

Asymmetric Information, Debt Capacity, And Capital Structure*

Michael L. Lemmon
University of Utah

Jaime F. Zender
University of Colorado Boulder

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* Lemmon: (801)585-5210 finml@business.utah.edu; Zender: (303)492-4689 jaime.zender@colorado.edu
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Asymmetric Information and Capital Structure

Abstract:

We present a tradeoff theory of capital structure in which costs associated with asymmetric information are the sole friction. By considering both the amount of debt as well as the restrictiveness of the associated debt covenants a more complete characterization of debt structure is examined than is considered in the standard tax/bankruptcy cost tradeoff model. The leverage choice, the restrictiveness of the associated debt covenants, and the renegotiation of the covenants are examined and empirical implications are developed.

The standard tradeoff theory of corporate capital structure considers the allocation of cash flow across debt and equity securities to be the primary impact of capital structure choice. An optimum is found by considering the implications of this allocation for taxes, bankruptcy costs, decision making incentives, information transmission, or other frictions. We develop a model of capital structure choice that considers both the allocation of cash flow and control rights in determining the firm's ideal debt structure. The model develops a tradeoff theory of capital structure in which costs associated with asymmetric information between the firm and external investors are the sole friction.

The model is an extension of Myers and Majluf's (1984) classic model. A firm with uncertain cash flow and asymmetric information between the firm and the market concerning the distribution of the cash flow is examined. To establish the firm, a capital constrained entrepreneur seeks financing from an inferiorly informed capital market. Myers and Majluf demonstrated that the sale of securities with low information sensitivity (debt) is beneficial in the presence of asymmetric information at the time of financing. Subsequent to the initial financing, a public signal concerning the strength of the economy/industry is observed. Based on this signal, the firm chooses to either continue, generating an uncertain future cash flow, or liquidate, for an immediate and certain value. Debt financing, however, generates the standard risk shifting incentives for equityholders with respect to this decision. This distortion in incentives creates an environment in which debt covenants, that allow the lender to demand immediate repayment of the loan on a state contingent basis, may be valuable additions to debt contracts. In the model, the debt covenants effectively allocate control of the liquidation decision to the firm or the lender based on the strength of the public signal. Because the

lender has inferior information relative to the entrepreneur, in some states the use of restrictive covenants entails a cost. The balance of this cost and the benefit of initially issuing debt generates the tradeoff in the capital structure choice.

Covenants are standard features of debt contracts. They take a variety of forms and may restrict firms from taking certain actions (engaging in mergers, the payment of dividends, issuing additional debt) that transfer wealth from lenders to shareholders or they may proscribe certain conditions the firm must maintain (minimum levels of net worth or interest coverage). The covenants modeled here are “proscriptive” covenants which act as an “early warning system” for the deterioration of the financial health of the firm and/or future default (*e.g.* Townsend (1979)).

The presence, nature, and restrictiveness of covenants have been shown to have an important *ex post* impact on the debt and the firm itself. For example, Asquith, Gertner, and Scharfstein (1994) found technical covenant violation to be the leading reason for default (ahead of a failure to make scheduled payments) in their sample of Junk-Bond issuers. Chava and Roberts (2008) demonstrate that capital investment declines following the violation of a covenant, as creditors use the threat of default to intervene in managerial decision making. The absence of control right allocations in the form of debt covenants from the *ex ante* capital structure discussion is, therefore, a potentially important omission. By presenting a model in which the amount of debt as well as the structure of its control rights are considered in the leverage decision we hope to further understand the role of debt covenants, provide more structure to their role in the capital structure decision, and to shed light on the broader capital structure question.

Closely related to this work is Garleanu and Zwiebel (2009). Garleanu and Zwiebel (see also Sridhar and Magee (1997)) point out that examining debt covenants is an interesting and important example of the broader property rights literature developed in Grossman and Hart (1986) and Hart and Moore (1990). Garleanu and Zwiebel develop a model that shows how restrictive covenants, which allocate control of decisions to a party with inferior information, may enhance value. Our model differs from theirs in that while they take the amount of debt and managerial incentives as exogenously given, these constructs become endogenous when we address the *ex ante* capital structure decision allowing a more complete consideration of the contracting problem. While it is not our main focus, we also provide an alternative to Garleanu and Zwiebel's explanation for the use of restrictive rather than unrestrictive covenants. Furthermore, we show that an important consideration in determining the restrictiveness of debt covenants is the firm's ability to renegotiate the covenants when they prevent efficient actions from being pursued. Thus, the use of restrictive covenants and their frequent renegotiation are closely tied.¹

One perspective on our results is that the model develops an endogenous measure of "debt capacity" that complements the pecking order of financing (Myers (1984)). An alternative perspective is that a more complete recognition of the impact of asymmetric information on the choice of financing identifies a balancing cost of debt financing under asymmetric information, placing Myers' analysis into a traditional tradeoff framework.

