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Accounting Conservatism and Debt Contracts: Efficient Liquidation and Covenant Renegotiation*

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Abstract

This paper develops a theoretical model to understand the role of accounting conservatism in debt contracts. The optimal debt contract includes an accounting based covenant that gives the creditor the right to liquidate when accounting information reveals unfavorable news about the firm. I find that the demand for accounting conservatism depends on whether renegotiation occurs and if so, at what cost. When the covenant is not renegotiable or when renegotiation cost is sufficiently high, more conservative accounting actually reduces the efficiency of debt contracts. When renegotiation cost is moderate, on the other hand, more conservative accounting may increase the entrepreneur's welfare under certain conditions, especially for firms with less promising investment opportunities and for firms with higher liquidation values. Both are characteristics of "traditional industries" characterized by low growth and high level of tangible assets in place. When renegotiation is costless, the degree of accounting conservatism becomes irrelevant and the first best liquidation is always achieved. These results call for more cross-sectional examinations on the role of accounting conservatism in debt contracts in empirical studies.

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1 Introduction

In a competitive capital market, debt will be efficiently priced such that risk-neutral debtholders break even in expectation. Although accounting information may help the contracting parties evaluate expected future profitability to determine the ex-ante interest rate, we expect it becomes irrelevant once the debt contract is signed. One role that accounting information can play to improve the contracting efficiency is when it can trigger some real actions such as liquidation.[1] This is consistent with stylized facts that debt contracts often include debt covenants that are contingent on accounting numbers. These covenants usually define constraints on a firm's net asset worth, working capital, financial ratio, or leverage. Violation of covenants will restrict the firm from engaging in specified activities such as issuing dividends or investing in new projects, or allow creditors to liquidate the assets and collect the collateral.

Watts (2003) in his influential paper on accounting conservatism argues that debt contracting is one important explanation for the demand for conservatism in financial reports, as debtholders are more interested in the downside risk than the upside potential of the firm's performance. However, Guay and Verrechia (2006) conjecture that firms can always undo the effect of conservatism by modifying the tightness of debt covenants to the optimal level without altering the informativeness of the accounting measurement system. Therefore it is not clear from a theoretical point of view how the properties of accounting information affect the debt contracting process. Recently a number of empirical studies have examined the association between the characteristics of accounting information and debt contracts. For example, Ball et al. (2008) find that the demand of accounting conservatism is due to debt markets using cross-country data. Begley and Chamberlain (2005) find that the use of accounting-based covenants is associated with less conservatism using a sample of public debt agreements. Beatty et al. (2008) and Nikolaev (2007) find that the covenant restrictiveness is positively correlated with accounting conservatism using samples of private loan agreements. These findings so far are inconclusive.

[1] Firms can issue new debts to replace old debts when future accounting information reveals better information about underlying economics of the firm. However, in this paper I do not consider the possibility of refinancing in order to focus on the role of accounting information through accounting-based debt covenants.

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Moreover, one important feature of debt contracts is that debt covenants are frequently violated and renegotiated (Smith, 1993). Using a large sample of private debt agreements, Dichev and Skinner (2002) find that 30% of firms in their sample violate the covenants. Roberts and Sufi (2007) document that 75% of long term private credit agreements have a major contract term renegotiated before the stated maturity date. Other studies that examine actual violations of debt covenants, such as Chen and Wei (1993) and Beneish and Press (1993), suggest that a large percentage of firms get waivers after violations (about 50% in the violation sample) and that the most frequently violated covenants are technical violations which usually involve covenants based on accounting numbers. The significance and frequency of renegotiation highlight the importance of incorporating renegotiation into a formal analysis of the debt contracting process.

In this paper I build a model to examine the impact of accounting conservatism on the efficiency of debt contracts, considering both non-renegotiable and renegotiable covenants.[2] In the model an entrepreneur seeks financing from the creditor to invest in a risky project. Both the entrepreneur and the creditor face ex-ante uncertainty about the prospect of the project. The optimal debt contract sets the face value and includes a debt covenant that might trigger liquidation when future accounting information reveals bad news before the maturity of debt. Without the accounting-based covenant, the entrepreneur has no incentive to liquidate the project ex-post as all proceeds from the liquidation will be paid to the creditor. Allowing for possible liquidation induced by the debt covenant in general increases the ex-ante efficiency of the debt contract and the entrepreneur's welfare. However, inefficient liquidation decisions may arise ex post when accounting information does not perfectly reveal the true state of the firm. In general increasing the overall informativeness of the accounting system always increases the entrepreneur's welfare, but as is shown here, the effect of accounting conservatism depends on the specific features of the debt contract.

Contrary to the hypothesis of the debt contracting explanation for accounting conservatism (Watts, 2003), I find that increasing accounting conservatism reduces the efficiency

[2] A large body of theoretical research in financial contracting focuses on the contingency and renegotiation of optimal contracts. That literature views debt contracts as dynamic state contingent contracts that often change through a combination of ex-ante contingencies and ex post renegotiation (Aghion and Bolton, 1992; Hart and Moore, 1998; Bolton and Scharfstein, 1990; etc). In this paper I do not model the security design but instead assume that for reasons outside the model debt financing is optimal for the entrepreneur.

of the liquidation decision and the entrepreneur's expected payoff when the debt contract includes non-renegotiable accounting-based covenants. The main intuition is that the entrepreneur trades off the expected efficiency loss due to liquidating good projects and not liquidating bad projects based on accounting information. As long as the project is ex-ante worth investing, the entrepreneur prefers more liberal accounting as the expected efficiency loss from liquidating a good project is larger than the expected loss from not liquidating a bad project.

However, in the model the debt contract is to some degree incomplete as the debt covenant can only be contingent on the imperfect accounting signal but not on the realized true state, which is assumed to be unverifiable. Therefore there will be scope for renegotiation to improve the contract efficiency when the initial contract induces inefficient liquidation after the true state is realized. Specifically, in the model two types of inefficiencies arise: liquidation of the good project upon observing a low signal and continuation of the bad project upon observing a high signal. If ex-post renegotiation is always efficient and costless, the properties of accounting system do not affect the outcome. But when renegotiation is costly, accounting information potentially becomes relevant to the entrepreneur's welfare and the efficient liquidation decision.

When the renegotiation cost is sufficiently large such that renegotiation is impossible for either inefficient case, more conservative accounting decreases the entrepreneur's expected payoff, essentially the same as the non-renegotiation result above. On the other hand, when the renegotiation cost is relatively small, renegotiation occurs in both inefficient cases. The choice of accounting systems then only affects the expected total renegotiation cost. In this case more conservative accounting increases the entrepreneur's expected payoff when the ex-ante probability of a firm facing positive NPV projects is lower. When the renegotiation cost is moderate, the entrepreneur trades off the expected renegotiation cost (but the efficient liquidation decision) on one type and the efficiency loss from the inefficient liquidation decision on the other type. A key determinant of the welfare effect of conservatism then is the liquidation value, and the preference over conservative accounting is increasing with the liquidation value. The reason is that when the liquidation value increases, the benefit from efficiently liquidating the bad project becomes so attractive that the entrepreneur is willing

to bear the loss from inefficiently liquidating a good project as a result of more conservative accounting.

These results provide some empirical implications on the cross-sectional variation of the demand for accounting conservatism in debt contracts. One implication is that the renegotiation cost needs to be taken into account when testing the demand for accounting conservatism in debt contracts. Firms with public debt usually have very high costs of renegotiation, and hence are expected to prefer less conservative accounting than firms with private debt. The investment opportunities and liquidation values are also important factors to be considered in examining the role of accounting conservatism in debt contracts. These cross-sectional effects should be more prominent at the industry level. Therefore more conservative accounting increases the debt contract efficiency in traditional industries with less promising investment opportunities and more tangible assets and decreases the debt contract efficiency in knowledge based industries with better investment opportunities and fewer tangible assets.[3] These predictions so far have not been tested by empirical studies.

I also derive from the model the relationship between accounting conservatism and the equilibrium face value of the debt, which is usually measured by the implied interest rate in the loan agreement in empirical studies. The results show that even though accounting conservatism may lower the entrepreneur's payoff, the ex-ante face value of debt may still decrease as the accounting system becomes more conservative. The implied interest rate of debt (or the face value of debt) is, therefore, not sufficient to assess the welfare implications of conservatism, since it ignores the ex-post efficient liquidation decisions. Empirical studies using the interest rate to examine the efficiency role of accounting conservatism in debt contracting need to use caution interpreting the results.

