Debt issues and capital structure with soft information

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Abstract

Purpose – The purpose of this paper is to investigate the role of “soft information” in firms’ debt issue and capital structure choices, and present a new model reconciling the gap between theories of capital structure and empirical findings.

Design/methodology/approach – The paper develops an analytical model of debt issues under asymmetric information in a setting where, in addition to observing the amount of debt the firm issues, outside investors obtain “soft information” signals through their own information production or noisy voluntary disclosures made by the firm. This paper analyzes the benefit and cost for the firm’s debt issue decisions in this setting, and specifies the effect of soft information on these decisions.

Findings – If sufficiently precise soft information is available to outside investors, the firm’s debt issue behavior is significantly altered relative to that in existing models. In particular, an inverted-U shape relationship is found between the intrinsic value of the firm and the amount of debt it issues. Moreover, there is a negative relationship between the amount of debt the firm issues and the precision of soft information. Further, it is found that firms about which outside investors receive more favorable soft information issue less debt.

Research limitations/implications – The model predicts an inverted-U shape relationship between firms’ debt ratios and operating performance. It also predicts that firms about which outside investors receive more favorable or more precise soft information have lower debt ratios on average. A rationale is provided for the existence of firms’ investor relations departments.

Originality/value – Firms’ capital structure choices remain a topic of significant importance. This paper incorporates the soft informations into firms’ debt issue decisions and proposes a new model of capital structure that generates insights into firms’ financing decisions and disclosure decisions, as well as information production by outside investors.

Keywords Debts, Information systems, Capital structure, Financing

Paper type Research paper

1. Introduction

Many empirical studies have documented an inverse relationship between leverage and profitability (e.g. Titman and Wessels, 1988; Barclay et al., 1995; Rajan and Zingales, 1995), which cannot be explained by existing theories in the literature. Under the signaling theories (e.g. Ross, 1977), firms with higher profitability issue more debt (and have higher leverage) than their lower profitability counterparts, in an effort to separate from these lower firm types. In the traditional trade-off theory of capital structure, firms trade off the cost of having a higher level of debt (arising from the increased probability of financial distress) against its tax benefits: higher profitability decreases the expected costs of financial distress and motivates firms to increase leverage. As pointed out by Myers (1993), this inverse relationship between leverage...
Debt issues and capital structure is perhaps the most pervasive empirical capital structure regularity, which represents a significant failure of existing models in explaining firms' debt issue behavior and choice of leverage[1]. One of the objectives of this paper is to develop a new theoretical analysis of debt issues under asymmetric information that can reconcile the above gap between the theoretical and empirical literature.

The second objective of this paper is to incorporate the role of additional noisy information ("soft" information hereafter) becoming available to outside investors around the time of a debt issue. In practice, outside investors may receive such information from a variety of sources. For example, they may generate such additional information based on industrial experts' discussion about a firm's projects, analysts' ratings of its stock, or analysts' forecasts about its future earnings. They may also generate such additional information based on the voluntary disclosures made by firms through their investor relations departments. This additional information available to outside investors is informative, but noisy. It is informative in the sense that it conveys the true quality of a firm to outside investors to a certain degree (e.g. professors in biotechnology or medicine may be able to assess the probability of a firm's new cancer drug being FDA approved), while it is noisy in the sense that outside investors cannot perfectly distinguish a good firm from a bad one by observing this information alone (e.g. experts can be wrong from time to time). In addition, firm insiders usually do not directly observe outside investors' "opinion" about their firm formed based on this information (which will affect how outside investors price and trade the firm's securities)[2]. Therefore, much of this additional information available to outside investors is "soft" in the sense that it is hard to quantify or verify immediately (i.e. it cannot be substantiated with hard evidence), and impossible to convey credibly[3]. We show in this paper that the availability of such information to outside investors not only affects the extent of information asymmetry facing firms in debt market (as one would expect), but also significantly affects the debt issue behavior (and therefore capital structure) of firms, leading to predictions that contrast significantly with existing models of debt issues.

We consider a risk-neutral firm that has a new project. The firm has no assets-in-place or internal capital, and needs to raise debt to fund its new project[4]. Firm insiders have private information about the intrinsic value of their firm. This intrinsic value can be high, medium, or low; while firm insiders know this true value, outside investors observe only the probability distribution over true firm value[5]. We model the soft information that becomes available to outside investors prior to a debt issue as a noisy signal imperfectly correlated with the firm's true intrinsic value. Since this soft information signal is noisy, firm insiders are not sure precisely what investors have learned about their firm (i.e. they do not know the realization of outside investors' soft information signals). However, since these soft information signals are (imperfectly) correlated with insiders' private information, insiders with more favorable private information can expect outside investors to receive a better realization of their soft information signals about their firm. We show that when the soft information signals available to outside investors are precise enough, the monotonically increasing relationship between the true value of a firm's new project and the amount of debt it issues that prevails in the Ross (1977) setting no longer holds. Instead, an inverted-U shape relationship emerges[6]. Specifically, in this case (the "soft information equilibrium" hereafter), high intrinsic value firms issue less debt than medium intrinsic value firms; low intrinsic value firms mimic high intrinsic value firms and medium intrinsic value firms with certain probabilities determined in equilibrium (by issuing
the same amount of debt as the above two firm types), and separate themselves with the remaining probability by issuing only the minimum amount of debt to raise external financing required.

The intuition behind the above soft information equilibrium is as follows. Since the high intrinsic value firm insiders are aware that outside investors’ soft information signals are informative (so that, on average, outside investors will receive a good realization of the soft information signal about their firm), they choose to issue less debt, knowing that outside investors will use their soft information as well as the amount of debt issued to value their firm, and therefore are likely to give their firm (and its equity) a high market value. Given that outside investors will value their firm highly in this soft information equilibrium, it is no longer optimal for the high intrinsic value firm to issue a very large amount of debt: it is better off issuing less debt and reducing the expected value of its bankruptcy cost. The above trade-off, however, goes the opposite way for the medium value firm. Given that, in contrast to the high intrinsic value firm, the medium intrinsic value firm’s value is closer to that of the low intrinsic value firm (in other words, its insiders’ private information about firm value is not as favorable as that of insiders of the high value firm), insiders of the medium intrinsic value firm are aware that they cannot rely as much on the soft information signals available to outside investors to distinguish themselves from the low intrinsic value firm. This means that, if they choose to issue only a small amount of debt (similar to the high intrinsic value firm), their firm may be significantly undervalued, due to pooling with the low intrinsic value firm. Thus, the medium intrinsic value firm chooses to issue a larger amount of debt than the high intrinsic value firm to ensure that its securities are correctly valued. Finally, the low intrinsic value firm, since it is never undervalued in equilibrium, can either attempt to mimic the high intrinsic value firm and the medium intrinsic value firm (by issuing the same amount of debt as the above two firm types), or it can issue the minimum amount of debt required to implement its new project (thus revealing its true value). While the former two strategies have the advantage of yielding the low intrinsic value firm a higher market value at the announcement of its debt issue, they have the disadvantage that the firm incurs a higher expected bankruptcy cost. In equilibrium, the low intrinsic value firm mixes between the above three strategies.