¹ Leland (1994) is an important paper considering the impact of debt covenants on the capital structure decision. It is a continuous time model of debt value and capital structure choice whose focus is very different from ours. In his model, debt covenants primarily determine the value of the firm at the bankruptcy point. Our focus is on how covenants affect decision making under asymmetric information.

The main theoretical results of the model can be summarized as follows. When renegotiation is very costly the standard features of the pecking order emerge from the model. The firm will prefer to issue first riskless debt, then risky debt, and finally external equity. The model identifies the liquidation value (Q) as a maximal level for the firm's "debt capacity." When renegotiation is very costly it is optimal for firms to use low amounts of debt combined with unrestrictive covenants. If renegotiation has low or no cost these predictions change. The use of high levels of debt combined with restrictive covenants becomes attractive, establishing the connection between the use of restrictive covenants and the ability of firms to renegotiate these covenants. Finally, a range of possible debt levels is identified for which a good firm is indifferent between the use of risky debt and external equity.

In all circumstances, the model identifies a relatively conservative amount of debt as being optimal. The main issues influencing the use of debt in the model are the firm's liquidation value and the nature of the informational asymmetry. Debt levels are appropriately compared to the level of guaranteed cash flow (liquidation value in the model) given the market's information. As liquidation value is dependent upon the state of the overall economy we immediately obtain the empirical implication that firms will tend to use more debt in economic expansions than in contractions. The model derives other interesting empirical predictions concerning leverage choice, the nature of covenants associated with the firm's debt, and the costs of renegotiating covenants.

Empirically, the main capital structure implications in the model may be examined either by directly considering the impact of proxies for the initial asymmetry of information, the information concerning the quality of the firm that may be used in debt

covenants, liquidation value, and the nature of the uncertain cash flow on leverage choice. Alternatively, this issue may be examined by considering the response of market participants to the informational limitations, the change in the nature and restrictiveness of debt covenants as leverage changes. This type of empirical examination will provide a structure to considerations of the relationship between asymmetric information and leverage choice. Ongoing research pursues both paths.

1. The Model with a Binary Public Signal

In this model, an entrepreneur/manager seeks funding for a firm. The entrepreneur's type or quality is assumed to be known precisely and privately by the entrepreneur (we will alternatively discuss an entrepreneur's type or the type of firm run by the entrepreneur, good entrepreneurs run good firms etc.). External investors (the market) know only that type is drawn from a distribution $F(t)$; where $F(t)$ is defined on the interval $[B, G]$, with $0 < B < G$, and $F(t)$ has a well defined mean, $E(t)$. Entrepreneurs with types in this interval are assumed to be observationally equivalent to the external market. For simplicity, we assume there are only two types and that types are drawn from the set $\{B, G\}$ where the *ex ante* probability of a good (type G) entrepreneur is θ .

Initial capital, I , is required to initiate a project and establish a firm. The realized value of the investment project, its time 2 payoff, is assumed to depend upon the entrepreneur's type and the value of a signal, w , that is publicly observable and verifiable at time I , where the signal, $w \in [\underline{w}, \bar{w}]$ has a distribution $H(w)$. In this section, we consider the case of a binary signal where, $w \in \{w_2, w_1\}$, the $\text{prob}(w = w_1) = p$, and $w_1 > w_2 > 0$. For expositional convenience, the signal will be discussed as an *ex post* indication of the

strength of the overall economy or the industry (where w_1 is termed a “strong” market and w_2 a weak market) as it will affect the fortunes of all observationally equivalent firms. However, with some increase in complexity we can model the signal as a purely firm specific release of information. As long as each possible level of such a signal may be reported by either type of firm the implications of the model would remain the same. If the project is funded and continues until time 2 it generates a cash flow of H or L where $H > L > 0$. A “high” cash flow H (success) is generated at time 2 with a probability equal to the product of the entrepreneur’s type and the realization of the public signal, $\text{Prob}(\text{cash flow} = H | \text{type} = t \text{ and signal} = w) = tw$, and a “low” cash flow L (failure) is realized with the complementary probability, $1 - tw$. For internal consistency we assume $1 > Gw_1 > Bw_2 > 0$. The random variables t and w are assumed to be independent.

