ in the case of success than a less risky one $R_h$, (that is, $R_l > R_h$), implying that the probabilities of success ($p_h$ and $p_l$) are inversely related to the project return ($R_h$ and $R_l$). This assumption reflects the nature that a less risky project has a higher probability of success and yet yields lower return than does a more risky project. Moreover, as we demonstrate in Section 3, this condition is required if the entrepreneur intends to distinguish herself from others. Second, we assume the expected return of a good project is higher than that of a bad project ($p_h R_h > p_l R_l$). This is reminiscent of the classical Spence-Mirrlees single-crossing condition commonly adopted in the signaling literature (see, e.g., Baldenius and Meng (2009), Fan (2007), and Spence (1973)). Thus from the perspective of the investor (as a debtholder), the investment project owned by the high-type entrepreneur is more desirable.

When contracting with the investors, the entrepreneur intends to choose the degrees of unconditional conservatism in order to overcome the adverse selection problem. The entrepreneur can only signal her type through the choice of unconditional conservatism, $\delta$, and the informativeness regarding the accounting signal is independent of the state, i.e., $\lambda = \bar{\lambda}$. The selection of $\delta$ is made public and serves as a signaling device for the entrepreneur to convey her private information. In response, the investor determines whether to fund the project and the financing is modelled as a debt contract that is specified as follows. If the project is indeed funded, the accounting system reports a signal before the project return is realized, and such a signal allows the contracting parties to pull back from a potential failure. We assume that upon receiving a low signal $S_L$, the project is liquidated and the investor receives an asset value $C_l$, leaving the entrepreneur empty-handed. On the other hand, if a high signal $S_H$ is reported, the investor continues holding the project and the project return (either successful or unsuccessful) is realized. We further assume that the high-type (less risky) entrepreneur’s project generates liquidation value higher than the low-type entrepreneur’s $C_h > C_l$. Thus, the liquidation value is negatively associated with the riskiness of

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9The analysis of conditional conservatism is deferred to Section 4.2.
10We abstract away the issues related to debt covenants and focus on analyzing whether accounting conservatism can be a signaling device. In this binary-signal setting, we simply assume that when the accounting signal is low, a debt covenant will be binding, thereby triggering liquidation. One can further assume that upon observing a low signal, the investor, with some probabilities, may determine whether to liquidate the project or not. Our results are not sensible to this assumption, as long as that probability of liquidating the project is common knowledge. Nevertheless, we also acknowledge that in a continuous setting, the relation between debt covenants and conservatism is more subtle if conservatism does not take the form of a downward monotone transformation of accounting signal (see Gigler et al. (2009)).
the project. In addition, the project return shall be sufficiently large $p^i R^i > C^i$ for all $i \in \{h, l\}$, so that the funding is always desirable for both types of entrepreneurs. If the project is successful, the investor receives a fixed payment $F$ (based on the market rate) and the entrepreneur retains the residual value $R - F$. However, if the project is unsuccessful, both parties receive nothing.

The timing of the game is as follows. At the beginning, the entrepreneur privately observes the probability of success (i.e., her type). She then proposes a level of accounting conservatism $\delta$ and a required funding $D = I - A$ to the investor. Based on this signal, the investor updates her belief about the expected return of the project and evaluates whether to fund the project. If the investor decides not to fund the project, the game ends and each party receives a null payoff. On the other hand, if the project is funded (and thus implemented), the investor requests a fixed payment $F$ that is collected contingent upon the non-liquidated successful project. The accounting system reports the signal following the level of conservatism ($\delta$ or $\lambda$) proposed by the entrepreneur. If the signal is low $S_L$, the project is liquidated and the investor receives a fixed liquidation value $C^i$, and the game ends. Otherwise, the project continues until its return is realized; the investor and the entrepreneur receive the payments in accordance with the debt contract. In Figure 2, we briefly summarize the sequence of events.

Given the aforementioned accounting system and the financial contract, we can express their corresponding payoffs explicitly as follows. Suppose that the entrepreneur has chosen a pair of conservatism parameters ($\delta$, $\lambda$) and assume that the investor funds the project. In such a scenario, the entrepreneur collects the residual value of the project if and only if the project is not liquidated and eventually turns out to be successful. Thus, the entrepreneur obtains

$$U^i_E = p^i(\lambda + \delta)(R^i - F^i) - A,$$  

where $p^i(\lambda + \delta)$ corresponds to the probability of seeing a non-liquidated successful project, $(R - F^i)$ is the net payoff the entrepreneur obtains after paying back $F^i$ to the investor, and $A$ is the cash commitment out of the entrepreneur’s pocket.

The investor’s payoff, upon funding the project, depends on the probability of success that is the entrepreneur’s private information. The investor’s expected payoff from contracting with a type-$i$ entrepreneur is

$$U^i_I = p^i(\lambda + \delta)F^i + p^i(1 - \lambda - \delta)C^i + (1 - p^i)(1 - \delta)C^i - (I - A).$$  

The first term of (3) represents the expected fixed repayment when the project is successful. The second and third terms correspond to the cases in which the accounting system report a low signal
$S_L$ when the state is "Good" and "Bad", respectively. The last term is the cash investment to facilitate the project.

Since the game involves multi-period interactions with incomplete information, we adopt the perfect Bayesian equilibrium (PBE) as our solution concept (Fudenberg and Tirole (1991)). In the next section, we characterize the equilibrium behavior.

3 Equilibrium analysis

In this section, we characterize the equilibrium behavior. Our primary interest is in the possibility of finding a “separating equilibrium” in which the high-type entrepreneur and the low-type entrepreneur intend to select different levels of conservatism. In such an equilibrium, the selection of conservatism is perfectly informative and the investor is able to infer the entrepreneur's type directly from her choice.

Under information asymmetry about the profitability of success, the investor is unable to offer different amounts of investment to different types of entrepreneurs, unless the choice of accounting conservatism acts as a self-selection mechanism. We first consider the unconditional conservatism $\delta$ and keep informativeness at a constant, i.e., $\lambda = \bar{\lambda}$. The entrepreneur can only signal her type through the choice of the unconditional conservatism, $\delta$. Our goals in this section, are two-fold. First, we want to investigate whether such signaling is possible; second, if it is possible, how should the high-type entrepreneur choose the appropriate unconditional conservatism in order to successfully distinguish herself (from the low-type entrepreneur) and at the same time maximize her expected payoff.

According to Fudenberg and Tirole (1991), each perfect Bayesian equilibrium in a signaling game specifies a belief system, based on which the different types of entrepreneurs and the investors choose their best responses. As a convention, we start with the extreme belief system in which the investor believes that the entrepreneur is high-type if and only if the entrepreneur selects the conservatism level $\delta^h$; for any other selection by the entrepreneur $\delta^l \neq \delta^h$, the investor naively believes that she faces a low-type entrepreneur. Since our goal is to investigate the possibility of sustaining a separating equilibrium, it is appropriate to adopt such a “most supportive” belief system.\footnote{It is the most supportive belief since this provides the maximum flexibility to sustain an equilibrium (by punishing any undesirable deviation).}

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Given this belief system, we can obtain the investor’s optimal strategy. Upon agreeing to fund the project, the investor requests a fixed payment that makes her break even in a competitive market. Thus, having observed the conservatism level $\delta^i$, she believes that the contract is offered by a type-$i$ entrepreneur and consequently her expected payoff is

$$U^i_1(\delta^i) = p^i(\tilde{\lambda} + \delta^i)F + p^i(1 - \tilde{\lambda} - \delta^i)C^i + (1 - p^i)(1 - \delta^i)C^i - (I - A).$$

The break-even condition gives rise to the fixed payment in equilibrium as follows:

$$F(\delta^i) = \frac{I - A - (1 - \delta^i - p^i\tilde{\lambda})C^i}{p^i(\delta^i + \lambda)}. \quad (4)$$

Unconditional conservatism has two effects on the fixed payment. When the system is more conservative (i.e. $\delta^i$ is lower), it increases the probability of liquidating the project. Consequently, the expected liquidating value is higher and the expected project return is lower. The effect of unconditional conservatism on the payment is uncertain. It is shown that when the latter effect is stronger than the former one, the fixed payment increases in the level of unconditional conservatism (i.e., $dF(\delta^i)/d\delta^i \leq 0$ for a small $C^i$).

Given the equilibrium fixed payment schedule, we now investigate the entrepreneur’s problem. Suppose that a type-$i$ entrepreneur follows the equilibrium strategy and selects the conservatism level $\delta^i$, her expected payoff is

$$U^i_E(\delta^i) = p^i(\tilde{\lambda} + \delta^i)[R^i - F(\delta^i)] - A$$

$$= p^i(\tilde{\lambda} + \delta^i)R^i - [I - A - (1 - \delta^i - p^i\tilde{\lambda})C^i] - A.$$ 

However, if she chooses an alternative conservatism level $\delta^j \neq \delta^i$, her expected payoff becomes

$$U^j_E(\delta^j) = p^i(\tilde{\lambda} + \delta^j)[R^j - F(\delta^j)] - A$$

$$= p^j(\tilde{\lambda} + \delta^j)R^j - \frac{p^j}{p^i}[I - A - (1 - \delta^j - p^j\tilde{\lambda})C^j] - A.$$ 

In equilibrium, a type-$i$ entrepreneur is induced to select the conservatism level $\delta^i$, and thus the following incentive compatibility constraint must be satisfied.