Our model generates several implications for firms’ debt issues and their capital structure in general. First, it predicts an inverted-U shape relationship between a firm’s ex post operating performance and the size of its debt issue and debt ratio. Second, it predicts that firms about which a greater amount of (for a given precision) or more precise (for given amount) soft information signals are available to outside investors are less likely to issue debt (and hence have lower debt ratios). Third, our model predicts that, controlling for the extent of information asymmetry facing the firm, the size (or likelihood) of a firm’s debt issue (and hence its debt ratio) is decreasing in the realizations of outside investors’ soft information signals about that firm. Finally, our model predicts that current shareholders are better off in a setting where outside investors have higher levels of (and more precise) soft information about their firm, especially when they plan to raise external financing by issuing risky debt or other information-sensitive securities.

The rest of this paper is organized as follows. Section 2 presents the model. Section 3 describes the testable predictions of our model. Section 4 concludes. The proofs of all propositions are confined to the Appendix.
2. The model

The model has two dates: time 0 (the present) and time +1 (the future).

Consider a firm initially set up by a risk-neutral entrepreneur. At time 0, the firm has an initial debt of \( D_0(D_0 \geq 0) \), and has access to a positive expected net present value project[7]. The up-front investment required to implement this new project is denoted by \( I \), and the project cash flows will be realized at time +1. At time 0, the firm has no internal capital and needs to issue debt \( (D) \) to outside investors to implement the new project[8]. While \( I \) is the minimum amount of debt the firm needs to issue to implement the new project, it can issue more and the additional fund raised will be used to buy back the firm’s equity in this case. If the firm chooses not to issue debt at time 0, the NPV of the new project will be lost forever. We normalize the risk-free rate of return to zero, and assume that all outside investors are risk-neutral.

The firm can be of three types based on its insiders’ ability to implement the new project: high (type H hereafter), medium (type M hereafter), and low (type L hereafter). A type H firm’s new project will generate a cash flow of \( c_H \) at time +1, where \( c_H \) is uniformly distributed on the interval \([0, 2h]\), i.e. \( c_H \sim U(0, 2h) \). Similarly, a type M firm’s new project will generate a cash flow of \( c_M(c_M \sim U(0,2m]) \) at time +1, and a type L firm’s new project will generate a cash flow of \( c_L(c_L \sim U(0,2l]) \) at time +1. Note that \( E(c_H) = h, E(c_M) = m; \) and \( E(c_L) = l \), and we assume that \( h > m > l \geq I \) (i.e. the new project of any type of the firm has a positive expected NPV). We also assume \( I > 0 \), implying that any debt issued will be risky debt. When the firm defaults on its debt, it declares bankruptcy and incurs a cost \( F \) (In this case, the final cash flow of the firm will be its cash flow from the new project minus the bankruptcy cost, \( F \)).

At time 0, there is information asymmetry between firm insiders and outside investors. Insiders know the true type (i.e. intrinsic value) of their own firm, while outside investors only know the prior probability distribution of the true type of the firm: they assess a probability \( p_H \) that the firm is of type H, a probability \( p_M \) that it is of type M, and a probability \( p_L \) that it is of type L. The expected value of the time +1 cash flow of the new project, \( h, m, \) and \( l \), as well as the investment required for the new project, \( I \), are common knowledge. At time 0, firm insiders decide on the amount of debt to issue (denoted by \( D \)). They announce \( D \) to outside investors and sell it to them subsequently. Once the debt issue is announced, firm insiders cannot withdraw it, nor can they change its amount. That is, the debt issue is enforced by an investment banker (who serves as the under-writer for the new issue) who is a long-run player in debt market with reputation concerns.

Prior to the announcement of the debt issue, outside investors receive a soft information signal \( e \) about the intrinsic value of the firm. This soft information signal has two possible realizations: it can be either “good” (\( e = G \)), or “bad” (\( e = B \)). Outside investors receive a good realization of the soft information signal about a firm with probability \( \alpha_i, i \in \{H, M, L\} \), and they receive a bad realization with the complementary probability \( (1 - \alpha_i) \):

\[
\Pr(e = G| i = H) = \alpha_H, \Pr(e = G| i = M) = \alpha_M, \Pr(e = G| i = L) = \alpha_L, \tag{1}
\]

\[
\alpha_H > \alpha_M > \alpha_L > 0. \tag{2}
\]

Only outside investors observe the realization of their soft information signals: firm insiders observe the prior probability distribution of the soft information signals, conditional on the true type of their own firm, as given in equation (1).
Note that assumption (2) implies that while outside investors’ soft information signals are informative, they are also noisy. They are informative in the sense that they are positively correlated with the true type of the firm: a type H firm has a higher probability of getting a good realization of their soft information signals than a type M firm, and a type M firm has a higher probability of getting a good realization of their soft information signals than a type L firm. They are noisy in the sense that outside investors cannot tell the true type of any firm with probability one by observing the realization of these soft information signals alone. Thus, while the information asymmetry between firm insiders and outside investors is lowered by the existence of the soft information signals, they do not completely disappear because of these signals.

Throughout the paper, we assume that firm insiders’ objective is to maximize the weighted average of their firm’s market values at time 0 and time +1, denoted by $V_i, i \in \{H, M, L\}$ with respect to the amount of debt to issue. Specifically, the objective function of the firm insiders is:

$$\max_{D_t} V_i = \gamma_0 V^0_i + \gamma_1 E(V^1_i),$$

where $\gamma_0$ and $\gamma_1$ are the weights firm insiders put on their firm’s market values at time 0 and time +1, respectively. They are constant across all three firm types. $V^0_i$ is the time 0 market value, and $V^1_i$ is the time +1 market value.

We also assume that firm insiders are precluded from trading in their own firm’s instruments.

At time +1, all information asymmetry is resolved, and all cash flows are realized. The sequence of events is summarized in Figure 1.

2.1 The soft information equilibrium

The equilibrium concept we use is that of an efficient perfect Bayesian equilibrium. An equilibrium in our setting consists of the following choices made by firm insiders and outside investors:

- firm insiders’ choice at time 0 regarding whether or not to issue debt, and the choice on the amount of debt to issue to outside investors (if they decide to issue); and
- the decision by outside investors regarding whether or not to accept the firm’s debt issue (if the firm issues debt).