An alternative, available at time 1, to continuing the project is that it may be liquidated (or “quit”). Liquidation of any firm generates a time 1 cash flow of Q with certainty.² The timing of the model is such that the liquidation decision is made knowing the realization of the public signal w . Because w is verifiable it can be used as the basis for a debt covenant which provides the lender the right (but not an obligation) to demand repayment of the loan at time 1. In this sense we model the inclusion of a proscriptive covenant that requires, for example the maintenance of certain accounting ratios, failure to satisfy the requirements results in default on the debt contract. The structure of the model implies that if the lender is given the right to call the loan, he will be making the liquidation decision based on inferior information. Initially we will assume that

² Firms may be liquidated either as a going concern or piece-meal. To the extent that it is more likely to be liquidated as a going concern in a strong economy the level of Q will be related to the business cycle and is not likely to be constant across time. This is not an issue in our static version of the model, however, it will influence the empirical predictions derived from the model.

renegotiation of this covenant is not possible (is infinitely costly). We then consider the nature and impact of renegotiation. Exposition of the model eases if we discuss the covenant as allocating the right to make the liquidation decision contingent on the realization of the public signal; we will do so in the sequel.

The entrepreneur/manager owns the rights to the project but has no capital. The required capital, I , must be raised by issuing some combination of equity and debt. More precisely, the entrepreneur chooses the face value of debt, F , the level of the public signal below which control of the liquidation decision is allocated to the lender, w' , and the proportion of the firm's equity to be sold externally, α , in order to maximize the informed value of his/her retained equity, $(1 - \alpha)$. Note that this is equivalent to assuming that the entrepreneur acts in the interest of shareholders (given his/her superior information).³ Intuitively, this structure generates an agency problem, one that increases with the amount of debt financing used by the firm. The asymmetric information motivates the *ex ante* use of debt and the resulting agency problem, which may be imperfectly controlled by the debt covenant, provides the *ex post* cost.

The First Best

We begin by examining first best decision making within the model. The time 0 informed (assuming knowledge of the entrepreneur's type) value of the firm can be written (using an indicator variable for continuation $\phi(w^*)$ which takes the value 1 if the realized signal $w \geq w^*$ and zero otherwise) as:

³ As in Garleannu and Zwiebel (2008) we assume debt contracts are optimal based on standard arguments from the security design literature. We leave for future work the incorporation of an optimal incentive contract (see Dybvig and Zender (1991)). Note that only the bad firm's manager need suffer from an agency problem for the development of our results so that career concerns of the managers would lead to the problems discussed here in the presence of second best incentive contracting.

$$\begin{aligned}
V_t^I &= E_w \{ (twH + (1-tw)L)\varphi(w^*) + Q(1-\varphi(w^*)) \} \\
&= \text{prob}(w \geq w^*) (tE(w|w \geq w^*)H + (1-tE(w|w \geq w^*))L) + \text{prob}(w < w^*)Q.
\end{aligned}$$

Maximizing this value by choice of w^* , it is straight forward to find the value of the public signal below which it is efficient for a firm of a given type to be liquidated. This

signal value is $w_t^* = \frac{Q-L}{t(H-L)}$. This “cutoff” level of the public signal has natural

properties. First, it decreases in the entrepreneur’s type ($w_B^* > w_G^*$); “good” firms should be continued in “worse” economic environments than should “bad” firms. Secondly, the cutoff level increases in $Q - L$; all else equal, when liquidation is more attractive than continuing and “failing” the more frequently you want to liquidate firms. Finally the cutoff level is decreasing in the difference between the continuation values for success (H) and failure (L); all else equal, the greater is the upside potential the more often you want to allow firms to continue.