**Definition 1.** A set of unconditional conservatism levels $\{\delta^i\}$’s are incentive compatible if for all $i$, $U^i_E(\delta^i) \geq U^i_E(\delta^j), \forall \delta^j \neq \delta^i$.

Incentive compatibility does not necessarily imply that the entrepreneur reveals her type through the level of unconditional conservatism. To address this issue, we should look for the
equilibrium in which the high-type entrepreneur and the low-type entrepreneur willingly choose different levels of unconditional conservatism, i.e., $\delta^h \neq \delta^l$. In such a scenario, the investor is able to identify the entrepreneur by observing the chosen level of unconditional conservatism. In the terminology of game theory, such an equilibrium is called a “separating equilibrium” (Fudenberg and Tirole (1991)).

**Definition 2.** Suppose that the entrepreneur can signal her type through the level of unconditional conservatism. An equilibrium $(\delta^h, \delta^l)$ is said to be a “separating equilibrium” if $\delta^h \neq \delta^l$.

It is straightforward to verify the necessary and sufficient conditions under which a separating equilibrium can be sustained. The condition is specified in the following proposition.

**Proposition 1.** Suppose that the entrepreneur can signal her type through the level of unconditional conservatism. A separating equilibrium exists if and only if the following condition holds:

$$\frac{(p^h - p^l)(I - A)}{p^l(p^h R^h - C^h)} + \lambda \frac{p^l(1 - p^h)C^h - p^h(1 - p^l)C^l}{p^l(p^h R^h - C^h)} \geq \frac{(p^h - p^l)(I - A)}{p^l(p^h R^l - C^h)} + \lambda \frac{p^l(1 - p^h)C^h - p^h(1 - p^l)C^l}{p^l(p^h R^l - C^h)}.$$

(5)

Proposition 1 identifies the conditions under which the high-type entrepreneur can successfully signal her type. This is built upon the observation that it is relatively more costly for her to commit to unconditional conservative accounting than the low-type entrepreneur.\footnote{Note that to be precise, we should also restrict the value of informativeness so that the resulting conservatism level is feasible, i.e., $\delta^h \in [0, \lambda]$. Because this does not alter the main economic driving forces of our problem, we omit the details in the main text. The exact condition is given in the appendix.} It can be verified that when information is complete, the entrepreneur has no incentive to handicap herself by enforcing unconditional conservatism. However, in the presence of information asymmetry, the low-type entrepreneur might have an incentive to misreport her type by committing $\delta^h < 1 - \bar{\lambda}$, for now the investor would ask for a lower repayment. In the condition identified in Proposition 1, the first inequality of (5) ensures that when the high-type entrepreneur commits $\delta^h$, her expected payoff is not lower than that when she is perceived as a low-type. The second inequality adds another constraint under which the low-type entrepreneur does not benefit from pledging $\delta^h$ in order to mimic the high-type one.

From (5), we observe that a necessary condition for this inequality to hold is that the project return in case of success for the low-type entrepreneur $R^l$ is higher than that for the high-type

\footnote{Note that to be precise, we should also restrict the value of informativeness so that the resulting conservatism level is feasible, i.e., $\delta^h \in [0, \lambda]$. Because this does not alter the main economic driving forces of our problem, we omit the details in the main text. The exact condition is given in the appendix.}
entrepreneur \((R^l > R^h)\) (see the denominator of (5)). To understand the intuition, note that as a type-\(l\) entrepreneur intends to misrepresent herself (by selecting a different conservatism level \(\delta^h\)), the expected payment \(p^l F(\delta^h)\) still depends on her true probability \(p^l\). In order to sustain a separating equilibrium, when the type-\(h\) entrepreneur reduces one unit of conservatism \(\delta^h\), conditional on the payment \(F(\delta^h)\), it must be more costly for the low-type entrepreneur than for the high-type one. It is shown in the Appendix that condition \(R^l > R^h\) is required in order to satisfy this condition.\(^{13}\) It is worth mentioning that this condition is different from the classical single-crossing condition, which in our context translates to the ordering over the expected return \(p^h R^h > p^l R^l\). This additional condition \((R^l > R^h)\) is endogenously derived from the setting of debt contracting, because of the investor’s unique payoff structure. In contrast, in most of signaling papers, the expected payments/ transfers are made only contingent on the selection of the signaling tools (see, e.g., Baldenius and Meng (2009), Fan (2007), and Spence (1973)).

Let us now proceed to characterize the equilibrium behavior assuming that such a separating equilibrium exists. As in the case of models with costly signals, given the conditions in Proposition 1, there are multiple (in fact, a continuum of) equilibria in our context. Thus, to be able to provide an unambiguous prediction of how the entrepreneur would behave, we have to adopt some “refinement” to select among the multiple equilibria. The refinement is the criterion according to which one equilibrium is more believable than others. Following the convention of the corporate finance literature, we adopt the efficient (or Pareto-dominant) signaling equilibrium concept for which the level of unconditional conservatism is the least costly (or the most efficient) from the high-type entrepreneur’s perspective. This refinement rules out all those separating equilibria in which the high-type entrepreneur uses other inefficient or unnecessarily distorted signaling (see Fan (2007) and Milgrom and Roberts (1986)). This approach is appropriate for our purpose because the entrepreneur has the discretion of choosing her conservatism level (see more discussions in (Tirole, 2006, Chapter 6) along this line).

Let \(U^i_E(\delta^j)\) denote the expected payoffs of a type-\(i\) entrepreneur by choosing the conservatism level \(\delta^j\). In an efficient separating equilibrium, the high-type entrepreneur’s problem is to find the

\(^{13}\)An alternative way to interpret this result is to look at the entrepreneur’s marginal utility while varying the conservatism level. Recall that the single-crossing condition follows from the local incentive compatibility constraint. In the appendix, we provide the mathematical derivations for this marginal utility argument and show why condition \(R^l > R^h\) is required in our context.
level of unconditional conservatism that maximizes her expected payoff:

$$\max_{\delta^h \in [0,1]} \{U_E^h(\delta^h) \mid \text{s.t. } U_E^l(\delta^l) \geq U_E^l(\delta^h)\},$$

(6)

where the constraint $U_E^l(\delta^l) \geq U_E^l(\delta^h)$ guarantees that the low-type entrepreneur has no incentive to mimic the high type. We summarize the equilibrium behavior in the following corollary.

**Corollary 1.** Suppose that the entrepreneur can signal her type through the level of unconditional conservatism and condition (5) holds. In an efficient separating equilibrium,

$$\delta^h = 1 - \bar{\lambda} - \frac{(p^h - p^l)(I - A)}{p^l(p^h R^l - C^h)} - \frac{\bar{p}^l(1 - p^h)C^h - p^h(1 - p^l)C^l}{p^l(p^h R^l - C^h)}, \text{ and } \delta^l = 1 - \bar{\lambda}.$$  

(7)

Corollary 1 clearly demonstrates that the high-type entrepreneur lowers the level of unconditional conservatism in order to signal her type ($\delta^h < \delta^l$). In this case, the low-type finds it suboptimal to mimic the high-type one and chooses a less conservative accounting system $\delta^l$ instead. We now turn to characterize the determinants of the level of unconditional conservatism in order to provide some testable empirical hypotheses.

First, the information asymmetry is certainly the main reason why the high-type entrepreneur will choose conservative accounting. The inverse hazard rate in (7) $H(p) \equiv (p^h - p^l)/p^h$ can serve as a proxy of the extent of asymmetric information (holding the investor’s prior $\theta$ constant). When the inverse hazard rate is higher (i.e., $p^l$ is smaller), the high-type entrepreneur suffers from pooling with the low-type entrepreneur; consequently, she is willing to commit to a more conservative accounting system by lowering $\delta^h$ ($\partial \delta^h / \partial p^l > 0$). Consistent with this result, LaFond and Watts (2008) provide evidence that information asymmetry gives rise to accounting conservatism and that the level of information asymmetry between inside and outside investors is positively related to the degree of conservatism.

Second, the level of unconditional conservatism increases in the amount of capital borrowing $D \equiv I - A$ ($\partial \delta^h / \partial D < 0$). In this model, the capital funding takes the form of debt financing, because the investor will receive a fixed payment when the project is successful. When the entrepreneur requires more leverage, she needs to repay the investor a higher fixed payment $F(\delta^h)$. As shown in (4), the fixed payment increases in the level of unconditional conservatism ($dF/d\delta^i < 0$) when $C^i$ is relatively smaller to $R^i$. This suggests that holding the fixed payment constant, when the amount of leverage $D$ is higher, the entrepreneur needs to make the accounting system more conservative in order to signal her type. In addition, one may consider the entrepreneur as an equityholder of the project. If the entrepreneur can successfully signal her type, the high-type entrepreneur’s
expected utility (or the value of equity) is larger than the low-type one’s \( U_E^h(\delta^h) > U_E^l(\delta^l) \). This result suggests that accounting conservatism is negatively correlated with a firm’s debt-to-equity ratio.