Each of the above choices made by firm insiders and outside investors has to satisfy the following requirements:

**Figure 1.**
Sequence of events
Debt issues and capital structure

- the choice of each firm type maximizes its insiders’ objective, given the equilibrium behavior and beliefs of firm insiders of other firm types and outside investors;
- the beliefs of firm insiders of all three firm types and outside investors are consistent with the equilibrium choices of others; further, along the equilibrium path, these beliefs are formed using Bayes’ rule;
- any deviation from equilibrium strategies by any firm type is met by beliefs by outside investors which yield them a lower expected payoff compared to that obtained in equilibrium; and
- when there are multiple equilibria, the equilibrium is defined as that set of choices and beliefs where the dissipative costs involved are the least (i.e. is efficient)[11].

We call the equilibrium that prevails in the setting where sufficiently precise soft information signals are available to outside investors “the soft information equilibrium.” We now characterize this equilibrium and discuss the trade-offs the firm faces in it.

P1. (The soft information equilibrium). If the soft information signals available to outside investors are precise enough, then an equilibrium exists, in which:
- the type H firm issues an amount of debt $D^*_H$ with probability one;
- the type M firm issues an amount of debt $D^*_M > D^*_H$ with probability one; and
- the type L firm issues an amount of debt $D^*_M$ with probability $\beta$; it issues $D^*_M$ with probability $\eta$ and it issues the minimum amount of debt required to implement the project, I, with the remaining probability $(1 - \beta - \eta)$.

In the soft information equilibrium, insiders of a type H firm are confident that, given the high probability of outside investors receiving a good realization of the soft information signals about their firm, the market will value their firm close to its intrinsic value even if they issue a small amount of debt (and therefore have a low expected bankruptcy cost). In other words, when the soft information signals are sufficiently precise, they serve as effective substitutes for the firm’s signals. The type M firm, on the other hand, cannot rely on the soft information signals to convey its true type to outside investors as much as the type H firm. Recall that, compared to the type H firm, the probability of outside investors receiving a good realization of the soft information signals about a type M firm is not significantly higher than that for a type L firm. Therefore, if a type M firm issues a small amount of debt (similar to that issued by a type H firm), it will face severe mimicking by type L firms. This, in turn, will lead to the type M firm being severely under-valued by outside investors. Thus, insiders of a type M firm will find it optimal to convey their firm’s true type to outside investors by issuing a large amount of debt (so that the degree of mimicking by the type L firms will not be very severe). Finally, for insiders of a type L firm, on the one hand, there is an advantage in mimicking the type H and type M firms, since by doing so outside investors will value their firm higher (compared to its true intrinsic value) at time 0. On the other hand, there is also a cost for a type L firm to mimic a type H or a type M firm. This is because by issuing more debt, a type L firm will face a higher probability of not being able to pay back its debt at time +1, leading to a higher expected bankruptcy cost. Meanwhile, if a type L firm issues the minimum amount of debt required to
implement the project (and thereby reveals its true type), even though it will have a lower expected bankruptcy cost, it will be valued less at time 0 (at its true intrinsic value) by outside investors compared to the values it will receive by mimicking the type H or type M firms. In equilibrium, the type L firm mixes among these three strategies: it mimics the type H firm or the type M firm with certain probabilities, and issues the minimum amount of debt required to implement the project with the remaining probability. Consistent with the above equilibrium behavior of the firm, outside investors infer that a firm issuing \( D^*_M \) is of type M with certain probability and is of type L with the remaining probability. Similarly, they infer that a firm issuing \( D^*_H \) is of type M with certain probability and is of type L with the remaining probability. If a firm issues \( I \) (the minimum amount of debt required to implement the project), outside investors infer that it is of type L with probability 1.

We now derive in detail the equilibrium strategies of the three firm types in the soft information equilibrium[12].

2.1.1 The type H firm’s problem. The time 0 market value of a firm depends upon two factors: the amount of debt it issues, and the realization of the soft information signals outside investors receive about it. For a firm issuing \( D^*_H \), if outside investors receive a good realization of the soft information signals about it, they assess a probability \( \alpha_H p_H / (\alpha_H p_H + \alpha_L p_L \beta) \) that this firm is of type H, and they assess that this firm is of type L with the complementary probability \( \alpha_L p_L \beta / (\alpha_H p_H + \alpha_L p_L \beta) \). Therefore, for a firm issuing \( D^*_H \) and about which outside investors received a good realization of the soft information signals, its time 0 market value (denoted by \( V^0(D^*_H, G) \)) is given by:

\[
V^0(D^*_H, G) = \frac{\alpha_H p_H (h - (F/2h)(D_o + D^*_H)) + \alpha_L p_L \beta (l - (F/2l)(D_o + D^*_H))}{\alpha_H p_H + \alpha_L p_L \beta}. \tag{4}
\]

If outside investors receive a bad realization of the soft information signals about a firm offering \( D^*_H \), they assess a probability \( (1 - \alpha_H) p_H / ((1 - \alpha_H) p_H + (1 - \alpha_L) p_L \beta) \) that this firm is of type H, and they assess that it is of type L with the complementary probability \( (1 - \alpha_L) p_L \beta / ((1 - \alpha_H) p_H + (1 - \alpha_L) p_L \beta) \). Therefore, for a firm offering \( D^*_H \), and about which outside investors received a bad realization of the soft information signals, its time 0 market value (denoted by \( V^0(D^*_H, B) \)) is given by:

\[
V^0(D^*_H, B) = \frac{(1 - \alpha_H) p_H (h - (F/2h)(D_o + D^*_H)) + (1 - \alpha_L) p_L \beta}{(1 - \alpha_H) p_H + (1 - \alpha_L) p_L \beta}. \tag{5}
\]

In addition, the expected time +1 payoff for insiders of a type H firm is given by:

\[
V^*_H = \gamma_0 \alpha_H V^0(D^*_H, G) + \gamma_0 (1 - \alpha_H) V^0(D^*_H, B) + \gamma_1 h - \gamma_1 \frac{F(D_o + D^*_H)}{2h}. \tag{6}
\]

Note that the precision of soft information increases with the intrinsic value of the firm. When the soft information signals available to outside investors are very precise (i.e. \( \alpha_H \) is very high), the time 0 market value of a firm issuing \( D^*_H \) and about which outside investors received a good realization of the soft information signals, \( V^0(D^*_H, G) \), is very
high as well. In other words, outside investors will give a high valuation to such a firm because they believe this firm is of type H with a high probability. The amount of debt a type H firm issues will be the result of its insiders’ trade off between signaling their firm’s true type (with a large amount of debt) and reducing their firm’s expected bankruptcy cost (by issuing a small amount of debt). When the soft information signals available to outside investors are precise enough, they can be strong substitutes for debt in signaling a type H firm’s true type to outside investors. In this case, issuing less debt will be more beneficial for a type H firm than to signal with a significant amount of debt that other firms cannot afford (i.e. completely separating from lower types). This is because issuing less debt will significantly lower the expected bankruptcy cost of a type H firm, while its market value will still be high because outside investors have a high probability of receiving a good realization of the soft information signals.