This paper is related to several other studies modeling the accounting based debt covenant. Magee and Sridhar (1997) show that it can be ex-ante optimal to design a financial contract that admits debtholders' discretionary waiving of debt covenants and firms' opportunistic investments ex-post. Gjesdal and Antle (2001) model the dividend restriction covenant in

[3]Indeed for some R&D intensive industries, the practice of immediately recognizing R&D expenditure as expense is consistent with the prediction of the model, as R&D expense is a form of ex-ante conservatism which will preempt ex-post conservatism and requires no recognition of loss when the R&D project fails in the future. The model's implication is mainly about the ex-post or conditional conservatism when there is new information about the project in the future.

incomplete market and attempt to examine the role of accounting construction in the optimal dividend constraint. Garleanu and Zwiebel (2009) analyze the design and renegotiation of covenants and show that adverse selection problems lead to the allocation of greater ex-ante decision rights to the uninformed creditor through tighter covenants that are frequently waived upon renegotiation ex-post.

Few studies have directly examined the demand of accounting conservatism in debt contracts. The closest study to mine is Gigler et al. (2009), which also examines the link between accounting conservatism and the efficiency of debt contracting. Their conclusion for the non-renegotiable contract setting is similar to mine in that more conservative accounting always reduces the efficiency of debt contracts, which counters the common debt contracting hypothesis of accounting conservatism. Gigler et al. (2009) consider a more general model in terms of continuous outcomes and endogenous optimal debt covenants. But they do not allow for renegotiation upon observing informative accounting signals at an intermediate date, hence in their model conservatism is never optimal.[4] By allowing for renegotiation conditional on information revealed at the intermediate stage, this paper adds to our understanding of the role of accounting conservatism in debt contracts and generates novel cross-sectional empirical predictions.

The remainder of the paper proceeds as follows: Section 2 introduces the basic model set up and the properties of the accounting information structure. Section 3 models the optimal debt contract without renegotiation. Section 4 models the optimal debt covenant with renegotiation. In this section both costless and costly renegotiation are considered. Section 5 discusses the results and empirical implications of the model. Section 6 concludes the paper.

2 The Model

I consider a wealth constrained risk-neutral entrepreneur who needs to finance the entire amount of investment I from a creditor to undertake a project. The entrepreneur faces

[4] Gigler et al. (2009) also consider renegotiation but of a very different kind as in my model. They show that any potentially ex-ante suboptimal debt covenant will be renegotiated to the optimal one. That is, the optimal debt covenant in the continuous model is renegotiation proof.

a competitive lending market and he offers the creditor a debt contract that ensures the creditor breaks even. For simplicity, assume the discount rate is zero. Both the entrepreneur and creditor are risk neutral. At time 0, the contract is signed and the project is undertaken. The project generates cash flows only at time 2, the end of project life. The debt contract has a face value of D at time 2 and gives the creditor priority to collect the proceeds from liquidation at time 1. In this model I do not address the more general question whether equity or debt should be issued, instead simply assume that debt is chosen for unmodeled reasons.[5]

The project is risky: in case of success it will pay out cash flows of X, otherwise the project fails with zero cash flows. It is easy to see that D must be lower than X. The entrepreneur can be either a good type (G) or a bad type (B). A good type entrepreneur's project has a higher probability of success (p_g) than a bad type (p_b). Furthermore, assume that the good type entrepreneur has a positive NPV project and the bad type has a negative NPV project in expectation, i.e,

$$p_g X > I > p_b X$$

If the information about the type is known to both parties, only the good type entrepreneur will seek financing and undertake the project. Ex-ante both the entrepreneur and creditor only have information about the probability (θ) of the entrepreneur being a good type. I assume that the ex-ante expected payoff from the project is positive so that the project is worth undertaking without knowing the entrepreneur's type:

$$[\theta p_g + (1-\theta)\, p_b]\, X > I$$

Liquidation decision: The liquidation value of the project is exogenously determined as

[5] The key rationalization for relying on debt contracts is that the entrepreneur can 'divert' or 'hide' project returns (and liquidation values) from the investor unless the investor actually assumes control during liquidation. Earlier literature (e.g., Hart and Moore, 1998) has shown that under these conditions debt contracts are optimal, i.e., the entrepreneur promises a fixed stream of payments to the investor and, if the entrepreneur defaults, the investor has the right to seize and liquidate the project. I therefore confine attention to debt contracts and ignore alternative contractual arrangements, e.g., to delegate all the decision rights to the entrepreneur, as this would be vulnerable to opportunistic behavior on the part of the entrepreneur who would always claim to have liquidated the project, leaving the creditor empty-handed.

K. The liquidation value can be viewed as the initial investment's asset value at time 1, which depreciates to zero if the firm waits until time 2 to liquidate the project. If the creditor liquidates the project at time 1, he will collect K; otherwise he waits until time 2 to collect D if the project succeeds, or gets nothing if the project fails. Success or failure, respectively, are verifiable events.

Assume that the liquidation value satisfies the condition $p_g X > I > K > p_b X$, i.e, with perfect verifiable information about the true type, the efficient liquidation decision is always to liquidate the bad type project and continue the good type project. Without any information about the project type it is efficient to continue the project. Therefore only the intermediate information that triggers the liquidation can improve the efficiency of the debt contract. However, the entrepreneur has no incentive to liquidate the project, since the proceeds from liquidation will be used to pay the creditor first as specified in the debt agreement. Without any contract that gives the creditor the right to liquidate the project, the creditor can not force liquidation at the intermediate date. In this aspect, the entrepreneur and the creditor has the conflict of interests regarding the liquidation decision.

Accounting system: At time 1 the true type is realized, but the true type is impossible or very costly to describe or verify, so that the ex-ante contract cannot be contingent on θ. However, both parties can perfectly identify which type is realized.[6] The contract can, however, be contingent upon an accounting signal that is informative about the realized type as in Aghion and Bolton (1992). The accounting signal is observable and verifiable and it can be either low (S_L) or high (S_H). Therefore the accounting-based covenant is necessary to trigger the liquidation event even though the true type is realized and known to both parties.

In this model the information structure follows Venugopalan (2004), which defines different accounting regimes by varying the conditional probabilities of observing high or low

[6]The assumption about the realized state of nature follows the incomplete contract literature since Grossman and Hart (1986).

signals for a certain type of entrepreneur. The conditional probabilities are defined as:

$$P(S_H \mid G) = \lambda + \delta \tag{1}$$
$$P(S_L \mid G) = 1 - \lambda - \delta$$
$$P(S_H \mid B) = \delta$$
$$P(S_L \mid B) = 1 - \delta$$
$$\text{for } \lambda \in [0,1] \text{ and } \delta \in [0, 1-\lambda]$$

This specification is consistent with the monotone ratio property (MLRP) as $P(S_H \mid G) > P(S_H \mid B)$. Higher values of $P(S_H \mid G)$ and $P(S_L \mid B)$ make the accounting system more informative about the true type. If both these values equal 1, the signal is perfectly informative about the true type. As discussed in Venugopalan (2004), the parameters λ and δ capture the degree of informativeness and conservatism of accounting system. The posterior probabilities of true type after observing the accounting signal are:

$$P(G \mid S_H) = \frac{(\lambda + \delta)\theta}{\lambda\theta + \delta}$$
$$P(B \mid S_L) = \frac{(1-\delta)(1-\theta)}{1 - \lambda\theta - \delta}$$

As λ increases, the above posterior probabilities increase, indicating that the accounting system is more informative. The parameter δ is defined within the range of $[0, 1-\lambda]$, capturing the degree of conservatism. An increase in δ makes the accounting system more liberal as the probability of $P(G \mid S_H)$ decreases and the probability of $P(B \mid S_L)$ increases. More conservative accounting is more informative at the top end (signal S_H) due to its downward bias. When $\delta = 0$, the bad type always produces signal S_L and the error of misreporting occurs when the good type also produces a low signal. The accounting system then is most conservative. On the other hand, the accounting system is most liberal when $\delta = 1 - \lambda$ so that the good type always generates high signal, while the error occurs when the bad type also generates signal S_H. The information structure of the accounting system in Venu-

gopalan (2004) allows for a direct examination of the effect of accounting informativeness and conservatism in a simple binary setting. [7]

To summarize the model setup, Figure 1 illustrates the timeline of events.