Third, since signaling through accounting conservatism is costly, it is intuitive that the degree of conservatism depends on the financial strength of the entrepreneur. In our model, the financial strength is represented by two parameters: the project return \( R^i \) and the liquidation value \( C^i \). Higher project return \( R^d \) makes the low-type entrepreneur more costly to imitate the high-type by committing \( \delta^h \). As shown by the denominator in (7), when accounting is more conservative, the project is more likely to be liquidated. Consequently, it reduces the low-type entrepreneur’s expected return (the first term in the parenthesis) and increases the cost of expected liquidation value (the second term). As the project return \( R^d \) is higher, the low-type entrepreneur’s opportunity cost of liquidating the project is higher. As a result, the high-type entrepreneur decreases unconditional conservatism when \( R^d \) is higher (\( \partial \delta^h / \partial R^d > 0 \)). In contrast, a sufficiently high project return \( R^h \) ensures that the high-type entrepreneur’s individual rationality constraint is satisfied, but this does not affect the degree of unconditional conservatism. Notably, this also has a clear empirical implication. Suppose that the researchers can observe ex post project return \( p^i R^i \). In this case, holding \( p^i \) constant, researchers may observe that the degree of conservatism increases in the project differential \( (p^h R^h - p^l R^l) \). In other words, a more profitable firm tends to choose more conservative accounting.

On the other hand, (7) indicates that the high-type entrepreneur must increase unconditional conservatism when the liquidation value of the less risky project is higher (\( \partial \delta^h / \partial C^h < 0 \)). A high liquidation value \( C^h \) reduces the repayment \( F(\delta^h) \) paid back to the investor, thereby increasing the low-type entrepreneur’s incentive to imitate the high-type one. Thus, a more conservative accounting must be utilized in order to mitigate this incentive. In contrast, as \( C^l \) plays an opposite role to \( C^h \), the high-type entrepreneur reduces unconditional conservatism when the liquidation value of the low-type project is higher (\( \partial \delta^h / \partial C^l > 0 \)). An empirical implication of this result is as follows. Suppose that the investment project is composed of both tangible and intangible assets. Intangible assets tend to be more risky and have lower liquidation values than tangible assets do. This assumption implies that the investment project owned by the high-type entrepreneur should exhibit a larger portion of tangible assets. In other words, the liquidation value \( C^h \) can serve as a proxy for the strength of the firm’s balance sheet. This suggests that firms with stronger strength of balance sheet tend to commit to more conservative accounting in order to signal their types.
We summarize the results in the following proposition.

**Proposition 2.** Suppose that the entrepreneur can signal her type through the level of unconditional conservatism and the condition (5) holds. In an efficient separating equilibrium, the level of unconditional conservatism increases in the extent of information asymmetry ($\partial \delta^h / \partial p_l > 0$), increases in the capital borrowing ($\partial \delta^h / \partial D < 0$), decreases in the project return of the low-type entrepreneur ($\partial \delta^h / \partial R_l > 0$), and increases in the liquidation value of the high-type project ($\partial \delta^h / \partial C^h < 0$).

## 4 Extensions

In this section, we discuss some variants of our model characteristics.

### 4.1 Real Effects

Our primary goal in this section is to illustrate that if either the entrepreneur or the investor can engage in real activities such as costly effort (or costly investment) to improve the project return, accounting conservatism may not only have adverse selection effects on the entrepreneur’s payoff but also incentive effects on the effort decisions. To elaborate on this, suppose that the effort decision can be made by the entrepreneur before contracting with the investor or by the investor after the project is funded. When the choices of effort are not contractible, a moral hazard problem arises on top of the existing information asymmetry problem.

Furthermore, due to the asymmetric payoff structures between the investor and the entrepreneur, the moral hazard issue regarding the effort decisions has different implications. On the one hand, as the project may be liquidated due to conservative accounting, the entrepreneur cannot fully endogenize the benefit of additional effort, which results in a downward distortion. On the other hand, when the investor makes an effort decision, she cannot fully benefit from the ex post effort. This is because if the project is successful, she will receive only a fixed payment irrespective of the realized project return (under the assumption that the project return is sufficiently large). This suggests that the investor’s incentive to make effort is stronger when she knows the entrepreneur is of low type. The conflict of interest between the entrepreneur and the investor (debtholder) further complicates this moral hazard problem. By whom the effort decision is made affects both parties’ expected payoffs and in turn, the entrepreneur’s choice of accounting conservatism. To illustrate this effect, we now assume that the realized project return $R^i$ and the
liquidation value \( C^i \) are determined by the entrepreneur’s type as well as the entrepreneur’s ex ante effort decision or the investor’s ex post effort decision. Below, we discuss these two scenarios accordingly.

### 4.1.1 Entrepreneur’s ex ante effort

Let us first consider the situation in which the entrepreneur is able to exert ex ante effort decision. In such a scenario, if the effort level of the type-\( i \) entrepreneur is \( k \), then the corresponding project return becomes \( R^i(k) \) (if successful), and the project liquidation value becomes \( C^i(k) \).\(^{14}\) The entrepreneur’s effort is personally costly and the corresponding disutility cost of effort is denoted by \( \psi^E(k) \).\(^{15}\) Based on the above model characteristics, we can characterize the real effects in the context of conservatism signaling, assuming that a separating equilibrium can be sustained.

When the entrepreneur’s effort is not contractible, she can only rely on the conservatism level to convey her type. This makes the signaling more difficult, as the investor must infer from the entrepreneur’s conservatism level not only her type (regarding the project profitability) but also her effort decision. Denote by \( \delta^h \) the conservatism level the high-type entrepreneur chooses in a separating equilibrium. If the entrepreneur specifies a different conservatism level \( \delta \neq \delta^h \), the investor’s expected payoff given her belief is

\[
U_I(\delta) = p^l(\bar{\lambda} + \delta)F(\delta) + p^l(1 - \bar{\lambda} - \delta)C^l(k(\delta)) + (1 - p^l)(1 - \delta)C^l(k(\delta)) - (I - A),
\]

where \( k(\delta) \) is the entrepreneur’s optimal effort level (from the investor’s perspective). This leads to the equilibrium fixed payment \( F(\delta) \) such that the investor’s payoff is break-even, i.e., \( U_I(\delta) = 0 \). Likewise, when the investor observes \( \delta^h \), her payoff function is given by

\[
U_I(\delta^h) = p^h(\bar{\lambda} + \delta^h)F(\delta^h) + p^h(1 - \bar{\lambda} - \delta^h)C^h(k(\delta^h)) + (1 - p^h)(1 - \delta^h)C^h(k(\delta^h)) - (I - A),
\]

and the corresponding equilibrium fixed payment, \( F(\delta^h) \), makes her payoff function break-even (\( U_I(\delta^h) = 0 \)).

Suppose that a type-\( i \) entrepreneur follows the equilibrium strategy and selects the conser-

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\(^{14}\)This effort can take on numerous forms such as exerting personally costly efforts, identifying investment opportunities or supplying critical assets in order to operationalize the project. Our analysis is intended to highlight the effect of effort decisions in general and thus we assume away specific forms of efforts.

\(^{15}\)Note that the entrepreneur is endowed with an asset value \( A \) before contracting with the investor. The disutility cost of effort can be covered by the asset value.
vatism level $\delta$, her expected payoff is

$$U^i_E(k, \delta) = p^i(\bar{\lambda} + \delta)[R^i(k) - F(\delta)] - A - \psi^i_E(k).$$

In equilibrium, the investor’s rational expectation regarding $k(\delta^h)$ must be consistent with the entrepreneur’s optimal effort decision. Thus, we obtain the following moral hazard constraint:

$$k(\delta^h) \in \arg \max_{k \geq 0} U^h_E(k, \delta^h). \quad (8)$$

Define $U^h_E(\delta^h) \equiv \max_{k \geq 0} U^h_E(k, \delta^h)$ and $k^h \equiv k(\delta^h)$ to simplify the notation. In equilibrium, the high-type entrepreneur is induced to select the conservatism level $\delta^h$, thereby leading to the following incentive compatibility constraint:

$$U^h_E(\delta^h) \geq \max_{k, \delta} U^h_E(k, \delta), \ \forall \delta \neq \delta^h, \ \text{and} \ \max_{k, \delta} U^l_E(k, \delta) \geq \max_{k} U^l_E(k, \delta^h). \quad (9)$$

Likewise, we can formulate the low-type entrepreneur’s problem.

The efficient signaling equilibrium can be characterized by the following problem:

$$\max_{(k, \delta)} \{p^h(\bar{\lambda} + \delta)[R^h(k) - F(\delta)] - A - \psi^h_E(k)\} \ \text{s.t.} \ (8) \ \text{and} \ (9).$$

From the above formulation, we observe that when the effort is not contractible, the incentive issues become more pronounced, as both the moral hazard and adverse selection problems are present. Based on this formulation, we can articulate the interdependence between the conservatism level and the entrepreneur’s effort decision and summarize our results in the following proposition.