For the soft information equilibrium to exist, insiders of a type H firm should be better off by issuing $D_H^*$ than mimicking a type M firm (by issuing $D_M^*$), or a type L firm (by issuing $h$). This generates the following additional constraints for insiders of a type H firm:

\[
\gamma_0 \alpha_H V^0(D_H^*, G) + \gamma_0 (1 - \alpha_H) V^0(D_H^*, B) + \gamma_1 h - \gamma_1 \frac{F(D_o + D_H^*)}{2h} \\
> \gamma_0 \alpha_H V^0(D_M^*, G) + \gamma_0 (1 - \alpha_H) V^0(D_M^*, B) + \gamma_1 h - \gamma_1 \frac{F(D_o + D_M^*)}{2h},
\]

(7)

and

\[
\gamma_0 \alpha_H V^0(D_H^*, G) + \gamma_0 (1 - \alpha_H) V^0(D_H^*, B) + \gamma_1 h - \gamma_1 \frac{F(D_o + D_H^*)}{2h} \\
> \gamma_0 \left(1 - \frac{F}{2l} (D_o + I)\right) + \gamma_1 \left(h - \frac{F}{2h} (D_o + I)\right).
\]

(8)

The left hand sides of the above two equations are the payoffs to insiders of a type H firm if they issue $D_H^*$, and the right hand sides are their payoffs if they issue $D_M^*$ or $I$.

2.1.2 The type M firm’s problem. In deciding the amount of debt to be issued by their firm, insiders of a type M firm also take into account the fact that outside investors value a firm based on both the amount of debt it issues, and the realization of the soft information signals they receive about this firm. For a firm issuing $D_M^*$, if outside investors observe a good realization of the soft information signals for it, they assess a probability $\alpha_M p_M / (\alpha_M p_M + \alpha_L p_L \eta)$ that the firm is of type M, and they assess that it is of type L with the complementary probability $\alpha_L p_L \eta / (\alpha_M p_M + \alpha_L p_L \eta)$. Therefore, for a firm issuing $D_M^*$, and about which outside investors received a good realization of the soft information signals, its time 0 market value (denoted by $V^0(D_M^*, G)$) is given by:

\[
V^0(D_M^*, G) = \frac{\alpha_M p_M (m - (F/2m)(D_o + D_M^*)) + \alpha_L p_L \eta (l - (F/2l)(D_o + D_M^*))}{\alpha_M p_M + \alpha_L p_L \eta}.
\]

(9)

If outside investors observe a bad realization of the soft information signal about a firm issuing $D_M^*$, they assess a probability $((1 - \alpha_M) p_M) / ((1 - \alpha_M) p_M + (1 - \alpha_L) p_L \eta)$
that it is of type M, and they assess that it is of type L with the complementary probability \((1 - \alpha_M)p_L + (1 - \alpha_L)p_L\). Therefore, for a firm issuing \(D_M^*\), and about which outside investors received a bad realization of the soft information signals, its time 0 market value (denoted by \(V^0(D_M^*, B)\)) is given by:

\[
V^0(D_M^*, B) = \frac{(1 - \alpha_M)p_M(m - (F/2m)(D_o + D_M^*)) + (1 - \alpha_L)p_L\eta}{(1 - \alpha_M)p_M + (1 - \alpha_L)p_L\eta}.
\] (10)

In addition, the expected time +1 payoff of insiders of a type M firm is given by:

\[
V_M^1(D_M^*) = m - (F(D_o + D_M^*)/2m),
\] and their expected equilibrium payoff is given by:

\[
V_M = \gamma_0\alpha_M V^0(D_M^*, G) + \gamma_0(1 - \alpha_M) V^0(D_M^*, B)) + \gamma_1m - \gamma_1 \frac{F(D_o + D_M^*)}{2M}.
\] (11)

When the soft information signals available to outside investors are very precise, insiders of a type M firm know that they cannot rely on the soft information signals to distinguish their firm from a type L firm as much as a type H firm can. In this case, if they issue a small amount of debt (similar to that issued by a type H firm), they face severe mimicking by type L firms, and hence the time 0 market value of their firm will be very low. Thus, for a type M firm, the soft information signals are very weak substitutes for its own signal (the amount of debt it issues) in mitigating the information asymmetry it faces. In order to distinguish their firm from type L firms, insiders of a type M firm will issue a significant amount of debt, thereby increasing the mimicking cost for type L firms (by increasing the expected bankruptcy cost of type L firms if they mimic). At the same time, issuing a large amount of debt also reduce the expected payoff of insiders of a type M firm because it increases their firm's expected bankruptcy cost. In equilibrium, the amount of debt issued by a type M firm balances its need to signal (which favors issuing more debt) and its expected bankruptcy cost (which favors issuing less debt).

When outside investors’ soft information signals are precise enough, they are stronger substitutes for debt signaling for type H firms than for type M firms. Therefore, type M firms will issue more debt than type H firms in equilibrium.

For the soft information equilibrium to exist, insiders of a type M firm should be better off issuing \(D_M^*\) than mimicking a type H firm (by issuing \(D_H^*\)), or mimicking a type L firm (by issuing \(I\)). This generates the following additional constraints for insiders of a type M firm:

\[
\gamma_0\alpha_M V^0(D_M^*, G) + \gamma_0(1 - \alpha_M) V^0(D_M^*, B)) + \gamma_1m - \gamma_1 \frac{FD_M^*}{2m} > \gamma_0\alpha_M V^0(D_H^*, G) + \gamma_0(1 - \alpha_M) V^0(D_H^*, B)) + \gamma_1m - \gamma_1 \frac{FD_H^*}{2m}.
\] (12)

and

\[
\gamma_0\alpha_M V^0(D_M^*, G) + \gamma_0(1 - \alpha_M) V^0(D_M^*, B)) + \gamma_1m - \gamma_1 \frac{FD_M^*}{2m} > \gamma_0\left(l - \frac{F}{2}(D_o + I)\right) + \gamma_1\left(m - \frac{F}{2m}(D_o + I)\right).
\] (13)
The left hand sides of the above two conditions are the payoffs to insiders of a type M firm if they chooses to issue $D^*_M$, and the right hand sides are the payoffs to them if they chooses to issue $D^*_H$ or $I$.