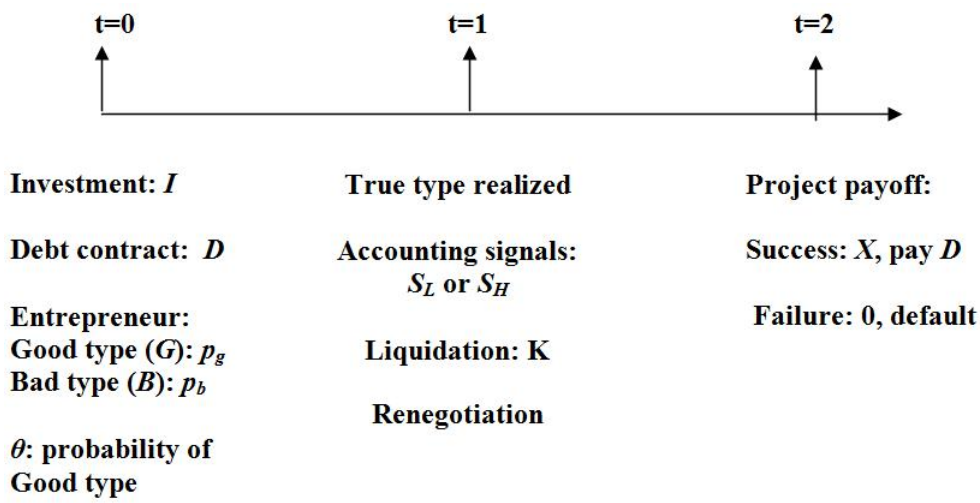

Figure 1: Timeline

3 Optimal debt contract without renegotiation

3.1 Two special cases

In this section I model the optimal debt contract in the absence of renegotiation. Before considering the more general debt contract with the accounting based covenant, we first look at two special cases: one with no accounting information at the intermediate stage, and the other with perfect accounting information.

No information: Without any accounting information, the creditor cannot force the liquidation at $t = 1$. The face value of the debt contract D_0 that gives the creditor a break-even return for lending the amount of I is:

[7] Gigler et al. (2009) introduce an additional notion of conservatism which allows the effect of δ on the conditional probability to differ for different realized types and find the same conclusion using either form of conservatism definition. It might be worthwhile in the future work to introduce their definition of conservatism in the renegotiable debt contract, as it might affect the tension in the efficient liquidation decision with costly renegotiation and hence generate potentially interesting results.

$$D_0 = \frac{I}{\theta p_g + (1-\theta)\, p_b} \tag{2}$$

where $\theta p_g + (1-\theta)\, p_b$ is the ex-ante probability that the creditor receives the full face value at the end of project period.

The entrepreneur's expected payoff from the project E_0 is given by:

$$E_0 = [\theta p_g + (1-\theta) p_b]\,(X - D_0) = [\theta p_g + (1-\theta) p_b] X - I \tag{3}$$

In equilibrium the creditor gets compensated for the possibility of default. Because of the competitiveness of the debt market, the whole surplus or the net present value of the project goes to the entrepreneur if the project is financed. Since the project has positive expected net present value, i.e, $[\theta p_g + (1-\theta) p_b] X - I > 0$, the entrepreneur will always seek financing and invest in the project.

Perfect information: When the accounting signal at the intermediate stage perfectly reveals the underlying true type, it is equivalent to assume $\lambda = 1$ in the information structure assumed in the equation (1). At time 1, upon observing a low signal, the creditor knows that the entrepreneur is a bad type and liquidating the project yields higher expected payoff than continuing, given $p_b D < p_b X < K$ by assumption. Thus the face value D_1 with the perfect accounting information is given by:[8]

$$D_1 = \frac{I - (1-\theta)\, K}{\theta p_g} \tag{4}$$

The entrepreneur receives a positive return when the project is a good type and zero when the project is a bad type, therefore his expected payoff from the investment is:

$$E_1 = \theta p_g\,(X - D_1) = \theta p_g X + (1-\theta)\, K - I > E_0 \tag{5}$$

[8]This can be easily shown as the creditor's expected payoff will be

$$\theta \cdot p_g D + (1-\theta)\, K - I$$

The optimal debt contract in (4) can be solved by applying the creditor's zero profit constraint to the above equation.

As shown above, the optimal debt contract with perfect ex-post information can always achieve the socially optimal liquidation decision. The creditor is strictly better off ex-post through the efficient liquidation of the bad project. However, the surplus from the efficiency improvement goes to the entrepreneur as stated in (5), because the entrepreneur can extract the rent ex-ante by offering a contract with a lower face value.

3.2 Contract with imperfect information

I now proceed to the more general case where accounting information is imperfect and reveals the true type with noise. The debt contract contingent on imperfect accounting signals may improve the efficiency of the liquidation decision, however, it may also introduce inefficient liquidations if accounting signals contain errors in revealing the true type. The properties of the accounting system will affect the precision and bias of accounting signals, which in turn will affect the creditor's liquidation decisions.

If the debt contract does not include a covenant that allows the creditor to liquidate the project, the debt contract remains effectively the same as in the no-information case. Therefore the optimal debt contract includes a debt covenant that gives the creditor the liquidation right only when the low signal is observed. However, given this covenant the creditor may not always want to execute the liquidation right even when the low signal (S_L) is observed. Whether the covenant effectively triggers liquidation upon observing a low signal depends on the creditor's tradeoff between the expected payment at time 2 and the liquidation value.

Based on the signal generated by the accounting system, the creditor updates his expectations about the probability of success of the project. Define the posterior probability of success after observing a high signal as q_h, and the probability of success after observing a low signal as q_l, where q_h and q_l are calculated as:

$$q_h = p_g P\left(G \mid S_H\right) + p_b P\left(B \mid S_H\right) = p_g \frac{\theta\left(\lambda+\delta\right)}{\lambda\theta+\delta} + p_b \frac{(1-\theta)\delta}{\lambda\theta+\delta}$$

$$q_l = p_g P\left(G \mid S_L\right) + p_b P\left(B \mid S_L\right) = p_g \frac{\theta(1-\lambda-\delta)}{1-\lambda\theta-\delta} + p_b \frac{(1-\theta)\left(1-\delta\right)}{1-\lambda\theta-\delta}$$

When the high signal is observed, the creditor updates his belief so that the posterior probability of dealing with a good type is higher than θ (this can be shown as $\frac{\lambda+\delta}{\lambda\theta+\delta} > 1$ and $\frac{\delta}{\lambda\theta+\delta} < 1$). On the other hand when the low signal is observed, the creditor updates his belief that the probability of dealing with a bad type is higher than $1-\theta$. It can also be easily shown that $q_h > q_l$.

Upon observing a high signal, the creditor cannot take any action but waits until time 2 to collect the face value. Upon observing a low signal, the creditor may liquidate the project if the expected payment at time 2 is smaller than the value he may receive from an early liquidation. Therefore the ex-ante expected payoff for the creditor at time 0 can be expressed as:

$$P\left(S_H\right) q_h D + P\left(S_L\right) max\{q_l D, K\} - I \tag{6}$$

where $P\left(S_H\right)$ and $P\left(S_L\right)$ represent the unconditional probabilities of observing the signal S_H and S_L respectively. From the assumed information structure, we have $P\left(S_H\right) = \lambda\theta + \delta$ and $P\left(S_L\right) = 1 - \lambda\theta - \delta$. Compared to the case with perfect accounting information, the creditor now relies on the posterior belief about the true type to make the liquidation decision. It is therefore possible that the debt covenant may not be always effective, in that the creditor may not want to liquidate the project even when the low signal is observed. This is explicitly shown in Proposition 1 below.

Proposition 1 *When the accounting signal at time 1 imperfectly reveals the entrepreneur's type, there exists some hurdle value of liquidation* $K^* \equiv \frac{q_l I}{\theta p_g + (1-\theta) p_b}$, *such that:*

- *If* $K \leq K^*$, *the optimal debt contract does not include any covenant to allow the creditor to liquidate the project at time 1, and the equilibrium face value of debt is* $D_2 = D_0 = \frac{I}{\theta p_g + (1-\theta) p_b}$.
- *If* $K > K^*$, *the optimal debt contract includes a covenant that gives the creditor the right to liquidate the project when the low signal is observed at time 1, and the equilibrium face value of debt is* $D_2 = \frac{I - P(S_L)K}{q_h P(S_H)} = \frac{I - (1-\lambda\theta-\delta) K}{\lambda\theta p_g + \delta\left[\theta p_g + (1-\theta) p_b\right]}$, *and* $D_1 < D_2 < D_0$.