In order to capture the major tensions of the more robust model but enjoy the simplicity of the model with only two levels of the public signal we will assume that in a strong economy, if $w = w_1$, both types of firms should continue ($w_1 > w_B^* > w_G^*$) while in a weak market, when $w = w_2$, only a good firm should continue ($w_B^* > w_2 > w_G^*$).

The Agency Problem

The liquidation decision of an unconstrained entrepreneur of type t , with debt outstanding, is easily derived. The entrepreneur acts to maximize the informed value of his retained shares for a given face value of debt. Assuming $L \leq F \leq Q$, and using the liquidation decision to maximize the informed value of equity

$$\begin{aligned}
S_t^I &= E_w \{ (tw \max(H - F, 0) + (1 - tw) \max(L - F, 0)) \phi(w_t^M) + \max(Q - F, 0) (1 - \phi(w_t^M)) \} \\
&= \text{prob}(w \geq w_t^M) (tE(w|w \geq w_t^M) \max(H - F, 0) + (1 - tE(w|w \geq w_t^M)) \max(L - F, 0)) \\
&\quad + \text{prob}(w < w_t^M) \max(Q - F, 0)
\end{aligned}$$

reveals that the manager of a type t firm would choose to continue if the public signal is greater than or equal to $w_t^M(F) = \frac{Q - F}{t(H - F)}$ and will liquidate the firm otherwise. Note that for any $F > L$ this value is less than w_t^* and that the difference between w_t^* and w_t^M , for a given type, increases in F ; in other words the agency problem introduced by the use of debt financing increases in the debt's face value. Clearly for $F \leq L$ (riskless debt) the manager follows the first best policy and if $F \geq Q$ the manager will choose to continue regardless of the value of the public signal (equity receives no payoff in liquidation). Finally, measuring the agency problem as the difference $w_t^* - w_t^M$, for a given F , the extent of the agency problem is negatively related to firm type; bad firms misbehave more than good.

Assuming the initial investment level is large enough, it will never be optimal to choose debt with a face value less than L . (To focus the discussion on the interesting issues, it will always be the case that firm cannot be financed entirely with risk free debt ($I > L$) in fact it will be useful to assume that it is not valuable to initiate a firm only to liquidate it ($I > Q$.) This is simply Myers and Majluf's result that firms use financial slack or riskless debt as the first choice for financing. Further, in the absence of renegotiation, there is no benefit to using debt with a face value larger than Q . This is because issuing debt with $F > Q$ is, at the margin, equivalent to issuing external equity (they have the same informational sensitivity). The motivation for issuing debt under asymmetric information is limited by the firm's liquidation value.

Finally it is useful to examine the behavior of the lender. If information is symmetric and the lender is in control of the liquidation decision they would act to maximize the value of their claim on the firm's cash flow.

$$\begin{aligned}
D_t^l &= E_w \{ (tw \min(F, H) + (1-t)w \min(F, L)) \varphi(w_t^D) + \min(F, Q)(1 - \varphi(w_t^D)) \} \\
&= \text{prob}(w \geq w_t^D) (tE(w|w \geq w_t^D) \min(F, H) + (1-tE(w|w \geq w_t^D)) \min(F, L)) \\
&\quad + \text{prob}(w < w_t^D) \min(F, Q).
\end{aligned}$$

If $F \leq L$ the lender is indifferent between continuation and liquidation. If $L < F \leq Q$, the lender always prefers to liquidate the firm; the limit on the upside potential of his claim causes the preference for certainty. Finally if $F > Q$ it can be shown that $w_t^D = \frac{Q-L}{t(F-L)}$.

In other words, the lender has a chance to capture some of the upside potential of continuation; the debt effectively becomes junk debt. An informed lender holding junk debt will not make the liquidation decision efficiently; preferring continuation only in some of the states for which it is efficient.