**Proposition 3.** Suppose that the entrepreneur can invest to improve the project return. In a separating equilibrium, the induced effort levels by the high-type and low-type entrepreneurs, denoted by $k^h$ and $k^l$ respectively, are determined by the following equations:

$$p^h(\bar{\lambda} + \delta^h)[R^h(k^h)] = (\psi^h_E)'(k^h), \quad (10)$$

$$p^l(R^l)'(k^l) = (\psi^l_E)'(k^l).$$

Proposition 3 shows that the optimal effort is obtained when the marginal benefit of effort (the left-hand side of (10)) equals to the marginal cost of effort (the right-hand side of (10)). To shed light on the effect of accounting conservatism on the entrepreneur’s effort, recall that in the absence of information asymmetry, the efficient effort levels can be characterized by $p^i(R^i)'(k^*) = (\psi^i_E)'(k^*)$, where $i = h, l$. Eq. (10) illustrates that the incentive to signal the project quality not
only affects the conservatism level, but also the real effort decision that the high-type entrepreneur undertakes. In the presence of information asymmetry, the high-type entrepreneur intends to signal her type through conservative accounting (thus \( \delta^h < 1 \)). Because the project will not be liquidated with a probability \( \lambda + \delta^h \) only, the entrepreneur cannot fully recoup the benefit of costly effort. Consequently, as the marginal benefit of costly effort is lower, the entrepreneur reduces effort level. In contrast, there is no downward distortion on the low-type entrepreneur’s effort \( k^l \), for in a separating equilibrium the low-type entrepreneur has no incentive to commit accounting conservatism.

The analysis thus far hinges on the assumption of non-contractible effort. A natural question is what if the effort decision is contractible? In such a scenario, the entrepreneur can, in addition to the conservatism level, declare her effort decision to signal her type. Thus, the high-type entrepreneur can simultaneously use two signaling devices to separate herself from the low-type one. Formally, we can formulate the equilibrium behaviors in an efficient separating equilibrium as follows. Denote by \((\delta^h, k^h)\) the high-type entrepreneur’s choice in a separating equilibrium. To sustain \((\delta^h, k^h)\) in a separating equilibrium, we must ensure the following incentive compatibility constraints:

\[
U^h_E(k^h, \delta^h) \geq U^h_E(k, \delta), \quad \text{and} \quad \max_{(k, \delta) \neq (k^h, \delta^h)} U^l_E(k, \delta) \geq U^l_E(k^h, \delta^h).
\]

(11)

And the efficient signaling equilibrium can be characterized by the following problem:

\[
\max_{(k, \delta)} \{ p^h(\bar{\lambda} + \delta)[R^h(k) - F(k, \delta)] - A - \psi^h_E(k) | \text{s.t. } (11) \}.
\]

The fact that the high-type entrepreneur can select the pair \((k, \delta)\) indicates the aforementioned two signal devices. Since our primary focus is on the intertwined adverse selection and moral hazard problems, we omit the detailed derivations of the separating equilibrium and proceed to the case in which the effort decision is made ex post by the investor.\(^\text{16}\)

### 4.1.2 Investor’s ex post effort

We now turn to the case in which the investor can exert costly effort after the project is funded. In this case, let us assume that after the investor exert level of unobservable effort \( k \), the corresponding

\(^{16}\text{Following Fan (2007) and Baldenius and Meng (2009), we can characterize the optimal mix of two signals. Apparently, the resulting conservatism level and the effort decision critically depend on the assumption of the marginal benefit of effort. As indicated by Fan (2007) and Baldenius and Meng (2009), the signaling cost is typically lower when the high-type entrepreneur is equipped with two signaling devices.}\)
project return and liquidation value are $R^i(k)$ and $C^i(k)$, respectively. The corresponding cost of effort is given by $\psi_I(k)$.

Let us first characterize the investor’s optimization problem. Denote by $\delta^h$ the conservatism level the high-type entrepreneur chooses in a separating equilibrium. If the entrepreneur specifies a different level of accounting conservatism $\delta \neq \delta^h$, the investor’s expected payoff, given her belief, is

$$U_I(k, \delta) = p_l(\bar{\lambda} + \delta)F(\delta) + p^l(1 - \bar{\lambda} - \delta)C^l(k) + (1 - p^l)(1 - \delta)C^l(k) - \psi(k).$$

Since the ex post effort decision is not observable, we need to consider the incentive compatibility constraint, $k(\delta) = \arg \max_{k \geq 0} U_I(k, \delta)$. The first-order condition shows that $k(\delta)$ is characterized by

$$[p^l(1 - \lambda - \delta) + (1 - p^l)(1 - \delta)](C^l)'(k(\delta)) = (\psi_I)'(k(\delta)). \quad (12)$$

A higher effort increases the expected liquidation value (the left side of (12)) and the marginal cost of effort (the right side of (12)). Because the investor (as a debtholder) will receive a fixed payment when the project is successful, the marginal benefit of effort on project return does not enter (12). Given the optimal level of $k(\delta)$, we can characterize the equilibrium fixed payment $F(\delta; k(\delta))$ which makes the investor break-even, i.e., $U_I(k(\delta), \delta) = 0$.

We next consider the entrepreneur’s problem. Suppose that the high-type entrepreneur follows the equilibrium strategy and selects the conservatism level $\delta^h$, her expected payoff is $U^h_E(\delta^h) = p^h(\bar{\lambda} + \delta^h)[R^h(k(\delta^h) - F(\delta^h))] - A$. On the contrary, if she chooses an alternative conservatism level $\delta \neq \delta^h$, her expected payoff becomes $U^h_E(\delta) = p^h(\bar{\lambda} + \delta)[R^h(k(\delta)) - F(\delta)] - A$. In equilibrium, the high-type entrepreneur is induced to select the conservatism level $\delta^h$, thereby leading to the following incentive compatibility constraint:

$$U^h_E(\delta^h) \geq \max_{\delta} U^h_E(k, \delta), \forall \delta \neq \delta^h, \text{ and } k(\delta^h) \in \arg \max_{k \geq 0} U_I(k, \delta^h).$$

In other words, the high-type entrepreneur first makes a conjecture on the investor’s optimal effort decision $k(\delta^h)$ and then chooses the degree of accounting conservatism in order to distinguish herself from the low-type one. The following proposition characterize the induced effort decisions when a separating equilibrium exists.

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17The second order condition is satisfied when the liquidation value is a concave of $k(\delta)$, $(C^l)''(k(\delta)) \leq 0$ and the cost of effort is convex in $k(\delta)$, i.e., $(\psi_I)''(k(\delta)) \geq 0$. 

---
**Proposition 4.** Suppose that the investor can invest to improve the project return. In a separating equilibrium, the induced effort levels by the high-type and low-type entrepreneurs, denoted by \( k_{I}^{h} \) and \( k_{I}^{l} \) respectively, are determined by the following equations:

\[
[p_{I}^{h}(1 - \bar{\lambda} - \delta^{h}) + (1 - p_{I}^{h})(1 - \delta^{h})](C_{I}^{h})'(k_{I}^{h}) = (\psi_{I}^{h})'(k_{I}^{h}),
\]

\[
(1 - p_{I}^{l})\bar{\lambda}(C_{I}^{l})'(k_{I}^{l}) = (\psi_{I}^{l})'(k_{I}^{l}).
\]

Proposition 4 clearly indicates that the distortion of the investor’s ex post effort decision is driven by two factors: the different payoff structures between the two parties and the cost of information asymmetry. First, because of the structure of debt contract, the investor (as a debtholder) receives a fixed payment when the project is successful. Thus, the marginal benefit of effort comes from the higher liquidation value rather than the project return. Second, recall that in the absence of asymmetric information, accounting conservatism is not necessary and the efficient effort levels can be characterized by \( p_{I}^{i}(R_{I}^{i})'(k_{I}^{i}) = (\psi_{I}^{i})'(k_{I}^{i}) \), where \( i = h, l \). As the high-type entrepreneur intends to signal her high return, the accounting system is distorted more conservatively \( \delta^{h} > 0 \); this constitutes an additional source of inefficiency. One interesting result of Proposition 4 is that as accounting conservatism increases the probability of liquidating the project, it reduces the investor’s incentive to exert effort. In contrast, accounting conservatism does not affect the choice of effort on the low-type entrepreneur \( k_{I}^{l} \).

**4.2 Conditional conservatism**

In our basic model, we explicitly assume that the only way for the high-type entrepreneur to separate from the low-type one is to commit unconditional conservatism by assuming that the informativeness of the accounting system is limited by \( \bar{\lambda} \). Could the entrepreneur signal her type through conditional conservatism? We investigate this possibility in this section. The major difference between unconditional and conditional conservatism is that in the former case, the change in the distribution of signals is not independent of the underlying state. Specifically, consider an accounting system that can generate, after the project is funded, one of two possible signals: \( S_{H} \) or \( S_{L} \). Given the states of the world, the accounting system generates the signals with the following conditional probabilities:

\[
P(S_{H}|G) = \lambda + \delta, \quad \text{and} \quad P(S_{L}|G) = 1 - \lambda - \delta,
\]

\[
P(S_{H}|B) = c(\delta), \quad \text{and} \quad P(S_{L}|B) = 1 - c(\delta),
\]
where $0 \leq \lambda \leq 1$, $0 \leq \delta \leq 1 - \lambda$. This information structure is different from (1) because here the effect of conservatism $\delta$ is conditional on the state of the world $\{G, B\}$. It may impose more stringent verifiability for reporting good state than for reporting bad state when $c'(\delta) < 1$. To satisfy the conditions specified in Gigler et al. (2009), we make the following assumptions for $c(\delta)$: $c(0) = 0$, $c(\delta) < \delta + \lambda$ in the interval $0 \leq \delta \leq (1 - \lambda)$, $c(\delta)$ increasing and strictly concave with $c'(\delta^0) = 1$ at some $\delta^0 \in (0, 1 - \lambda)$.\footnote{It can be verified that the parameter $c(\delta)$ satisfies those five conditions in Gigler et al. (2009) under which unconditional conservatism can be represented statistically. The condition (A1) is satisfied: $P(S_H|G, \delta)/P(S_H|B, \delta) = (\lambda + \delta)/c(\delta) > 1$ and $P(S_L|G, \delta)/P(S_L|B, \delta) = (1 - \lambda - \delta)/(1 - c(\delta)) < 1$ for $c(\delta) < \delta + \lambda$. The condition (A3) is satisfied because in the region $\delta < \delta^0$, $d[P(S_H|G, \delta)/P(S_H|B, \delta)]/d\delta < 0$ and $d[P(S_L|G, \delta)/P(S_L|B, \delta)]/d\delta < 0$. Finally, the conditions (A2) and (A4) are satisfied as $dP(S_H|G, \delta)/d\delta = 1$ and $dP(S_H|B, \delta)/d\delta = c'(\delta) > 0$. Since $c'(\delta) < 1$ for $\delta < \delta^0$, and $c'(\delta) > 1$ for $\delta > \delta^0$, the region $\delta < \delta^0$ represents conditional conservatism as defined in (A5i) and (A5ii) in Gigler et al. (2009).} We assume that the informativeness of the accounting system is fixed at a constant, i.e., $\lambda = \bar{\lambda}$. The entrepreneur can only signal her type through the choice of conditional conservatism $\delta$ and $c(\delta)$. We intend to investigate whether such signaling is possible and how the high-type entrepreneur’s choice of $\delta$ is different from that under unconditional conservatism.