Proof. See Appendix ■

$P(S_L)K$ is the expected liquidation value that the creditor may collect at the intermediate stage when observing a low accounting signal. $q_h P(S_H)$ is the probability of success at time 2 when the project is allowed to continue upon observing a high signal. When the liquidation value is greater than K^*, the imperfect accounting information allows the liquidation at time 1 and the equilibrium face value of debt is lower than in the no-information case (D_0). Compared to the perfect information case, the imperfect accounting information introduces noise into both the liquidation decision at time 1 and the expected probability of default at time 2, therefore the ex-ante face value of debt is higher than the perfect information case.

Proposition 1 also suggests that the effectiveness of any covenant in the optimal debt contract depends on the exogenous liquidation value. When the liquidation value is relatively small, the creditor may not choose to liquidate the project even when a low signal is observed. The reason is that the creditor wants to avoid the excessive inefficient liquidation when accounting information contains noise and the benefit from an early liquidation becomes less attractive as the liquidation value decreases. The relation between the liquidation hurdle value and the accounting information is further shown in Corollary 1:

Corollary 1 *The hurdle value of liquidation K^* is decreasing in the informativeness ($\partial K^*/\partial\lambda < 0$) and increasing in the degree of conservatism of the accounting system ($\partial K^*/\partial\delta < 0$).*

It is intuitive to see that a more informative accounting system increases the parameter space over which the debt covenant is effective. However increasing accounting conservatism has the opposite effect. As the accounting system becomes more conservative ($\delta \downarrow$), the low signal contains more noise since increasing conservatism increases the probability of generating a low signal for the good type project; therefore, a debt covenant that allows for liquidation upon observing a low signal may induce more excessive inefficient liquidation of the good type. Indeed when the accounting system is most liberal ($\delta = 1 - \lambda$), the critical liquidation value becomes $K^* = \dfrac{p_b I}{\theta p_g + (1-\theta)\, p_b}$, which is always less than $p_b X$. In this case, the bad project is always correctly identified when the low signal is observed. Hence it is always optimal for the debt contract to include a debt covenant that allows liquidation upon observing a low signal.

Consider now the expected payoff of the entrepreneur under the optimal debt contract with an effective debt covenant (i.e, when the liquidation value is sufficiently large, $K > K^*$). When the low signal is observed, the creditor liquidates the project and collects the liquidation value. The entrepreneur gets a positive payoff only from continuing the project given that the high signal is observed. Hence the entrepreneur's expected payoff under the optimal debt contract is:

$$E_2 = P(S_H) \cdot q_h \cdot (X - D_2)$$

Substituting the values of $P(S_H)$, q_h, and D_2 into the above equation, the entrepreneur's expected payoff can be represented as:

$$E_2 = \underbrace{\theta p_g X + (1-\theta) K - I}_{E_1} - \underbrace{\theta (1-\lambda-\delta)(p_g X - K)}_{\text{Expected Loss}_G} - \underbrace{\delta (1-\theta)(K - p_b X)}_{\text{Expected Loss}_B} \tag{7}$$

As shown in equation (7), the entrepreneur's optimal expected payoff with imperfect accounting information can be broken down into three components: first best expected payoff, expected efficiency loss from liquidating the good project, and expected efficiency loss from not liquidating the bad project. The characteristics of the accounting system affect the probability of having these two types of inefficiencies. An increase in accounting conservatism ($\delta \downarrow$) has two effects on the efficiency of liquidation:

- It increases the probability of observing a low signal for a good type project, i.e, $P(G, S_L)$, and therefore increases the expected efficiency loss from liquidating a good project by $\theta\delta(p_g X - K)$
- It decreases the probability of observing a high signal for a bad type project, i.e, $P(B, S_H)$, and therefore reduces the expected efficiency loss from not liquidating a bad project by $(1-\theta)\delta(K - p_b X)$

The overall impact of accounting characteristics can be summarized in Proposition 2 below:

Proposition 2 *With imperfect accounting information, the entrepreneur's expected payoff*

given the optimal debt contract is increasing in the informativeness of accounting system and decreasing in the degree of accounting conservatism. i.e, $\partial E_2/\partial\lambda > 0$*;* $\partial E_2/\partial\delta > 0$

Proof. See Appendix ■

As mentioned above, maximizing the entrepreneur's welfare is equivalent to the social welfare maximization as the creditor's welfare is always zero due to the competitive lending market. Proposition 2 hence summarizes a key result of our analysis: more conservative accounting decreases the efficiency of debt contracting and therefore decreases the overall social welfare. This implication, essentially the same conclusion as in Gigler et al. (2009), may seem in contrast to the conventional view on the debt contracting hypothesis of accounting conservatism; however, the intuition is immediate from analyzing the expected payoff function of the entrepreneur. The overall impact of increasing conservatism depends on the relative magnitude of the loss from inefficiently liquidating good projects and the gain from efficiently liquidating bad projects. Since by assumption $[\theta p_g + (1-\theta)\, p_b]\, X > I > K$, more conservative accounting will reduce the overall benefit to the entrepreneur. In other words, if the project is worth undertaking ex-ante, the entrepreneur prefers as liberal as possible an accounting system so that the good project is liquidated as infrequently as possible. When $\lambda \to 1$ (and therefore $\delta \to 0$), the accounting system produces the perfect signal, hence the face value of debt (D_2) and entrepreneur's expected benefit (E_2) will converge to the first best benchmark.

In the non-renegotiable debt contract setting discussed in this section, accounting conservatism can never be optimal. In the next section I model the renegotiable debt contract, in which accounting conservatism may improve the efficiency of debt contracting process under certain conditions.

4 Optimal debt contract with renegotiation

The debt contract in the model is incomplete because the debt covenant can only be contingent on observed accounting signals but not on realized true states. Therefore the contract may result in inefficient actions ex post when the good type generates a low signal or when the bad type generates a high signal. In these cases, the contracting parties would want

to renegotiate the liquidation decision induced by the initial covenant so as to increase the efficiency of the contracting arrangement if the true state is observable. In fact, the empirical evidence documents that renegotiation of debt contracts is both frequent and significant. For example, Roberts and Sufi (2007) document that 75% of private credit agreements have a major contract term renegotiated after origination and before the stated maturity date, based on a random sample of 1,000 private loan agreements between financial institutions and publicly listed firms. Other studies examine the violation of debt covenants, such as Chen and Wei (1993) and Beneish and Press (1993). Both of them document a large percentage of renegotiation and waiver decisions in their samples of covenant violations (57 out of 128, and 53 out of 91 respectively). They also find that the most frequent covenant violations are technical violations which usually involve covenants based on accounting numbers.

Introducing the possibility of renegotiation may change the efficiency of the debt contract and the role of accounting information as modeled in Section 3. The major implication of the non-renegotiation model is that the most liberal accounting system minimizes the inefficiencies induced by the covenant based on noisy accounting signals. If ex-post renegotiation is efficient and costless, we expect that the inefficiency due to the incomplete contract will disappear. The Coase Theorem indicates that the initial contractual arrangement does not matter because the ex-post efficient decision can always be achieved; therefore the choice of the accounting system would not affect the ex-post efficiency either. Only when there is some degree of inefficiency in the renegotiation process does accounting information become welfare relevant. One factor that might drive the inefficiency of renegotiation is the existence of renegotiation costs. With costly renegotiation, the arrangement of the ex-ante accounting system will affect the ex-post efficiency of the contract.

4.1 Costless renegotiation

Assume that the initial debt contract includes a debt covenant that gives the creditor the right to liquidate the project if the low accounting signal is observed at time 1. At time 1 the contracting parties may want to renegotiate the action to be taken if the initial debt covenant induces an inefficient liquidation decision. I assume for now that renegotiation is costless. Following Aghion and Bolton (1992), it is reasonable to assume that the creditor can make

a take-it-or-leave-it renegotiation offer with the full bargaining power only when the debt covenant is violated; otherwise the entrepreneur can make the renegotiation offer with the full bargaining power.[9] Notice that ex-ante the entrepreneur can always make a take-it-or-leave-it debt contract offer to the creditor as the lending market is competitive. Therefore, as will be shown below, the entrepreneur can always extract the extra bargaining surplus from the creditor through the ex-ante competitive debt contract even when the creditor has the full bargaining power ex post.