2.1.3 The type L firm’s problem. Since the type L firm has the lowest intrinsic value among all three firm types, it can never be undervalued in equilibrium: it will be either overvalued (when it mimics a type H firm or a type M firm), or correctly valued (when it separates and reveals its true type by issuing $I$). Therefore, the decision insiders of a type L firm face is whether to issue minimum debt $I$, low debt $D^*_H$ (mimicking a type H firm), or high debt $D^*_M$ (mimicking a type M firm). If they issue $I$, outside investors value their firm at its intrinsic value at both time 0 and time +1. If they issue more debt than $I$ (either $D^*_H$ or $D^*_M$), their firm receives a valuation higher than its intrinsic value at time 0, but they also bear a higher risk of incurring the bankruptcy cost at time +1. Facing this trade off, insiders of a type L firm play a mixed strategy in the soft information equilibrium: it issues $D^*_H$ with probability $\beta$, $D^*_M$ with probability $\eta$, and $I$ with the remaining probability $(1 - \beta - \eta)$. They adjust their mimicking probabilities so that they are indifferent among issuing $D^*_H$, $D^*_M$, and $I$. In other words, offering any of the above three levels of debt generates the same expected payoff for insiders of a type L firm. In the soft information equilibrium, the expected payoff of insiders of a type L firm, denoted by $V^*_L$, is given by:

$$V^*_L = \gamma_0 \left( I - \frac{F}{C_2} (D_o + I) \right) + \gamma_1 \left( I - \frac{F}{C_2} (D_o + I) \right) = \gamma_0 \alpha_L V^0(D^*_H, G)$$

$$+ \gamma_0 (1 - \alpha_L) V^0(D^*_H, B) + \gamma_1 I - \gamma_1 \frac{F(D_o + D^*_H)}{2I}$$

$$= \gamma_0 \alpha_L V^0(D^*_M, G) + \gamma_0 (1 - \alpha_L) V^0(D^*_M, B) + \gamma_1 I - \gamma_1 \frac{F(D_o + D^*_M)}{2I}. \quad (14)$$

In addition, in the soft information equilibrium, a type H firm issues less debt than a type M firm, which is equivalent to:

$$(1 - \alpha_L) (V^0(D^*_H, B) - V^0(D^*_M, B)) < \alpha_L (V^0(D^*_M, G) - V^0(D^*_H, G)). \quad (15)$$

In summary, for the soft information equilibrium to exist, all three firm types’ behavior has to be consistent with each other, implying that (7), (8) and (12)-(15) have to hold simultaneously[13].

2.2 Characteristics of the soft information equilibrium

In this section, we characterize the relationship between the precision and the realization of the soft information signals available to outside investors and the equilibrium amount of debt the firm issues in the soft information equilibrium.

P2. (Relationship between the amount of debt issued and the precision of soft information).

In the soft information equilibrium, when the soft information signals available to outside investors are more precise (i.e. as $\alpha_L$ decreases for a given $\alpha_H$ and $\alpha_M$), the type H and type M firms will issue less debt (i.e. $D^*_H$ and $D^*_M$ will be smaller).

When the precision of outside investors’ soft information signals increases (i.e. as $\alpha_L$ falls for given $\alpha_H$ and $\alpha_M$), getting a good realization of the soft information signals ($\tilde{B}$) rather than a bad realization ($\bar{B}$) conveys more information about the true type of the
firm to outside investors (since now these soft information signals are more informative), and the type L firm will mimic the type H and the type M firms less often. This is because if the type L firm does not reduce its probabilities of mimicking the type H and type M firm, outside investors will give it a very low value at time 0 such that the cost of mimicking (associated with incurring the cost of bankruptcy at time +1 more often) will dominate its benefits (associated with a higher market value at time 0). Hence, in the soft information equilibrium, when the soft information signals are more precise, the market value of a firm issuing $D_H^*$ at time 0 will be greater (because less type L firms mimic type H than before). In this case, the benefit of reducing the amount of debt the type H firm issues at time 0 (that is, incurring the cost of bankruptcy at time +1 less often) outweighs the cost of it (that is, more mimicking by the type L firms and hence a lower market value at time 0), and thus the type H firm will issue less debt than when the soft information signals are less precise. For a similar argument, when the soft information signals are more precise, the type M firm will issue less debt in equilibrium as well.

P3. (Relationship between the amount of debt issued and the realization of outside investors’ soft information signals). Let the soft information signals available to outside investors about a group of firms be precise enough. Then, firms about which outside investors receive more favorable realization of the soft information signals will issue less debt than firms about which they receive less favorable realizations of the soft information signals.

To understand the intuition behind this proposition, it is useful to compare how often a good or bad realization of the soft information signals arrives for different firms. Among all firms issuing more debt than the minimum requirement to implement the new project ($I$), firms issuing less debt are type H firms (and type L firms mimicking them), and firms issuing more debt are type M firms (and type L firms mimicking them). Outside investors receive a good realization of the soft information signals about a type H firm more often than about a type M firm. Meanwhile, they are equally likely to receive a good realization of the soft information signals about a type L firm mimicking a type H firm compared to about a type L firm mimicking a type M firm. Therefore, for firms issuing more debt than $I$, outside investors will be more likely to receive a good realization of the soft information signals about firms issuing less debt ($D_H^*$) than about firms issuing more debt ($D_M^*$). On the other hand, there is a fraction of type L firms issuing the minimum amount of debt required to implement the project ($I$). Because outside investors are least likely to receive a good realization of the soft information signals about the type L firm, firms issuing the least amount of debt are least likely to have a good realization of the soft information signals. Under the conditions specified in the appendix, the former effect will overcome the latter one, and in the soft information equilibrium, firms about which outside investors receive more favorable realization of the soft information signals will issue less debt than firms about which outside investors receive less favorable realizations of the soft information signals.

3. Implications and testable hypotheses

(1) The relationship between the debt ratios and the size of a firm’s debt issue, and its subsequent operating performance. In contrast to Ross (1977), which predicts a positive relationship between a firm’s debt ratio and its subsequent operating performance, our model implies that a firm’s ex post operating performance will
initially increase in the amount of debt it issues (and thus in its debt ratio), and it will then decrease in the amount of debt (and debt ratio) it issues. In other words, there will be an inverted-U shape relationship between a firm’s ex post operating performance and the size of its debt issue and debt ratio. Consistent with this prediction, Barclay et al. (1995) find a significantly negative correlation between a company’s leverage ratio and its unexpected earnings; Smith and Watts (1992) documents that firms with more growth options (i.e. greater access to positive net present value projects) have lower leverage.