Let us first briefly characterize the optimal unconditional conservatism under complete information. Denote the choice of conditional conservatism as $\hat{\delta}$ so as to differentiate unconditional conservatism $\delta$. The investor is able to differentiate the entrepreneur’s type. When the investor funds a type-$i$ entrepreneur, the joint expected payoff $W$ is

$$W \equiv U^i_L + U^i_H = p^i(\hat{\lambda} + \hat{\delta})R^i - A + p^i(1 - \hat{\lambda} - \hat{\delta})C^i + (1 - p^i)(1 - c(\hat{\delta}))C^i - (I - A),$$

for any given $\delta$. The first-order condition shows that $\partial W/\partial \hat{\delta} = p^i(R^i - C^i) + p^iC^ic'(\hat{\delta}) > 0$, suggesting that the optimal levels of conservatism: $\hat{\delta} = 1 - \bar{\lambda}$ for $i \in \{h, l\}$. This suggests that under complete information, the optimal conditional conservatism is identical to the optimal unconditional conservatism.

**Remark 1.** *In the absence of information asymmetry, the optimal conditional conservatism is identical to the optimal unconditional conservatism $(\hat{\delta} = 1 - \bar{\lambda})$.*

We once again follow Fudenberg and Tirole (1991) and start with the extreme belief system in which the investor believes that the entrepreneur is high-type if and only if the entrepreneur selects the conservatism level $\hat{\delta}^h$; for any other selection by the entrepreneur $\hat{\delta}^l \neq \hat{\delta}^h$, the investor naively believes that she faces a low-type entrepreneur. Since our goal is to investigate the possibility
of sustaining a separating equilibrium, it is appropriate to adopt such a “most supportive” belief system. Given this belief system, we then characterize the investor’s optimal strategy. Upon agreeing to fund the project, the investor requests a fixed payment that makes her break even due to the competitive market condition. Thus, having observed the conservatism level $\delta^i$, she believes that a type-$i$ entrepreneur appears and consequently her expected payoff is

$$U^i_j(\delta^i) = p^j(\lambda + \delta^i) F(\delta^i) + p^j(1 - \lambda - \delta^i) C^i + (1 - p^j)(1 - c(\delta^i))C^i - (I - A).$$

The break-even condition gives rise to the fixed payment in equilibrium as follows:

$$F(\delta^i) = \frac{I - A - p^j(1 - \lambda - \delta^i)C^i - (1 - p^j)(1 - c(\delta^i))C^i}{p^j(\lambda + \delta^i)}.$$

(14) illustrates that conditional conservatism has asymmetric effects on the payment. When the system is more conservative (i.e., $\delta^i$ is lower), it increases the probability of liquidating the project, but its marginal effect is stronger for the good state than for the bad state since $c'(\delta^i) < 1$.

Given the equilibrium fixed payment schedule, we now investigate the entrepreneur’s problem. Suppose that a type-$i$ entrepreneur follows the equilibrium strategy and selects the conservatism level $\delta^i$, her expected payoff is

$$U^i_E(\delta^i) = p^i(\lambda + \delta^i)[R^i - F(\delta^i)] - A$$

$$= p^i(\lambda + \delta^i) R^i - [I - A - p^i(1 - \lambda - \delta^i)C^i - (1 - p^i)(1 - c(\delta^i))C^i] - A.$$

However, if she chooses an alternative conservatism level $\delta^j \neq \delta^i$, her expected payoff becomes

$$U^i_E(\delta^j) = p^j(\lambda + \delta^j)[R^j - F(\delta^j)] - A$$

$$= p^j(\lambda + \delta^j) R^j - \frac{p^j}{p^i} [I - A - p^j(1 - \lambda - \delta^j)C^j - (1 - p^j)(1 - c(\delta^j))C^j] - A.$$ 

To successfully signal the entrepreneur’s type, the choices of conditional conservatism $\{\delta^i\}$ must satisfy incentive compatible constraint, for all $i$, $U^i_E(\delta^i) \geq U^i_E(\delta), \forall \delta \neq \delta^i$. The necessary and sufficient conditions under which a separating equilibrium can be sustained is characterized in the Appendix. We summarize the results in the following proposition:

**Proposition 5.** Suppose that the entrepreneur can signal her type through $\delta^i$. Assume that there exist the efficient separating equilibria under unconditional and conditional conservatism, denoted by $(\delta^h, \delta^i)$ and $(\delta^h, \delta^i)$ respectively. Then, $\delta^i = 1 - \lambda$ and $\delta^h$ is characterized by

$$\delta^h = \delta^h - \frac{(1 - p^h)C^h[c(\delta^h) - \delta^h]}{p^h R^i - C^h},$$

and $\delta^h$ is higher than $\delta^h$ when $c(\delta^h) < \delta^h$. 

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The major difference between unconditional and conditional conservatism is that under conditional conservatism regime, the accounting signal is tilted toward reporting the low signal $S_L$ with a probability $c(\delta)$ (rather than $\delta$ under unconditional conservatism). As shown by (15), this consequently changes the investor’s required payment and the low-type entrepreneur’s incentive to mimic the high-type one. Whether or not the high-type entrepreneur benefits more from conditional conservatism depends on the characteristics of the firm. When $c(\hat{\delta}^h) < \hat{\delta}^h$, $P(S_H|B)$ is lower under conditional conservatism than under unconditional conservatism. This in turn increases the low-type entrepreneur’s cost of mimicking the high-type. Thus, the entrepreneur commits to a less conservative accounting in a conditional sense (see the second term of (16)). The difference is also affected by the on the property of $c(\delta)$. To elaborate on this, consider the impact of an increase in $D$ on unconditional conservatism $\hat{\delta}^h$. By implicit differentiation of (16) with respect to $D$, we obtain

$$\frac{\partial \hat{\delta}^h}{\partial D} \left( 1 - \frac{(1 - p^h)C^h[c'(\hat{\delta}^h) - 1]}{p^hR^l - C^h} \right) - \frac{\partial \delta^h}{\partial D} = 0.$$ 

Note that conditional conservatism imposes more stringent verifiability for reporting good state than for reporting bad state when $c'(\delta) < 1$. Following Gigler et al. (2009), there exists some $\delta^0 \in (0, 1 - \lambda)$ such that $c'(\delta^0) = 1$ and for all $\delta < \delta^0$, $c'(\delta) < 1$. Given that $\partial \delta^h/\partial D < 0$, we observe that when $\hat{\delta}^h \leq \delta^0$, then $\partial \hat{\delta}^h/\partial D$ is still negative. This sign will not change ($\partial \hat{\delta}^h/\partial D > 0$) unless the accounting system is sufficiently conditional liberal ($\hat{\delta}^h > \delta^0$ and $c'(\hat{\delta}^h) > 1 + (p^hR^l - C^h)/(1 - p^h)C^h$). In other words, as the entrepreneur’s own internal capital is lower (or the amount of borrowing is higher), the amount of borrowing is higher, and conditional conservatism may give rise to a countervailing effect relatively to unconditional conservatism on the amount of capital borrowing.

5 Concluding Remarks and Discussions

Empirical studies have suggested that firms that report more conservatively are charged a lower interest rate. In this paper, we provide another explanation for the negative association between lower interest rates and conservatism accounting. We argue that the prospect of signaling project return may give rise to the demand for conservative accounting, even though it may not necessarily improve contracting efficiency ex post. Thus, the negative correlation between lower interest rates and conservative accounting may be explained by the heterogeneity of firms, such as riskiness and leverage.
We further extend our analysis to incorporate the real effects of accounting conservatism. We consider two scenarios in which this effort can be taken either by the entrepreneur before contracting with the investor or by the investor after the project is funded. On top of the existing information asymmetry problem, effort inefficiency may result from the non-contractibility and from the asymmetric payoff structures between the investor (debtholder) and the entrepreneur. We show that accounting conservatism may not only have adverse selection effects on the entrepreneur’s payoff, but also incentive effects on the effort decisions. Finally, we find that, compared to the uncondition conservatism, conditional conservatism may either alleviate or amplify the distortion required for the signaling purpose. Overall, our results speak to the strategic role for accounting conservatism in the context of debt contracting.