At time 1, there are four pairs of combinations of realized true types and accounting signals: (G, S_H), (G, S_L), (B, S_L), (B, S_H). If the realized combination is (G, S_H), the creditor does not have the right to liquidate the project under the initial debt contract with covenant. The continuation decision is efficient for this case. If the combination (B, S_L) is realized, the debt covenant allows the creditor to liquidate the project when the low signal is observed and the creditor will actually liquidate the project, which is also efficient. It is in the other two cases that the initial debt contracts induce inefficient liquidation decisions and there will be scope for renegotiation.

First look at the case when the high signal is observed but the true type is "bad" (B, S_H). The initial debt covenant does not allow for liquidation by the creditor. Given that the entrepreneur has all the bargaining power, he will offer the creditor the amount of $p_b D$ to liquidate the project and leave himself $K - p_b D$ after liquidation. The creditor will accept the offer because his expected payoff is the same whether he accepts the offer or not. The whole renegotiation surplus goes to the bad type entrepreneur, therefore the entrepreneur is strictly better off by $K - p_b X$ through the renegotiation. Hence renegotiation results in a Pareto improvement and leads to the socially optimal liquidation decision.

In the case when the low signal is observed but the true type is "good" (G, S_L), renegotiation also improves the contract efficiency. Under the initial contract the creditor has the right to liquidate the project when a low signal is realized. Now since the creditor has all the bargaining power when the covenant is violated, he will threaten to liquidate the

[9] Aghion and Bolton (1992) point out that debt financing can be viewed as a way to allocate the control right in a 'state-contingent' fashion with equityholders retaining control in the nondefault state and creditors taking control in the default state. It is a typical assumption that the party with control right has the full bargaining power in the renegotiation process.

project and ask for the entire future cash flows X if he allows the project to continue. The entrepreneur gets the same expected payoff zero whether or not he accepts the renegotiation offer. I assume that when the entrepreneur is indifferent in the monetary payoff, the renegotiation will work toward the efficient outcome, i.e, the good type entrepreneur will accept the offer and allow the project to continue. Therefore the creditor gets the expected payoff $p_g X$ instead of K as a result of renegotiation with the good type entrepreneur. In this case, again, renegotiation results in a Pareto improvement.

Table 1 summarizes the expected payoffs for both parties under each scenario in the renegotiable debt contract. The left item in the bracket of each cell represents the entrepreneur's ex post payoff, and the right item in the bracket represents the creditor's ex post payoff at the end of the operation period.

Table 1: Expected ex post payoffs with renegotiation

Signals / True Type	S_H	S_L
Good Type	No renegotiation $[p_g(X-D),\, p_g D - I]$	Renegotiation $[0,\, p_g X - I]$
Bad Type	Renegotiation $[K - p_b D, p_b D - I]$	No renegotiation $[0, K - I]$

The face value of debt can be solved by applying the creditor's zero profit constraint to the creditor's ex-ante expected payoff as calculated by the sum of expected payoffs under four possible realizations in Table 1, denoted as D_3

$$D_3 = \frac{I - (1 - \lambda\theta - \delta)\, K - \overbrace{\theta\,(1 - \lambda - \delta)\,(p_g X - K)}^{(a)}}{\lambda\theta p_g + \delta\,[\theta p_g + (1-\theta)\, p_b]} \tag{8}$$

It is intuitive to compare the face value under costless renegotiation (D_3) with the face value without renegotiation (D_2) to understand the intuition of renegotiation in the debt contract. The difference between these two equilibrium face values is marked as (a) in equation (8), which represents the surplus to the creditor from the efficiency gain by not liquidating the good project when a low signal is observed. However, even though the

creditor captures the entire surplus from renegotiation when the debt covenant is violated, the expected gain from renegotiation will be extracted upfront by the entrepreneur through a lower face value of debt. In the other renegotiation case when the high signal is observed, the entrepreneur has the bargaining power and captures the entire surplus from renegotiation. Therefore when costless renegotiation of debt contract is feasible, the efficient liquidation decision can always be implemented and the entire surplus from efficient renegotiation will go to the entrepreneur, whose payoff will be exactly the same as the first best benchmark:[10]

$$E_3 = \theta p_g X + (1-\theta)K - I \tag{9}$$

The next proposition follows immediately from this observation:

Proposition 3 *In the debt contract with costless renegotiation, the first-best benchmark performance is achieved and the ex-ante properties of the accounting system (λ, δ) do not affect the entrepreneur's payoff.*

The irrelevance of accounting information is consistent with Coase Theorem. With costless renegotiation, ex-post efficiency can always be achieved. The entrepreneur can freely choose any accounting system and still achieve the first best efficient liquidation. However, the accounting-based covenant is necessary and serves the purpose of a trigger for costless renegotiation ex-post.

4.2 Costly Renegotiation

In this section I consider the debt contract with costly renegotiation. From now on I assume that there is a fixed amount of cost c in the renegotiation process. Some examples of these costs are direct costs paid to lawyers or accountants and personal efforts involved, and others could be indirect costs such as the free-rider or externality costs, arising when multiple creditors are involved. Renegotiation cost varies significantly across different types

[10] The entrepreneur's payoff can also be derived as follows: in Table 1 the entrepreneur gets non-zero payoff only when the high signal is observed. The entrepreneur's expected payoff from financing and investment now becomes:

$$E_3 = P(S_H, G) \cdot p_g(X - D_3) + P(S_H, B) \cdot (K - p_b D_3)$$

Substituting D_3 into the equation above, we get equation (9)

of lending agreements. Public debts are viewed to be more costly to renegotiate than private loans since public debts are subject to more legal restrictions and require the consent of majority bondholders in order to renegotiate the initial contract (Smith and Warner, 1979). In the private lending agreement, renegotiation is typically easier as there are fewer lenders involved and the lenders usually have better means of monitoring or controlling the firm. Within private loans, renegotiation cost is higher for large syndicated loans with multiple creditors. Chen and Wei (1993) document that covenant violations and follow-up waivers or renegotiation decisions occur most frequently in private bank loans with one creditor, and less likely in private loans with more than one creditor, and very rarely in public debts. The variation of renegotiation cost will affect the extent of ex-post efficiency through renegotiation and the role of accounting information.

As in the case of costless renegotiation, renegotiation may improve the two possible inefficiencies under the initial contract when the low signal is observed for a good type or when the high signal is observed for a bad type. The surplus from efficiently not liquidating the good project is $p_g X - K$ and the surplus from efficiently liquidating the bad project is $K - p_b X$. Whether or not renegotiation occurs depends on the relative magnitude of the renegotiation cost and these two surplus terms. There are three possible cases to be considered: when the renegotiation cost is "large", "small" or "moderate", respectively. Compared to the no-renegotiation case where more liberal accounting is always preferred by the entrepreneur and the costless renegotiation case where accounting information is irrelevant, the costly renegotiation provides a role for conservative accounting in debt contracting, as discussed below.

In the model it is reasonable to assume that the renegotiation cost is paid by the party who makes the renegotiation offer. When the debt covenant is not violated, the entrepreneur makes the renegotiation offer and pays the cost out of the liquidation value if the project is liquidated through renegotiation. When the debt covenant is violated, the creditor makes the renegotiation offer and pays the cost out of his own pocket. Recall that the entrepreneur in the model is wealth constrained, but the creditor is not.

Case I: "Large" renegotiation cost, i.e, $c > max\{K - p_b X, p_g X - K\}$. In this scenario, the renegotiation cost is greater than any possible surplus from the renegotiation, hence

renegotiation is not cost-effective. Then the same conclusion can be reached as for the non-renegotiable contract discussed in section 3, and the entrepreneur still prefers more liberal accounting.

Case II: "Small" renegotiation cost, i.e, $c < min\{K - p_b X, p_g X - K\}$. When the renegotiation cost is relatively small, it is always worthwhile to renegotiate at time 1 to obtain a Pareto improvement in each of the inefficient states (G, S_L) and (B, S_H), because the surplus from renegotiation in both states ($p_g X - K$ and $K - p_b X$, respectively) is greater than the cost. Case II generalizes the costless renegotiation results in section 4.1, except that the entrepreneur or the creditor now needs to pay an additional cost of c when renegotiation occurs. The payoff functions shown in Table 2 below, therefore, are similar to those in Table 1, adjusted for the cost c.