(2) The relationship between the likelihood of a firm issuing debt, its debt ratio, and the precision of outside investors’ soft information signals. Our model (P2) implies that firms about which a greater amount of (for a given precision) or more precise (for given amount) soft information signals are available to outside investors will be less likely to issue debt (and hence will have lower debt ratios). Using the extent and the precision of voluntary corporate disclosures and other management communications, or the extent of analyst coverage as proxies for the availability of soft information signals to outside investors, this implies that, after controlling for information asymmetry, firms with a greater extent of corporate disclosures (or disclosures with greater precision) will have less frequent debt issues and lower debt ratios on average. Evidence consistent with this prediction is provided by Chang et al. (2005), who find that firms with more analyst coverage have lower debt ratios and are less likely to issue debt as opposed to equity.

(3) The relationship between the size of a firm’s debt issues and the realization of outside investors’ soft information signals. Our model (P3) implies that, controlling for the extent of information asymmetry facing the firm, the size (or likelihood) of a firm’s debt issue (and hence its debt ratio) will be decreasing in the realizations of outside investors’ soft information signals about that firm. Using revisions in analyst recommendations and earnings forecasts in a certain period as proxies for the realizations of outside investors’ soft information signals about a firm, this implies a negative relationship between the likelihood and (or) size of a firm’s debt issue and the revision in analyst recommendations and earnings forecasts. In other words, our model predicts that a firm is less likely to issue debt (and if it does issue, it will issue smaller amounts) during periods in which analysts’ earning forecasts and recommendation revisions about it are more favorable.

(4) The desirability of increased and more precise disclosures around corporate events like debt issues. Our model implies that current shareholders are better off in a setting where outside investors have higher levels of (and more precise) soft information about their firm, especially when they plan to raise external financing by issuing risky debt or other information-sensitive securities. This means that investor relations departments set up by firms and “road-shows” around corporate events may be accomplishing an economically meaningful role by increasing the amount and precision of the soft information available to outside investors.

4. Conclusion
We develop a model of debt issues under asymmetric information in a setting where, in addition to observing the amount of debt the firm issues in a certain period of time, outside investors obtain “soft information” signals about firms through noisy
voluntary disclosures made by firms or information production by outside investors. We show that, if sufficiently precise soft information is available to outside investors, firms’ debt issue behavior is significantly altered in equilibrium relative to that in existing models (e.g. Ross, 1977). In particular, while Ross (1977) predicts that higher intrinsic value firms will issue more debt than lower intrinsic value firms, our model predicts an inverted-U shape relationship between the intrinsic value of a firm and the amount of debt it issues. Moreover, we predict that firms about which outside investors receive more favorable soft information will on average issue less debt compared to firms about which outside investors receive less favorable soft information. Further, we have predictions for the relationship between the precision of outside investors’ soft information and the amount of debt that firms issue, and for firms’ debt to equity ratios. Finally, our model provides a rationale for the existence of “investor relations” departments in many firms.

Notes

1. One may point out that in Myers and Majluf (1984), firms issuing risky debt are of higher quality compared to firms issuing equity, and hence exhibit higher profitability. However, in Myers and Majluf (1984), firms exhaust their debt capacity before resorting to equity issuance. Therefore, Myers and Majluf (1984) cannot explain the inverse relationship between leverage and profitability for firms that are not debt-constrained.

2. This additional information may affect a firm’s stock price through outside investors’ trading. But given that stock prices are very noisy in practice, the probability that firm insiders infer outside investors’ opinion by observing the stock price is very low.

3. Consistent with a similar distinction made in the legal and economics literature (see e.g. Stein, 2002), we use the term “soft information” to denote information which is difficult to quantify or verify immediately and impossible to convey credibly, as against “hard information,” which is quantifiable and often verifiable (e.g. accounting numbers).

4. Since our objective in this paper is develop a new theoretical analysis of debt issues under asymmetric information, we assume, for simplicity, that all external financing is raised by issuing debt. Our assumption is thus opposite to that made by equity issue models (e.g. Myers and Majluf, 1984)) which assume that all external financing is raised by issuing equity. However, it can be shown that our results will be qualitatively unchanged even if this assumption is relaxed (so that the firm optimally chooses the fraction of external financing to be raised by issuing debt).

5. Note that in absence of soft information, this is essentially a three-type version of the Ross (1977) setting with the additional assumption of a minimum amount of debt the firm has to issue for the purpose of implementing its new project.

6. Given that most public firms have a reasonable amount of soft information available to outside investors, we believe that the inverse relationship between leverage and profitability documented in the empirical literature captures the second half of the inverted-U shape relationship in our model.

7. We allow for the firm to have existing (initial) debt only for generality. All our results go through if we set the initial debt equal to zero.

8. For expositional simplicity we assume that all external financing is raised by issuing debt. It can be shown that our results will be qualitatively unchanged even if this assumption is relaxed (so that the firm optimally chooses the fraction of external financing to be raised by issuing debt).

9. Note that this is equivalent to maximizing shareholders.value since shareholders.value is monotonically increasing in firm value. In addition, having a high value at time 0 is
important for the firm because it can get better pricing for its risky debt when its market value is higher, which leads to a higher time \( t+1 \) expected cash flow to equity holders. See Ross (1977) for a detailed discussion on equilibrium incentive schedule for firm insiders.

10. Thus, our equilibrium definition is based on the perfect Bayesian equilibrium (PBE) concept, first formally defined for dynamic games with incomplete information by Fudenberg and Tirole (1991). See Milgrom and Roberts (1986), Engers (1987), or Cho and Sobel (1990) for a detailed discussion of why the notion of a Pareto efficient PBE is the appropriate equilibrium concept here.

11. Given the rich strategy space for the agents in this model, we can think of three broad categories of equilibrium that may exist depending on various parameter values: (i) separating equilibrium in which the soft information signals available to outside investors play no role in the firm and outside investors’ decision-making, where each of the three types (type H, type M, and type L) of the firms behaves differently in equilibrium, therefore fully reveal their true types, and outside investors choose to ignore the soft information signals; (ii) pooling equilibrium in which the soft information signals available to outside investors play no roles, where each of the three types (type H, type M, and type L) of the firm takes the same action by choosing the same debt level, and outside investors choose to ignore the soft information signals; (iii) partial pooling equilibria in which a subset of the three types (type H, type M, and type L) of the firm take the same action in equilibrium, and the rest of the firm types take a different action, where the soft information signals are utilized by the outside investors in forming their beliefs. Since our main objective in this paper is to study the role of the soft information signals in the firm’s capital structure decision, our focus here is on the equilibria belonging to category (iii).