Several extensions are in order. Debt covenants are designed to reduce a variety of the agency costs. In this study, we focus on the positive covenants by which control right shifts to debtholders in the case of mediocre performance. Recall that accounting conservatism determines the link between future project return and accounting signals on which debt covenants are based. Thus, if debt covenants do incorporate the nature of accounting conservatism, researchers may observe a positive relation between the tightness of debt covenants and accounting conservatism (see Guay and Verrecchia (2006) and Beatty (2008)). However, it is also possible that debtholders may stipulate negative covenants by which firms for example are restricted to taking more risky investments, paying dividend payments to shareholders or issuing more junior debts. In this case, the connection between debt covenants and accounting conservatism may not be straightforward. It is not clear how accounting conservatism we study herein would be affected by this form of negative debt covenants.

The main insight of this paper is that the high-type entrepreneur may reveal her private information by self-selecting accounting conservatism in debt contracting (which is not necessary under information symmetry). However, the potential problem with these choices of accounting conservatism is that the high-type entrepreneur may want to initiate renegotiation before the actual outcome is realized (but after accounting conservatism has been contracted and the audit report is released). It is conceivable that this renegotiation would improve the investor’s payoff regardless of her beliefs about the entrepreneur’s type and would also increase the entrepreneur’s payoff. Nevertheless, the low-type entrepreneur will foresee this possibility of renegotiation and therefore will prefer to initially choose conservative accounting as well, which results in breakdown of the proposed equilibrium. Ex post renegotiations may significantly alter the ex ante incentives of the
entrepreneur and the investor and ultimately lead to different equilibrium outcomes. Alternatively, if the entrepreneur, after signing the contract, observes favorable market information (such as a lower interest rate of borrowing), she may initiate another debt contract with a new investor and use the proceeds to retire the old debt. This could allow the entrepreneur to benefit from better market conditions, and consequently she may be willing to commit to the original contract without renegotiation.\footnote{See Gigler et al. (2009) and Li (2009) for the impact of renegotiations on debt contracting in the absence of information asymmetry.}

Our model can be extended to examine whether the entrepreneur will be able to signal her type by accounting conservatism when the capital is raised as a form of equity financing. As we illustrate in the paper, when debt covenants are held constant, accounting conservatism may increase the probabilities of liquidating investment projects, which lowers an entrepreneur’s payoff significantly and her incentive to make ex ante effort. In contrast, under equity financing, an entrepreneur and an investor (as a shareholder) will share future project return together and the control right of a firm will not be shifted to the investor. Accounting conservatism may change the information content of accounting reports on which a firm’s stock prices are traded, but it does not affect directly on a firm’s liquidity (i.e., there is no difference between two parties’ payoff structures). Indeed, Bagnoli and Watts (2005) consider a market setting in which a manager trades off between the market value of a firm and beating earnings expectation. They show that when the cost of missing earnings expectations are high, a separating equilibrium can occur. Our study complements theirs by showing the effect of accounting conservatism in debt contracting. Naturally, it would be interesting to study the impact of accounting conservatism when a firm are funded by a combination of debt and equity financing. How would the trade-off between liquidity and equity value affect the choices of accounting conservatism? This analysis may add more insights on the debate over the debt-contract theory (see Watts (2003), Ball et al. (2008), and Gigler et al. (2009)).

Appendix

**Proof of Proposition 1.** Our strategy is to first identify the necessary incentive compatibility constraints for the entrepreneur and the investor in a separating equilibrium. Following this, we then characterize the necessary and sufficient conditions under which the separating equilibrium can be sustained.
Recall that if the entrepreneur specifies a different conservatism level $\delta \neq \delta^h$, the investor’s expected payoff given her belief is

$$U_I(\delta) = p^l(\bar{\lambda} + \delta)F(\delta) + p^l(1 - \bar{\lambda} - \delta)C^l + (1 - p^l)(1 - \delta)C^d - (I - A),$$

which leads to the equilibrium fixed payment

$$F(\delta) = \frac{I - A - p^l(1 - \bar{\lambda} - \delta)C^l - (1 - p^l)(1 - \delta)C^d}{p^l(\bar{\lambda} + \delta)}.$$  

Having obtained the equilibrium fixed payment schedule, we now investigate the entrepreneur’s problem. Suppose that a high-type entrepreneur follows the equilibrium strategy and selects the conservatism level $\bar{\lambda}$, her expected payoff is

$$U_E^h = p^h(\bar{\lambda} + \delta^h)[R^h - F(\delta^h)] - A$$

$$= p^h(\bar{\lambda} + \delta^h)R^h - [I - A - p^h(1 - \bar{\lambda} - \delta^h)C^h - (1 - p^h)(1 - \delta^h)C^h] - A.$$ 

On the contrary, if she chooses an alternative conservatism level $\delta \neq \delta^h$, her expected payoff becomes

$$U_E^h(\delta) = p^h(\bar{\lambda} + \delta)[R^h - F(\delta)] - A$$

$$= p^h(\bar{\lambda} + \delta)R^h - \frac{p^h}{p^l} \left\{ I - A - p^l(1 - \bar{\lambda} - \delta)C^l - (1 - p^l)(1 - \delta)C^d \right\} - A.$$ 

Note that even if in the investor’s mind the entrepreneur is low-type, while calculating the entrepreneur’s expected payoff, she knows that the true probability of success is $p^h$ rather than $p^l$. In equilibrium, the high-type entrepreneur is induced to select the conservatism level $\delta^h$. Thus, the following incentive compatibility constraint must hold:

$$U_E^h(\delta^h) \geq U_E^h(\delta), \forall \delta \neq \delta^h.$$ 

When $p^hR^h > C^l$, $U_E^h(\delta)$ is strictly increasing in $\delta$. Thus, the entrepreneur will choose the maximum $\delta = 1 - \bar{\lambda}$ and the above incentive compatibility constraint can be further simplified as follows:

$$U_E^h = p^h(\bar{\lambda} + \delta^h)R^h - [I - A - p^h(1 - \bar{\lambda} - \delta^h)C^h - (1 - p^h)(1 - \delta^h)C^h] - A$$

$$\geq U_E^h(1 - \bar{\lambda}) = p^hR^h - \frac{p^h}{p^l} \left\{ I - A - (1 - p^l)C^l \right\} - A. \quad (17)$$

Similarly, we can also articulate the low-type entrepreneur’s best strategy. If the low-type entrepreneur chooses a conservatism level $\delta \neq \delta^h$, her expected payoff is

$$U_L^l(\delta) = p^l(\bar{\lambda} + \delta)[R^l - F(\delta)] - A$$

$$= p^l(\bar{\lambda} + \delta)R^l - \left\{ I - A - p^l(1 - \bar{\lambda} - \delta)C^l - (1 - p^l)(1 - \delta)C^d \right\} - A,$$
which is maximized at $\delta = 1 - \bar{\lambda}$. In this case, the equilibrium expected payoff is $U_E^l \equiv U_E^l(1 - \bar{\lambda}) = p^lR^l - \{I - A - (1 - p^l)\lambda C^l\} - A$. On the contrary, if the low-type entrepreneur pretends to be high-type (by selecting $\delta^h$), her expected payoff becomes

$$p^l(\bar{\lambda} + \delta^h)[R^l - F(\delta^h)] - A$$

$$= p^l(\bar{\lambda} + \delta^h)R^l - \frac{p^l}{p^h} \left\{I - A - p^h(1 - \bar{\lambda} - \delta^h)C^h - (1 - p^h)(1 - \delta^h)C^h\right\} - A.$$

In equilibrium, the low-type entrepreneur should find it suboptimal to misrepresent herself:

$$p^lR^l - \left\{I - A - (1 - p^l)\bar{\lambda}C^l\right\} - A \geq p^l(\bar{\lambda} + \delta^h)R^l - \frac{p^l}{p^h} \left\{I - A - p^h(1 - \bar{\lambda} - \delta^h)C^h - (1 - p^h)(1 - \delta^h)C^h\right\} - A.$$ \hspace{1cm} (18)

Thus, a separating equilibrium exists if and only if we can find a $\delta^h$ such that (IC-H) and (IC-L) hold simultaneously. Rewriting the two constraints, we obtain that

$$\frac{p^hR^h - \frac{p^h}{p^l} \{I - A - (1 - p^l)\bar{\lambda}C^l\} - p^h\bar{\lambda}R^h + [I - A - p^h(1 - \bar{\lambda})C^h - (1 - p^h)C^h]}{p^hR^h - C^h} \leq \delta^h$$

$$\leq \frac{p^lR^l - \{I - A - (1 - p^l)\bar{\lambda}C^l\} - p^l\bar{\lambda}R^l + \frac{p^l}{p^h}[I - A - p^h(1 - \bar{\lambda})C^h - (1 - p^h)C^h]}{p^l(R^l - C^h/p^h)},$$

where the first inequality follows from (IC-H) and the second inequality is due to (IC-L). Simplifying the inequality yields the conditions given in the proposition. Thus, a separating equilibrium exists if and only if condition (5) holds.