Table 2: Expected ex-post payoffs with costly renegotiation (Case II)

Signals / True Type	S_H	S_L
Good Type	No renegotiation $[p_g(X - D),\, p_g D - I]$	Renegotiation $[0,\, p_g X - c - I]$
Bad Type	Renegotiation $[K - p_b D - c, p_b D - I]$	No renegotiation $[0, K - I]$

The equilibrium face value of debt (D_4^{II}) in this case is solved by applying the zero profit constraint to the creditor's ex-ante expected payoff at time 0 given the payoff matrix in Table 2.

$$D_4^{II} = \frac{I - (1 - \lambda\theta - \delta)\, K - \theta\,(1 - \lambda - \delta)\,(p_g X - K - c)}{\lambda\theta p_g + \delta\,[\theta p_g + (1 - \theta)\, p_b]} \tag{10}$$

Compared with D_3 under costless renegotiation in equation (8), the only difference is the renegotiation cost when the low signal is observed. Even though the entrepreneur only pays the renegotiation cost ex-post when the high signal is observed, his expected payoff is also lowered by the renegotiation cost occurred by the creditor since the ex-ante debt contract needs to compensate the creditor for the cost. Intuitively the first best liquidation decisions can always be achieved through the low cost renegotiation, however the entrepreneur needs to bear the expected renegotiation cost. The entrepreneur's expected payoff (E_4^{II}) will be

lower than the first best payoff E_1, as shown below:

$$E_4^{II} = E_1 - [\theta(1-\lambda-\delta) + (1-\theta)\delta]c - I \tag{11}$$

Renegotiation cost occurs in the two inefficient cases induced by the initial contract: $\theta(1-\lambda-\delta)c$ when the low signal is generated for the good type project, and $(1-\theta)\delta c$ when the high signal is generated for the bad type project. Changing the properties of accounting system (λ, δ) will affect the total expected renegotiation cost. It is easy to observe that when the accounting system becomes more informative, the expected renegotiation cost goes down as the probability of occurring ex-post renegotiation decreases in general. When the accounting system becomes more conservative, the impact on the entrepreneur's expected payoff depends on the ex-ante probability of being a good type (θ). Since $\frac{\partial E_4^{II}}{\partial \delta} = (2\theta - 1)c$, we can get the following proposition:

Proposition 4 *When the renegotiation cost is small, more conservative accounting increases the entrepreneur's expected payoff if and only if* $\theta < 1/2$.

Proposition 4 suggests the possibility for accounting conservatism to improve the entrepreneur's welfare, which is in contrast with prior results of no role for accounting conservatism either in the non-renegotiable contract or in the costless renegotiable contract. The intuition is that increasing accounting conservatism increases the probability of generating a low signal for the good type and consequently increases the expected renegotiation cost for the scenario (S_L, G); on the other hand it decreases the probability of generating a high signal for the bad type to the same degree and consequently reduces the expected renegotiation cost for the scenario (S_H, B). The overall outcome of increasing conservatism on the total renegotiation cost depends on the ex-ante probability of being the good type or bad type. If the project is more likely to be a bad type, then the reduction of expected renegotiation cost in (S_H, B) outweighs the increase of expected renegotiation cost in (S_L, G). Therefore more conservative accounting is preferred by the entrepreneur when ex-ante the entrepreneur is more likely to face a negative NPV project($\theta < 1/2$).[11]

[11]Some signaling models predict that good firms might commit to more conservative accounting and adopt

Case III: "Moderate" renegotiation cost, i.e, $c \in [K - p_b X, p_g X - K]$ *or* $c \in [p_g X - K, K - p_b X]$. In this case renegotiation cost prevents the renegotiation for one of the two inefficiencies. The exogenous liquidation value K determines the relative magnitude of the two surplus terms. Larger liquidation values increase the efficiency gain from liquidating the bad project. Specifically if $K > K^s \equiv \frac{p_g X + p_b X}{2}$ then $p_g X - K < K - p_b X$, and vice versa. At K^s, the surplus from renegotiation is the same in the two inefficient states.

When the liquidation value is small ($K < K^s$), renegotiation in the (B, S_H) state is not cost effective. Hence renegotiation only occurs in the state (G, S_L), and the inefficiency in the state (B, S_H) remains unsolved. Accordingly the entrepreneur's payoff is smaller than the first best benchmark due to two components: 1) the expected renegotiation cost at the state (G, S_L); 2) the loss due to the inefficient liquidation decision at the state (B, S_H).

On the other hand, when the liquidation value is large ($K > K^s$), liquidating the bad project becomes more attractive and the opposite result is obtained. Renegotiation will occur in the state (B, S_H) but not in the state (G, S_L). The entrepreneur's expected payoff is smaller than the first best benchmark payoff due to: 1) the expected renegotiation cost at the state (B, S_H); 2) the loss due to the inefficient liquidation decision at the state (G, S_L).

The impact of accounting conservatism on the entrepreneur's payoff depends on the tradeoff between the expected renegotiation cost (yet the efficient liquidation decision) in one state and the efficiency loss due to the inefficient liquidation decision in the respective other state. As the accounting becomes more conservative, the probability of observing state (G, S_L) increases and of observing state (B, S_H) decreases. Therefore the effect of accounting conservatism on the overall outcome depends on the ex-ante probability of being a good type, θ. In general, there exists a threshold of θ below which the entrepreneur will prefer conservative accounting and the threshold of θ varies with the exogenous liquidation value K.

The following proposition summarizes the effect of accounting conservatism under moderate renegotiation cost.

Proposition 5 *In the presence of moderate renegotiation cost (Case III), more conservative*

earnings-based covenants to signal their type when facing credit rationing (Levine and Hughes, 2005), which provides a different explanation for the choice of accounting conservatism in firms with different investment opportunities.

accounting increases the entrepreneur's expected payoff if and only if:

$$\theta \leq \theta^*(K) = \begin{cases} \dfrac{1}{1+\frac{c}{K-p_b X}}, & for K < K^s \\ \\ \dfrac{1}{1+\frac{p_g X - K}{c}}, & for K > K^s \end{cases}$$

Proof. See Appendix ■

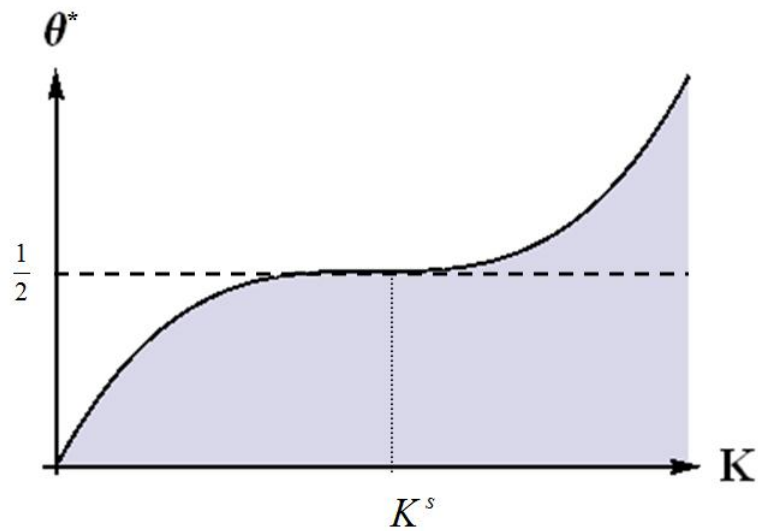

Figure 2: Preference for accounting conservatism (Case III)

Figure 2 illustrates how the liquidation value K affects the threshold of θ below which more conservative accounting will increase the entrepreneur's welfare. The preference set of conservative accounting is represented by the shadow area in the graph. As shown in the figure, at K^s, the threshold at K^s is $\theta^*(K^s) = \frac{1}{2}$. At this point, the creditor is indifferent between renegotiation and no-renegotiation in both states and renegotiation will occur in either case; therefore the threshold of θ is coincident with that in Case II (see Proposition 4). In general, we have the following corollary:

Corollary 2 *The threshold of $\theta^*(K)$ below which the entrepreneur prefers more conservative accounting increases with the liquidation value K.*

As the liquidation value increases, the efficiency improvement from renegotiation in the

state (B, S_H) also increases and therefore the entrepreneur is more likely to prefer more conservative accounting.