12. Note that in this section we only discuss conditions that are important in facilitating readers to understand the intuition behind the soft information equilibrium. Proofs of all propositions are confined to the appendix.

13. To illustrate the existence of the soft information equilibrium, consider the scenario where \( \gamma_0 = 0.3 \) and \( \gamma_1 = 0.7 \) (i.e. firm insiders are long-term players with reputation concerns who care about both current and future firm value, and they care about the future to a larger degree). The distribution of the firm is: \( p_H = 0.2, \ p_M = 0.4, \text{ and } p_L = 0.4 \). The precision of the soft information signals is given by: \( \alpha_H = 0.9, \alpha_M = 0.3, \text{ and } \alpha_L = \theta \). The new project requires an up-front investment of \( I = 40 \) and its expected cash flows for the three types of the firm are: \( h = 150, \ m = 100, \text{ and } l = 50 \). The bankruptcy cost when the firm defaults is \( F = 40 \). In such a setting, the soft information equilibrium is characterized as follows: the type H firm issues \( D_H^* = 54 \); the type M firm issues \( D_M^* = 85 \); and the type L firm mimics the type H firm with probability \( \beta = 0.6 \), it mimics the type M firm with probability \( \eta = 0.1 \), and it issues the minimum amount of debt required to implement the new project (\( I = 40 \)) with probability 0.3. In other words, in this equilibrium, there is an inverted-U shape relationship between the intrinsic value of the firm and the amount of debt it issues.

References


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Appendix

Proof of PI

In the soft information equilibrium, the conjectured equilibrium strategies of the firms are:

- the type H firm issues $D_H^*$;
- the type M firm issues $D_M^*$; and
- the type L firm mimics the type H firm by issuing $D_H^*$ with probability $\beta$; it mimics the type M by issuing $D_M^*$ with probability $\eta$; and it issues $I$ with the remaining probability $(1-\beta-\eta)$.

The equilibrium beliefs of outside investors are as follows. If a firm issues $I$, they assess that it is of type L with probability 1: i.e. $\mu(L|I,e) = 1$. If a firm issues $D_H$, and about which they receive a good realization of the soft information signals, they assess a probability $\mu(H|D_H) = \alpha_H p_H/(\alpha_H p_H + \alpha_L p_L \beta)$ that this firm is of type H, and they assess that it is of type L with the remaining probability $\mu(L|D_H) = \alpha_L p_L \beta/(\alpha_H p_H + \alpha_L p_L \beta)$. If a firm issues $D_M$, and about which they receive a bad realization of the soft information signals, they assess a probability $\mu(H|D_M) = (1-\alpha_H)p_H/(1-\alpha_H)p_H + (1-\alpha_L)p_L \beta)$ that this firm is of type H, and they assess that it is of type L with the remaining probability $\mu(L|D_M) = (1-\alpha_L)p_L \beta/(1-\alpha_H)p_H + (1-\alpha_L)p_L \beta)$. If a firm issues $D_H^*$, and about which they receive a good realization of the soft information signals, they assess a probability $\mu(M|D_H) = \alpha_M p_M/(\alpha_M p_M + \alpha_L p_L \eta)$ that this firm is of type M, and they assess that it is of type L with the remaining probability $\mu(L|D_H) = (1-\alpha_M)p_L \eta/(1-\alpha_M)p_M + (1-\alpha_L)p_L \eta)$. If a firm issues $D_M^*$, and about which they receive a bad realization of the soft information signals, they assess a probability $\mu(M|D_M) = (1-\alpha_M)p_M/(1-\alpha_M)p_M + (1-\alpha_L)p_L \eta)$ that this firm is of type M, and they assess that it is of type L with the remaining probability $\mu(L|D_M) = (1-\alpha_L)p_L \eta/(1-\alpha_M)p_M + (1-\alpha_L)p_L \eta)$. If a firm issues debt at a level other than $D_H$ or $D_M$, outside investors assess that it is of type L with probability 1: i.e. $\mu(L|D,e) = 1, \forall D \neq D_H$ and $D \neq D_M$.

Given the equilibrium strategies of the three firm types, for a firm that issues $D_H$ and about which outside investors received a good realization of the soft information signals, its time 0 market value, denoted by $V^0(D_H, G)$, is given by:
Similarly, for a firm that issues $D_H^*$ and about which outside investors received a bad realization of the soft information signals, its time 0 market value, denoted by $V^0(D_H^*, B)$, is given by

$$V^0(D_H^*, B) = \frac{(1 - \alpha_H)p_H (h - \frac{F}{2l}(D_H^* + D_o)) + (1 - \alpha_L)p_L \eta}{(1 - \alpha_H)p_H + (1 - \alpha_L)p_L \eta}.$$  \hfill (A2)

The expected equilibrium payoff for insiders of a type H firm at time +1 is given by: $V_H^1(D_H^*) = h - \frac{F(D_H^* + D_o)}{2l}$. Therefore, the expected equilibrium payoff for insiders of a type H firm is given by: $V_H^* = \gamma_0 \alpha_H V^0(D_H^*, G) + \gamma_0 (1 - \alpha_H) V^0(D_H^*, B) + \gamma_1 h - \gamma_1 - \frac{F(D_H^* + D_o)}{2l}$, where $V^0(D_H^*, G)$ is given by (A1) and $V^0(D_H^*, B)$ is given by (A2). Further, for the soft information equilibrium to exist, insiders of a type H firm should be better off issuing $D_H^*$ than issuing debt at any other level. It can be shown that the incentive compatibility constraints of the type H firm are given by:

$$(\alpha_H - \frac{1}{h} \alpha_L)(V^0(D_M^*, G) - V^0(D_H^*, G)) \leq \left(\frac{l}{h}(1 - \alpha_L) - (1 - \alpha_H)\right)
$$

$$(V^0(D_M^*, B) - (V^0(D_H^*, B))),$$

and

$$\frac{F}{2l} (D_H^* - I) \leq \gamma_0 \alpha_H V^0(D_H^*, G) + \gamma_0 (1 - \alpha_H) V^0(D_H^*, B) - \gamma_0 \left(l - \frac{F}{2l}(D_o + I)\right).$$ \hfill (A4)

Given the equilibrium strategies of the three firm types, for a firm that issues $D_M^*$ and about which outside investors received a good realization of the soft information signals, its time 0 market value, denoted by $V^0(D_M^*, G)$, is given by:

$$V^0(D_M^*, G) = \frac{\alpha_M p_M (m - \frac{F}{2m}(D_M^* + D_o)) + \alpha_L p_L \eta (l - \frac{F}{2l}(D_M^* + D_o))}{\alpha_M p_M + \alpha_L p_L \eta}.$$ \hfill (A5)