Note that from (IC-H), the marginal cost of unconditional conservatism is given by $\partial U_E^h/\partial \delta^h = p^hR^h - C^h > 0$. In contrast, the low-type entrepreneur’s marginal cost of conservatism is $\partial U_E^l/\partial \delta^h = p^lR^l - p^lC^h/p^h$. A separating equilibrium can be sustained if and only if a lower $\delta^h$ will make the low-type entrepreneur more costly than the high-type one; that is, $\partial U_E^h/\partial \delta^h < \partial U_E^l/\partial \delta^h$ for any given $C^h$. Consider a fixed $C^h = p^hR^h$, so that $\partial U_E^h/\partial \delta^h = 0$, then $\partial U_E^l/\partial \delta^h$ is positive if and only if $\partial U_E^l/\partial \delta^h = p^lR^l - p^lR^h > 0$, which will be satisfied only when $R^l > R^h$. This condition holds for all $C^h < p^hR^h$. Furthermore, we should also restrict the value of informativeness so that the resulting conservatism level is feasible, i.e., $\delta^h \in [0, \bar{\lambda}]$. This would require that

$$[p^l(p^hR^h - C^h) - p^l(1 - p^h)C^h + p^h(1 - p^l)C^l]\bar{\lambda} \geq (p^h - p^l)(I - A),$$

and

$$[p^lR^l - (1 - p^l)C^l - p^lC^h]\bar{\lambda} \leq p^lR^l - (I - A)(1 - \frac{p^l}{p^h}) - p^hC^h - \frac{(1 - p^h)C^h}{p^h}.$$
Proof of Corollary 1. From Proposition 1,

$$U_e^h(\delta^h) = p^h(\bar{\lambda} + \delta^h)R^h - [I - A - p^h(1 - \bar{\lambda} - \delta^h)C^h - (1 - p^h)(1 - \delta^h)C^h] - A.$$  

The high-type entrepreneur’s problem can be expressed as follows:

$$\max_{\delta^h \in [0,1]} \left\{ p^h(\bar{\lambda} + \delta^h)R^h - [I - A - p^h(1 - \bar{\lambda} - \delta^h)C^h - (1 - p^h)(1 - \delta^h)C^h] - A \mid \text{s.t. (IC-L)} \right\}.$$  

The objective function is increasing in $\delta^h$. Thus, the constraint (IC-L) is binding at optimality, which gives rise to the formula for $\delta^h$ in the corollary. □

Proof of Proposition 3. Define $U_e^h(\delta^h) \equiv \max_{k \geq 0} U_e^h(k, \delta^h)$, $k^h \equiv k(\delta^h)$, $k^h(\delta) = \arg\max_{k \geq 0} U_e^h(k, \delta^h)$, and $U_e^h(\delta) \equiv \max_{k \geq 0} U_e^h(k, \delta)$ to simplify the notation. A separating equilibrium exists if and only if we can find a $\delta^h$ such that $U_e^h(\delta^h) \geq U_e^h(\delta)$, $\forall \delta \neq \delta^h$ and $U_e^h \geq U_e^h(\delta^h)$ hold simultaneously. In such an equilibrium, we can apply the first-order conditions to characterize the entrepreneur’s effort decisions as stated in the proposition. □

Proof of Proposition 4. Recall that if the entrepreneur specifies a different conservatism level $\delta \neq \delta^h$, the investor’s expected payoff given her belief is

$$U_I(k, \delta) = p^l(\bar{\lambda} + \delta)F(\delta) + p^l(1 - \bar{\lambda} - \delta)C^l(k) + (1 - p^l)(1 - \delta)C^l(k) - (I - A) - \psi_I(k).$$  

As the investor is allowed to choose the effort level, $k(\delta) = \arg\max_{k \geq 0} U_I(k, \delta)$. Applying the first-order condition, we obtain that $k(\delta)$ is characterized by

$$[p^l(1 - \bar{\lambda} - \delta) + (1 - p^l)(1 - \delta^l)](C^l)'(k(\delta)) = (\psi_I)'(k(\delta)).$$  

We can then obtain the equilibrium fixed payment

$$F(\delta) = \frac{I - A + E(k(\delta)) - p^l(1 - \bar{\lambda} - \delta)C^l(k(\delta)) - (1 - p^l)(1 - \delta)C^l(k(\delta))}{p^l(\bar{\lambda} + \delta)}.$$  

Likewise,

$$U_I(k, \delta^h) = p^h(\bar{\lambda} + \delta^h)F(\delta^h) + p^h(1 - \bar{\lambda} - \delta^h)C^h(k) + (1 - p^h)(1 - \delta^h)C^h(k) - (I - A) - \psi_I(k).$$  

Thus, the investor will choose effort level $k^h = \arg\max_{k \geq 0} U_I(k, \delta^h)$ and the corresponding equilibrium fixed payment is

$$F(\delta^h) = \frac{I - A + \psi(k^h) - p^h(1 - \bar{\lambda} - \delta^h)C^h(k^h) - (1 - p^h)(1 - \delta^h)C^h(k^h)}{p^h(\bar{\lambda} + \delta^h)}.$$
Let us now turn to the entrepreneur’s problem. Suppose that a high-type entrepreneur follows the equilibrium strategy and selects the conservatism level \( \delta^h \), her expected payoff is

\[
U_E^h = p^h(\bar{\lambda} + \delta^h)[R^h(k^h) - F(\delta^h)] - A
\]

\[
= p^h(\bar{\lambda} + \delta^h)R^h(k^h) - [I - A + \psi(k^h) - p^h(1 - \bar{\lambda} - \delta^h)C^h(k^h) - (1 - p^h)(1 - \delta^h)C^h(k^h)] - A.
\]

On the contrary, if she chooses an alternative conservatism level \( \delta \neq \delta^h \), her expected payoff becomes

\[
U_E^h(\delta) = p^h(\bar{\lambda} + \delta)[R^h(k(\delta)) - F(\delta)] - A
\]

\[
= p^h(\bar{\lambda} + \delta)R^h(k(\delta)) - \frac{p^h}{p^l} \left\{ I - A + \psi_1(k(\delta)) - p^l(1 - \bar{\lambda} - \delta)C^l(k(\delta)) - (1 - p^l)(1 - \delta)C^l(k(\delta)) \right\} - A.
\]

In equilibrium, the high-type entrepreneur is induced to select the conservatism level \( \delta^h \). Thus, the following incentive compatibility constraint must hold:

\[
U_E^h(\delta^h) \geq U_E^h(\delta), \forall \delta \neq \delta^h.
\]

Similarly, we can also articulate the low-type entrepreneur’s best strategy. If the low-type entrepreneur chooses a conservatism level \( \delta \neq \delta^h \), her expected payoff is

\[
U_E^l(\delta) = p^l(\bar{\lambda} + \delta)R^l(k(\delta)) - \left\{ I - A + \psi_1(k(\delta)) - p^l(1 - \bar{\lambda} - \delta)C^l(k(\delta)) - (1 - p^l)(1 - \delta)C^l(k(\delta)) \right\} - A,
\]

which is maximized at \( \delta = 1 - \bar{\lambda} \). On the contrary, if the low-type entrepreneur pretends to be high-type (by selecting \( \delta^h \)), her expected payoff becomes

\[
U_E^l(\delta^h) = p^l(\bar{\lambda} + \delta^h)R^l(k^h) - \frac{p^l}{p^h} \left\{ I - A + \psi_1(k^h) - p^h(1 - \bar{\lambda} - \delta^h)C^h(k^h) - (1 - p^h)(1 - \delta^h)C^h(k^h) \right\} - A.
\]

In equilibrium, the low-type entrepreneur should find it suboptimal to misrepresent herself: \( U_E^l(1 - \bar{\lambda}) \geq U_E^l(\delta^h) \). Thus, a separating equilibrium exists if and only if we can find a \( \delta^h \) such that

\[
U_E^h(\delta^h) \geq U_E^l(\delta), \forall \delta \neq \delta^h\text{ and } U_E^l(1 - \bar{\lambda}) \geq U_E^l(\delta^h)\text{ hold simultaneously.}
\]

In a separating equilibrium, if we apply the first-order conditions, the induced effort levels are as specified in the proposition.