The results in Proposition 4 and Proposition 5 suggest that increasing accounting conservatism may benefit the entrepreneur under certain circumstances that are determined by a variety of factors such as magnitude of renegotiation cost, ex-ante investment opportunity set, and exogenous liquidation value. In the next section I discuss the empirical implications of these results in detail.

5 Face value of debt and accounting conservatism

The face value of debt in the model is usually measured by the implied interest rate in the empirical literature. These empirical studies (for example, Zhang, 2008) often use the interest rate as a proxy for the cost of debt and find that more accounting conservatism is associated with lower interest rate of loan agreements, concluding that accounting conservatism improves the efficiency of debt contracting. From this model, we can derive the impact of accounting conservatism on the implied interest rate directly, which allows us to draw some implications on the empirical evidence.

In the case of the debt contract without renegotiation, we have the following corollary:

Corollary 3 *There exists some cutoff value of liquidation K^c, with $K^c > K^*$, such that:*

$$\begin{cases} \partial D_2/\partial\delta > 0, \quad for K > K^c \\ \\ \partial D_2/\partial\delta < 0, \quad for K^* < K < K^c \end{cases}$$

where $K^c \equiv \dfrac{I\left[\theta p_g + (1-\theta)\, p_b\right]}{\theta p_g + (1-\theta)\, p_b + \lambda\theta\,(1-\theta)\,(p_g - p_b)}$

Proof. See Appendix. ■

Increasing conservatism affects the face value of debt through increasing the probability of observing a low signal (triggering liquidation) at time 1 and decreasing the probability of collecting the face value of debt at time 2. The creditor accepts a lower face value when

he may collect higher expected liquidation value at time 1 and asks for a higher face value when the probability of collecting the face value at time 2 increases. As shown in Corollary 3, the tradeoff between these two effects depends on the liquidation value K. For projects with sufficiently large liquidation value ($K > K^c$), the face value of debt decreases as the accounting system becomes more conservative.

The entrepreneur's expected payoff is not equivalent to the face value of debt. It is interesting to observe that even though the entrepreneur's expected payoff decreases as the accounting system becomes more conservative in this case, the implied interest rate of debt financing may not necessarily increase with accounting conservatism.

In addition, from the equilibrium debt contract in the case with costless renegotiation we can also derive a similar implication on the implicit interest rate of debt financing as in Corollary 4 below:

Corollary 4 *With costless renegotiation, the face value of debt decreases as the accounting becomes more conservative,* $\partial D_3/\partial\delta > 0$.

Proof. See Appendix ■

Therefore, even when the accounting information is irrelevant to the expected payoff of the entrepreneur, increasing accounting conservatism reduces the face value of debt in equilibrium as shown in Corollary 4. However the lower face value does not necessarily translate into an ex-ante benefit of entrepreneur, as the entrepreneur can extract all the rent from the creditor in the competitive lending market. More conservative accounting shifts the ex-post allocation of the project payoff more to the creditor through the liquidation right, hence ex-ante the entrepreneur will set a lower face value to extract the rent from the creditor.

Corollary 3 and 4 suggest that one needs to be careful to interpret the result on the ex-ante interest rate as the evidence of contracting efficiency of accounting conservatism. Zhang (2008) in fact tests the contracting efficiency hypothesis of accounting conservatism using both the ex-ante interest rate and ex-post accelerated covenant violations. However, as shown in this model, the ex-post accelerated covenant violation may not be equivalent to the efficiency of debt contract either. Increasing accounting conservatism always increases the

probability of violating covenant and induces early liquidation; however, more conservative accounting may actually reduce the efficiency of the liquidation decision.

6 Discussions and empirical implications

Recently a large body of empirical literature has tested the association between accounting conservatism and some features of debt contracts, especially debt covenants. However, this literature by and large focuses on particular firms or industries and offers limited evidence on cross-sectional differences. Ignoring cross-sectional differences may explain the low statistical power in large sample tests (for example, Frankel and Litov, 2007) or inconclusive results about the role of accounting conservatism. This model may help better understand the driving forces behind the empirical results, and also provide additional implications for further articulating cross-sectional tests of the role of accounting conservatism in debt contracts.

Renegotiation cost: As suggested by the model, renegotiation cost is an important factor that shapes the use of accounting information in debt contracts. Typically we expect the renegotiation cost to be lower for private bank loans than for public bonds, and also lower for loans with a single creditor than for syndicated loans with multiple creditors. Therefore the model predicts that in public bond issues, the accounting system should be more liberal when debt covenants are based on accounting information. On the other hand, in the private debt agreements, more conservative accounting may be preferred. The model reconciles well with some of the empirical evidences. Begley and Freedman (2004) report that the use of accounting-based debt covenants has declined sharply over the last three decades, which happen to be the period during which financial reporting becomes more conservative (Basu, 1997). Begley and Chamberlain (2005) also find the evidence that the use of accounting-based covenants is associated with less accounting conservatism by examining the public debt market. Earlier literature (Leftwich, 1983) finds that private debt contracts often include provisions based on systematic conservative adjustments from GAAP accounting. Recent empirical evidence using the sample of private bank loans (Zhang, 2008) or syndicated loans (Beatty et al., 2008) also finds more conservative accounting in these lending agreements.

Investment opportunity set: Another important implication from the model is that

the preference for accounting conservatism depends on the ex-ante investment opportunity set, indicated by θ in the model. Most empirical studies on the debt contracting hypothesis of accounting conservatism do not consider the interaction between the investment opportunity set and the use of accounting information in the debt covenants. The model predicts that debt contracts based on more conservative accounting may improve the efficiency of firms' investment and liquidation decisions when firms are more likely to face bad projects ex-ante; and vice versa. Although investment opportunities and growth opportunities are not exactly the same, firms with more positive NPV projects available are more likely to expand and grow in their investment. Therefore we expect growth firms either more likely to adjust accounting system to be more liberal, or less likely to seek debt financing if they cannot adjust accounting system freely.

Liquidation value: Liquidation value also plays a role in the use of accounting information in debt contracts. The first implication is from Proposition 2 that accounting-based debt covenants are ineffective for firms with extremely low liquidation values. Therefore we expect to observe less use of accounting-based covenants for firms with more intangible assets, especially in the knowledge-based industries. When liquidation value is relevant and the accounting-based covenant is effective, Proposition 6 predicts that firms are more likely to prefer conservative accounting as the liquidation value increases. This suggests that on average debt contracts demand more conservative accounting for the traditional industries with more tangible assets in place, and more liberal accounting for the new high-tech industries with more intangible assets.

Interest rate and accounting conservatism: As stated in Corollaries 2 and 3, the face value of debt usually decreases with accounting conservatism, even though the social welfare or the entrepreneur's expected payoff may not increase as accounting becomes more conservative. This result has implications for the empirical tests of using interest rates to test the debt contracting hypothesis of accounting conservatism. For example, Zhang (2008) finds a negative relationship between initial interest rate in the lending agreement and accounting conservatism. This evidence, however, can not be directly used to infer the efficiency implications of accounting conservatism.

Covenant tightness and accounting conservatism: Guay and Verrechia (2006) ar-

gue that the covenant tightness can replicate the effect of accounting conservatism in debt contracts. Empirically Beatty et al. (2008) find that conservatism in debt covenants and conservatism in accounting information are complements rather than substitutes. In this model due to the binary setting, I could not examine simultaneously how the choice of debt covenants and the properties of accounting system affect the efficiency of debt contracts. However, since accounting conservatism in the model arises from the potential efficiency improvement induced by ex-post renegotiation, both the tightness of covenant and conservatism in financial reports can be mechanisms to trigger the violation and renegotiation of covenants. One possible way to formally examine the relationship between the covenant tightness and accounting conservatism is to extend the endogenous optimal covenant model in Gigler et al. (2009) to the renegotiation setting in this paper, and it would be interesting to see whether accounting conservatism and covenant conservatism are complement or supplement to each other in the efficient debt contracting process.

7 Conclusion

This paper provides a theoretical model to understand the role of accounting information in debt contracts. I model the optimal debt contract with accounting-based covenants when the entrepreneur seeks financing for a risky project. The debt covenant gives the creditor the right to liquidate when accounting information reveals bad news about the project. The impact of accounting information on the entrepreneur's payoff depends on the efficiency of the ex-post liquidation decision triggered by the debt covenant. When the covenant is not renegotiable or the renegotiation cost is very high, conservative accounting actually reduces the welfare of the entrepreneur and the efficiency of debt contracts. When the covenant can be renegotiated at no costs, accounting information becomes irrelevant as ex-post efficiency can be achieved as long as ex-ante debt covenant is based on some accounting information. When the renegotiation cost is relatively small or moderate, conservative accounting can increase the entrepreneur's welfare under some conditions, especially when the firm has less promising investment opportunities and higher liquidation value.