For a firm issues $D_M^*$ and about which outside investors received a bad realization of the soft information signals, its time 0 market value, denoted by $V^0(D_M^*, B)$, is given by:

$$V^0(D_M^*, B) = \frac{(1 - \alpha_M)p_M (m - \frac{F}{2m}(D_M^* + D_o)) + (1 - \alpha_L)p_L \eta (l - \frac{F}{2l}(D_M^* + D_o))}{(1 - \alpha_M)p_M + (1 - \alpha_L)p_L \eta}.$$ \hfill (A6)

The expected time +1 payoff for insiders of a type M firm is given by $V_M^1(D_M^*) = m - \frac{F(D_M^* + D_o)}{2m}$. Therefore, the expected equilibrium payoff for insiders of a type M firm is given by $V_M^* = \gamma_0 \alpha_M V^0(D_M^*, G) + \gamma_0 (1 - \alpha_M) V^0(D_M^*, B) + \gamma_1 m - \gamma_1 \frac{F(D_M^* + D_o)}{2m}$. Further, for the soft information equilibrium to exist, insiders of a type M firm should be better off issuing $D_M^*$ than issuing debt at any other level. It can be shown that the incentive compatibility constraints of the type M firm are given by:
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\[(1 - \alpha_M) - \frac{1}{m}(1 - \alpha_L))(V^0(D^*_M, B) - V^0(D^*_H, B) \leq \left( \alpha_M - \frac{l}{m} \alpha_L \right) \quad (A7) \]

\[(V^0(D^*_M, G) - V^0(D^*_H, G)), \]

and

\[\gamma \frac{F}{D^*_M - I} \leq \gamma_0 \alpha_M V^0(D^*_M, G) + \gamma_0(1 - \alpha_M) V^0(D^*_M, B) - \gamma_0 \left( l - \frac{F}{2} (D_0 + I) \right). \quad (A8)\]

In the soft information equilibrium, insiders of a type L firm play a mixed strategy: they issue $D^*_H$ with probability $\beta$ issue $D^*_M$ with probability $\eta$ and issue I with the remaining probability $(1 - \beta - \eta)$. In equilibrium they are indifferent between these three actions: issuing debt at any of the above three levels generates the same payoff for insiders of a type L firm. Therefore, the equilibrium payoff for insiders of a type L firm, denoted by $V^*_L$, is given by $V^*_L = \gamma_0 l - (F(D_0 + I)/2l) + \gamma_1 l - (F(D_0 + I)/2l) = \gamma_0 \alpha_L V^0(D^*_H, G) + \gamma_0(1 - \alpha_L) V^0(D^*_M, G) + \gamma_0(1 - \alpha_M) V^0(D^*_M, B) + \gamma_1 l - \gamma_1 (F(D_0 + I)/2l)$, from which we can solve for the equilibrium debt levels of type H firms, type M firms, and type L firms mimicking them. They are given by:

\[D^*_H = 2\gamma_0 \alpha_L V^0(D^*_H, G) F + 2\gamma_0(1 - \alpha_L) V^0(D^*_M, B) F - 2\gamma_0^2 F + \gamma_0(D_0 + I) + I, \quad (A9)\]

and

\[D^*_M = 2\gamma_0 \alpha_L V^0(D^*_M, G) F + 2\gamma_0(1 - \alpha_L) V^0(D^*_M, B) F - 2\gamma_0^2 F + \gamma_0(D_0 + I) + I. \quad (A10)\]

In the soft information equilibrium, a type H firm issues less debt than a type M firm, which is guaranteed by the following parametric constraint:

\[(1 - \alpha_L)(V^0(D^*_H, B) - V^0(D^*_M, B)) < \alpha_L(V^0(D^*_M, G) - V^0(D^*_H, G)). \quad (A11)\]

In summary, in the soft information equilibrium, all three firm types' behavior has to be consistent with each other, which will be true if (A3), (A4) and (A7)-(A11) hold. Q.E.D.

**Proof of P2**

For any fixed $\alpha_H$ and $\alpha_M$, the precision of outside investors' soft information signals increases as $\alpha_L$ decreases. It can be shown that $(\partial/\partial \alpha_L)D^*_H = 2(\gamma_0/\gamma_1)(1/F)V^0(D^*_H, G) - V^0(D^*_M, B)) + 2(\gamma_0/\gamma_1)(\alpha_L/F)(\partial/\partial \alpha_L)(V^0(D^*_H, G) - V^0(D^*_M, B)) + 2(\gamma_0/\gamma_1)(l/F)(\partial/\partial \alpha_L) V^0(D^*_H, B) + (\partial/\partial \alpha_L) D^*_H$, which is positive when the following condition is satisfied:

\[(V^0(D^*_H, G) - V^0(D^*_M, B) + \alpha_L \frac{\partial}{\partial \alpha_L} V^0(D^*_H, G) + (1 - \alpha_L) \frac{\partial}{\partial \alpha_L} V^0(D^*_M, B) > 0. \quad (A12)\]

Similarly, $(\partial/\partial \alpha_L)D^*_M$ is positive if the following condition is satisfied:

\[(V^0(D^*_M, G) - V^0(D^*_M, B) + \alpha_L \frac{\partial}{\partial \alpha_L} V^0(D^*_M, G) + (1 - \alpha_L) \frac{\partial}{\partial \alpha_L} V^0(D^*_M, B) > 0. \quad (A13)\]

Q.E.D.

**Proof of P3**

In the soft information equilibrium, the average amount of debt issued by firms about which outside investors receive good realizations of the soft information signals is: $(\alpha_H p_H + \alpha_L p_L \beta)D^*_H + (\alpha_M p_M + \alpha_L p_L \eta)D^*_M + \alpha_L (1 - \beta - \eta)I$. The average amount of debt
issued by firms about which outside investors receive bad realizations of the soft information signals is:

\[
\frac{1}{C_{0}} C_{11} H \left( 1 - \alpha_L \right) D_H + \frac{1}{C_{0}} C_{11} L \left( 1 - \alpha_L \right) D_L + \left( 1 - \alpha_M \right) p_M + (1 - \alpha_L) p_L \eta \left( 1 - \beta - \eta \right) I. \]

Therefore, the average amount of debt issued by firms about which outside investors receive good realizations of the soft information signals is less than that issued by firms about which outside investors receive bad realizations of the soft information signals if and only if

\[
\alpha_L < \frac{1 - \beta - \eta I + (p_M + p_L \eta - 2 \alpha_M p_M) D_M + (p_H + p_L \beta - 2 \alpha_H p_H) D_H}{2(p_L \beta D_H + p_L \eta D_M + (1 - \beta - \eta) I)}.
\]

(A14)

Q.E.D.

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Debt issues and capital structure

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