Furthermore, in an efficient equilibrium, the Lagrangian can be written as follows:

\[
L = p^h(\bar{\lambda} + \delta^h)R^h(k^h) - \frac{p^h}{p^l} \left\{ I - A + \psi_1(k^h) - p^h(1 - \bar{\lambda} - \delta^h)C^h(k^h) - (1 - p^h)(1 - \delta^h)C^h(k^h) \right\}
\]

\[
+ \mu[U_E^l(1 - \bar{\lambda}) - U_E^l(\delta^h)]
\]

\[
+ \gamma \left\{ [p^h(1 - \bar{\lambda} - \delta^h) + (1 - p^h)(1 - \delta^h)](C^h)'(k^h) - (\psi_1)'(k^h) \right\},
\]

where \( \mu \) and \( \gamma \) are the corresponding Lagrange multipliers for the low-type entrepreneur’s incentive constraint and the investor’s moral hazard constraint, respectively. In equilibrium, the conservatism level must maximize the above Lagrangian:
all type, the choices of conditional conservatism following incentive compatibility constraint must be satisfied. To successful signal the entrepreneur’s problem. Suppose that a high-type entrepreneur follows the equilibrium strategy and selects the expected payoff given her belief is

\[ \text{In equilibrium, a type-}i \text{ entrepreneur is induced to select the conservatism level} \hat{\delta}_i \text{, and thus the following incentive compatibility constraint must be satisfied. To successful signal the entrepreneur’s}\]

Proof of Proposition 5. Let us first investigate the entrepreneur’s problem. Suppose that a type-i entrepreneur follows the equilibrium strategy and selects the conservatism level \( \hat{\delta}_i \), her expected payoff is

\[
U^i_E(\hat{\delta}_i) = p^i(\hat{\lambda} + \hat{\delta}_i)[R^i - F(\hat{\delta}_i)] - A
\]

\[
= p^i(\hat{\lambda} + \hat{\delta}_i)R^i - [A - p^i(1 - \hat{\lambda} - \hat{\delta}_i)C^i - (1 - p^i)(1 - c(\hat{\delta}_i))C^i] - A.
\]

However, if she chooses an alternative conservatism level \( \hat{\delta}_j \neq \hat{\delta}_i \), her expected payoff becomes

\[
U^j_E(\hat{\delta}_j) = p^j(\hat{\lambda} + \hat{\delta}_j)[R^j - F(\hat{\delta}_j)] - A
\]

\[
= p^j(\hat{\lambda} + \hat{\delta}_j)R^j - \frac{p^j}{p^j}[A - p^j(1 - \hat{\lambda} - \hat{\delta}_j)C^j - (1 - p^j)(1 - c(\hat{\delta}_j))C^j] - A.
\]

In equilibrium, a type-i entrepreneur is induced to select the conservatism level \( \hat{\delta}_i \), and thus the following incentive compatibility constraint must be satisfied. To successful signal the entrepreneur’s type, the choices of conditional conservatism \( \{\hat{\delta}_i\} \) must satisfy incentive compatible constraint, for all \( i, U^i_E(\hat{\delta}_i) \geq U^i_E(\hat{\delta}), \forall \hat{\delta} \neq \hat{\delta}_i. \)

Moreover, if the entrepreneur specifies a different conservatism level \( \hat{\delta} \neq \hat{\delta}_h \), the investor’s expected payoff given her belief is

\[
U_I(\hat{\delta}) = p^l(\hat{\lambda} + \hat{\delta})F + p^l(1 - \hat{\lambda} - \hat{\delta})C^l + (1 - p^l)(1 - c(\hat{\delta}))C^l - (I - A),
\]

which leads to the equilibrium fixed payment

\[
F(\hat{\delta}) = \frac{I - A - p^l(1 - \hat{\lambda} - \hat{\delta})C^l - (1 - p^l)(1 - c(\hat{\delta}))C^l}{p^l(\hat{\lambda} + \hat{\delta})}.
\]

Having obtained the equilibrium fixed payment schedule, we now investigate the entrepreneur’s problem. Suppose that a high-type entrepreneur follows the equilibrium strategy and selects the
conservatism level \( \delta^h \), her expected payoff is

\[
U_E^h = p^h(\bar{\lambda} + \delta^h)[R^h - F(\delta^h)] - A
\]

\[
= p^h(\bar{\lambda} + \delta^h)R^h - [I - A - p^h(1 - \bar{\lambda} - \delta^h)C^h - (1 - p^h)(1 - c(\delta^h))C^h] - A.
\]

On the contrary, if she chooses an alternative conservatism level \( \delta \neq \delta^h \), her expected payoff becomes

\[
U_E^h(\delta) = p^h(\bar{\lambda} + \delta)[R^h - F(\delta)] - A
\]

\[
= p^h(\bar{\lambda} + \delta)R^h - \frac{p^h}{p^l} \left\{ I - A - p^l(1 - \bar{\lambda} - \delta)C^l - (1 - p^l)(1 - c(\delta))C^l \right\} - A.
\]

Note that even if in the investor’s mind the entrepreneur is low-type, while calculating the entrepreneur’s expected payoff, she knows that the true probability of success is \( p^h \) rather than \( p^l \). In equilibrium, the high-type entrepreneur is induced to select the conservatism level \( \delta^h \). Thus, the following incentive compatibility constraint must hold:

\[
U_E^h(\delta^h) \geq U_E^h(\delta), \quad \forall \delta \neq \delta^h.
\]

Since \( U_E^h(\delta) \) is strictly increasing in \( \delta \), the above incentive compatibility constraint can be further simplified as follows:

\[
U_E^h = p^h(\bar{\lambda} + \delta^h)R^h - [I - A - p^h(1 - \bar{\lambda} - \delta^h)C^h - (1 - p^h)(1 - c(\delta^h))C^h] - A
\]

\[
\geq U_E^h(1 - \bar{\lambda}) = p^hR^h - \frac{p^h}{p^l} \left\{ I - A - (1 - p^l)\bar{\lambda}C^l \right\} - A.
\]

Similarly, we can also articulate the low-type entrepreneur’s best strategy. If the low-type entrepreneur chooses a conservatism level \( \delta \neq \delta^h \), her expected payoff is

\[
U_E^l(\delta) = p^l(\bar{\lambda} + \delta)[R^l - F(\delta)] - A
\]

\[
= p^l(\bar{\lambda} + \delta)R^l - \left\{ I - A - p^l(1 - \bar{\lambda} - \delta)C^l - (1 - p^l)(1 - c(\delta))C^l \right\} - A,
\]

which is maximized at \( \delta = 1 - \bar{\lambda} \). In this case, the equilibrium expected payoff is \( U_E^l = U_E^l(1 - \bar{\lambda}) = p^lR^l - \left\{ I - A - (1 - p^l)\bar{\lambda}C^l \right\} - A \). On the contrary, if the low-type entrepreneur pretends to be high-type (by selecting \( \delta^h \)), her expected payoff becomes

\[
p^l(\bar{\lambda} + \delta^h)[R^l - F(\delta^h)] - A
\]

\[
= p^l(\bar{\lambda} + \delta^h)R^l - \frac{p^l}{p^h} \left\{ I - A - p^h(1 - \bar{\lambda} - \delta^h)C^h - (1 - p^h)(1 - c(\delta^h))C^h \right\} - A.
\]
In equilibrium, the low-type entrepreneur should find it suboptimal to misrepresent herself $U_L'(1 - \bar{\lambda}) \geq U_L'(\hat{\delta}^h)$:

$$p^l R^l - \left\{ I - A - (1 - p^l)\bar{\lambda}C^l \right\} - A$$

$$\geq p^l (\bar{\lambda} + \hat{\delta}^h) R^l - \frac{p^l}{p^h} \left\{ I - A - p^h(1 - \bar{\lambda} - \hat{\delta}^h)C^h - (1 - p^h)(1 - c(\hat{\delta}^h))C^h \right\} - A.$$

Thus, a separating equilibrium exists if and only if we can find a $\hat{\delta}^h$ such that (IC-H) and (IC-L) hold simultaneously. From Corollary 1, we obtain that the efficient equilibrium arises when (IC-L) binds, i.e.,

$$p^l R^l - \left\{ I - A - (1 - p^l)\bar{\lambda}C^l \right\}$$

$$= p^l (\bar{\lambda} + \hat{\delta}^h) R^l - \frac{p^l}{p^h} \left\{ I - A - p^h(1 - \bar{\lambda} - \hat{\delta}^h)C^h - (1 - p^h)(1 - c(\hat{\delta}^h))C^h \right\}.$$

Collecting the terms related to $\hat{\delta}^h$ yields:

$$p^l \hat{\delta}^h R^l - \frac{p^l}{p^h} \left\{ p^h \hat{\delta}^h C^h + (1 - p^h)c(\hat{\delta}^h)C^h \right\}$$

$$= p^l R^l - \left\{ I - A - (1 - p^l)\bar{\lambda}C^l \right\} - p^l \bar{\lambda} R^l + \frac{p^l}{p^h} \left\{ I - A - p^h(1 - \bar{\lambda})C^h - (1 - p^h)C^h \right\}. \quad (19)$$

Note we can further rewrite (19) as:

$$\hat{\delta}^h (p^l R^l - \frac{p^l}{p^h} C^h) - \frac{p^l}{p^h} (1 - p^h)C^h (c(\hat{\delta}^h) - \hat{\delta}^h)$$

$$= p^l R^l - \left\{ I - A - (1 - p^l)\bar{\lambda}C^l \right\} - p^l \bar{\lambda} R^l + \frac{p^l}{p^h} \left\{ I - A - p^h(1 - \bar{\lambda})C^h - (1 - p^h)C^h \right\}.$$

Substituting in the optimal unconditional conservatism $\hat{\delta}^h$ characterized by (18) yields

$$\hat{\delta}^h - \frac{p^l}{p^h} (1 - p^h)C^h (c(\hat{\delta}^h) - \hat{\delta}^h)\left( p^l R^l - \frac{p^l}{p^h} C^h \right) - \hat{\delta}^h = 0,$$

which completes the proof. \[\Box\]

**References**


Figure 1: Probabilities

\[ U_E^h \]
\[ U_E^l \]
\[ \theta \]
\[ 1-\theta \]

\[ p^h \]
\[ 1-p^h \]
\[ \lambda + \delta \]
\[ 1-\lambda + \delta \]

\[ \delta \]
\[ 1-\delta \]

Good State (G)
Bad State (B)

High Signal (\( S_H \))
Low Signal (\( S_L \))

\[ \lambda + \delta \]
\[ 1-\lambda + \delta \]

\[ \delta \]
\[ 1-\delta \]

High Signal (\( S_H \))
Low Signal (\( S_L \))