The model focuses on the ex-ante properties of accounting information system that en-

trepreneur commits to choose and also truthfully reports the accounting signal generated by the system. One possible deviation is that the entrepreneur can manipulate the signal to avoid the possible debt covenant violation. Empirical studies have documented evidence of earnings management through income increasing accruals when the debt covenant becomes tight. Therefore incorporating the entrepreneur's manipulation of accounting reports ex-post may affect the preference over ex-ante accounting system.

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Appendix

Proof. Proposition 1

i). If $q_l D > K$, the zero profitability constraint of creditor's payoff in (6) becomes:

$$P(S_H)q_h D_2 + P(S_L)q_l D_2 - I = 0$$

Substitute$P(S_H)$, $P(S_L)$ q_l and q_h into the equation, we can get:

$$[\theta p_g + (1-\theta)p_b]D_2 - I = 0 \Rightarrow D_2 = \frac{I}{\theta p_g + (1-\theta)p_b}$$

Next substitute the equilibrium face value of debt into the condition $q_l D > K$, we can get $K < K^*$, where $K^* = \dfrac{q_l I}{\theta p_g + (1-\theta)p_b}$

ii). If $q_l D > K$, the zero profitability constraint of creditor's payoff in (6) becomes:

$$P(S_H)q_h D + P(S_L)K - I = 0$$

Substitute$P(S_H)$, $P(S_L)$, q_l and q_h into the equation, we can get:

$$\begin{aligned}
&(\lambda\theta + \delta) \cdot [p_g \frac{\theta(\lambda+\delta)}{\lambda\theta+\delta} + p_b \frac{(1-\theta)\delta}{\lambda\theta+\delta}]D + (1-\lambda\theta-\delta)K - I = 0 \\
&\Rightarrow \lambda\theta p_g + \delta[\theta p_g + (1-\theta)p_b]D + (1-\lambda\theta-\delta)K - I = 0 \\
&\Rightarrow D_2 = \frac{I - (1-\lambda\theta-\delta)\,K}{\lambda\theta p_g + \delta\,[\theta p_g + (1-\theta)\,p_b]}
\end{aligned}$$

Substitute D_2 into the condition $q_l D > K$, we can get $K > K^*$, where K^* is the same as in (i).

Now examine the properties of K^*. Take the partial derivative of q_l with respect to λ and δ separately:

$$\frac{\partial q_l}{\partial \lambda} = \frac{\theta(1-\theta)(1-\delta)(p_b - p_g)}{(1-\lambda\theta-\delta)^2} < 0$$

$$\frac{\partial q_l}{\partial \delta} = \frac{\lambda\theta(1-\theta)(p_b - p_g)}{(1-\lambda\theta-\delta)^2} < 0$$

Therefore $\partial K^*/\partial\lambda < 0$ and $\partial K^*/\partial\delta < 0$. ■

Proof. Proposition 2 Without the effective accounting based-covenant, $\partial E_2/\partial\lambda = 0$ and $\partial E_2/\partial\delta = 0$. With the accounting-based debt covenant, from equation (6), the entrepreneur's expected payoff can be written as:

$$E_2 = \lambda\theta p_g X + (1-\lambda\theta)K + \delta[\theta p_g + (1-\theta)p_b]X - K$$

Take the partial derivative of E_2 with respect to λ and δ respectively, we get:

$$\frac{\partial E_2}{\partial\lambda} = \theta(p_g X - K)$$

$$\frac{\partial E_2}{\partial\delta} = [\theta p_g + (1-\theta)p_b]X - K$$

Given the assumption $p_g X - K > 0$ and $[\theta p_g + (1-\theta)p_b]X - K > 0$, we have $\partial E_2/\partial\lambda > 0$ and $\partial E_2/\partial\delta > 0$ ■

Proof. Proposition 5

When $K < K^s$, the renegotiation occurs only in state (G, S_L) and not in (B, S_H). The expected payoffs to both parties are summarized in the table below.

Table 3: Expected payoffs with costly renegotiation (Case III)

Signals / True Type	S_H	S_L
Good Type	No renegotiation $[p_g(X-D),\, p_g D - I]$	Renegotiation $[0,\, p_g X - c - I]$
Bad Type	No renegotiation $[p_b(X-D), p_b D - I]$	No renegotiation $[0, K - I]$

The face value of debt can be solved by the zero profit constraint:

$$D_4^{IIIa} = \frac{I - (1-\theta)(1-\delta)K - \theta(1-\lambda-\delta)(p_g X - c)}{\lambda\theta p_g + \delta[\theta p_g + (1-\theta)p_b]}$$

The entrepreneur's payoff is therefore:

$$E_4^{IIIa} = \theta p_g X + (1-\theta)K - \theta(1-\lambda-\delta)c - \delta(1-\theta)(K - p_b X)$$

Take the partial derivative of E_4^{IIIa} with respect to δ:

$$\partial E_4^{IIIa}/\partial\delta = \theta c - (1-\theta)(K - p_b X)$$

$$\Rightarrow \partial E_4^{IIIa}/\partial\delta < 0 \text{ iff } \theta < \frac{1}{1+\frac{c}{K-p_b X}} \tag{12}$$

When $K > K^s$, the renegotiation occurs only in state (B, S_H) and not in (G, S_L). Similarly the entrepreneur's expected payoff will be:

$$E_4^{IIIb} = \theta p_g X + (1-\theta)K - \theta(1-\lambda-\delta)(p_g X - K) - \delta(1-\theta)c \tag{13}$$

Take the partial derivative of E_4^{IIIb} with respect to δ:

$$\partial E_4^{IIIb}/\partial\delta = \theta(p_g X - K) - (1-\theta)c$$

$$\Rightarrow \partial E_4^{IIIb}/\partial\delta < 0 \text{ iff } \theta < \frac{1}{1+\frac{p_g X - K}{c}} \tag{14}$$

Combine (12) and (14) we have Proposition 5.

■

Proof. Corollary 3

From proposition 2, take the partial derivative of D_2 with respect to δ if $K > K^*$, we get:

$$\partial D_2/\partial\delta = \frac{K\{\lambda\theta p_g + (1-\lambda\theta)[\theta p_g + (1-\theta)p_b]\} - I[\theta p_g + (1-\theta)p_b]}{\{\lambda\theta p_g + \delta\,[\theta p_g + (1-\theta)\,p_b]\}^2}$$

Therefore $\partial D_2/\partial\delta > 0$ iff

$$K > K^c = \frac{I[\theta p_g + (1-\theta)p_b]}{\lambda\theta p_g + (1-\lambda\theta)[\theta p_g + (1-\theta)p_b]}$$

Next check whether K^c is greater or less than K^*. Since $\partial K^*/\partial\delta < 0$, we only compare K^c with $K^*_{\delta=0}$:

$$K^c - K^*_{\delta=0} = \frac{\lambda^2\theta^2 p_g(1-\theta)(p_g - p_b)}{(1-\lambda\theta)[\theta p_g + (1-\theta)p_b][\theta p_g + (1-\theta)p_b + \lambda\theta(1-\theta)(p_g - p_b)]} > 0$$

Where $K^*_{\delta=0} = \dfrac{[\theta p_g + (1-\theta)p_b] - \lambda\theta p_g}{(1-\lambda\theta)[\theta p_g + (1-\theta)p_b]}$.

Therefore for $K > K^c$, we have $\partial D_2/\partial\delta > 0$; and for $K^* < K < K^c$, we have $\partial D_2/\partial\delta < 0$

■

Proof. Corollary 4

Take the partial derivative of D_3 with respect to δ as in equation (8):

$$\partial D_3/\partial\delta = \frac{[\theta p_g + (1-\theta)p_b][\theta p_g X + (1-\theta)K - I] + \lambda\theta p_g(1-\theta)(K - p_b X)}{\{\lambda\theta p_g + \delta[\theta p_g + (1-\theta)p_b]\}^2}$$

Since $\theta p_g X + (1-\theta)K - I > 0$ and $K - p_b X > 0$, we have $\partial D_3/\partial\delta > 0$

■