It will always be optimal for $w_G^* \leq w' \leq w_B^*$. The structure of the model, therefore, provides a natural measure of the restrictiveness of the debt covenants. A covenant written as $w' = w_G^*$, labeled a nonrestrictive covenant, assigns control to the lender only in those states for which it is efficient for all firms to liquidate. With such a covenant no firm is inefficiently constrained and there is no scope for any firm to renegotiate to waive a violated covenant. There will, however, be opportunities for bad firms to renegotiate a lower debt burden in exchange for a voluntary liquidation. As w' is increased from this level, the covenant becomes more restrictive until the point $w' = w_B^*$ (the most restrictive covenant); the lender is assigned control in all states except those for which it is efficient

for all firms to continue. In this case, renegotiation entails the good firm offering to take on a larger debt burden in exchange for the lender waiving the violation. For restrictive covenants on the interior of the range ($w_B^* > w' > w_G^*$), conditional on the realization of w , there may be scope for renegotiation by either type of firm. The main result of Garleanu and Zwiebel (2009) is to offer an explanation for the observed tendency of covenants to be written very restrictively and to be often renegotiated when violated. Our analysis provides an alternate explanation of why this is more beneficial than writing unrestrictive covenants and having firms volunteer to liquidate for concessions.

As is standard in pooling equilibria,⁴ the manager of the highest type firm (type G) chooses his preferred financial structure (F, w', α) taking into account the informational asymmetry and its impact on the outcomes of his choices. Bad firms mimic these choices. For a good firm, the manager's decision problem can be written in terms of the expressions derived above.

The Decision Problem – No Renegotiation

For a type G firm, the manager's problem can be written as:

$$\begin{aligned} \text{Max}_{w', F, \alpha} \quad & (1 - \alpha)S'_G(F, w') \\ \text{s.t.} \quad & \alpha E_t(S'_t(F, w')) + E_t(D'_t(F, w')) = I \end{aligned}$$

For notational simplicity, we define the uninformed equity and debt values as:

$$S^U(F, w') = E_t(S'_t(F, w')) \text{ and } D^U(F, w') = E_t(D'_t(F, w')).$$

⁴ It can be easily shown that the pooling equilibria are the natural focus at time 0 in this model. The good firm's ability to separate from the bad using an initial financing arrangement depends upon the good firm being able to limit the benefit to the bad firm from pooling (using debt rather than equity financing) or by imposing costs on the bad firm from mimicking (debt distorts the decision making incentives of the bad firm). However as long as we assume that the required investment is sufficiently large (implying a large benefit for the bad firm from pooling in its initial financing) the bad firm will always prefer to pool rather than separate. A sufficient condition for this is $I > Q$, which can simply be interpreted as assuming that it is not a value added investment to initiate a firm solely for the purposes of liquidating it at time I .

The type G manager selects the structure of the external debt (choosing F , the face value, and w' , the restrictiveness of the covenant) and the proportion of the firm's equity α to sell externally in order to maximize the (informed) value of his retained shares, subject to the constraint that the required capital I is raised. Strictly speaking the capital constraint should be written as a weak inequality, however given that the manager of a good firm sells securities under asymmetric information it will never be optimal to raise more than is required. With the constraint written as an equality, it can be solved for the level of external equity as a function of F and w' :

$$\alpha = 1 - \frac{S^U(F, w') + D^U(F, w') - I}{S^U(F, w')}.$$

The constraint can then be substituted into the maximand and the manager's objective function can be written:

$$\begin{aligned} Obj(F, w') &= (S^U(F, w') + D^U(F, w') - I) \frac{S^I_G(F, w')}{S^U(F, w')} \\ &= (V^U(F, w') - I) \frac{S^I_G(F, w')}{S^U(F, w')}. \end{aligned}$$

Where the first term, the uninformed firm value less the required investment, captures the impact of inefficient decision-making and the second term captures the impact of the asymmetric information on the value of the entrepreneur's claim.

In this version of the model the optimal choices, given the problem faced by the manager of a good firm, are most simply identified by comparing the value of the manager's objective function for different F and w' . By doing so we are able to illustrate the model's basic tensions. When there are only two levels of the public signal we label the choice of $w' = w_2$ as an unrestrictive covenant and the choice $w' = w_1$ as a restrictive

covenant. A first result to note is that the value of the good manager's objective function, $Obj(F, w')$, with an unrestrictive covenant is larger at $F = F^L > L$ than at $F = L$; $Obj(F^L, w_2) > Obj(L, w_2)$, where $F^L = \frac{Q - w_2 BH}{1 - w_2 B} < Q$ is the face value of debt at which a bad firm is indifferent between liquidation and continuation when $w = w_2$ is observed (the highest level of risky debt for which there is no cost associated with the bad manager's incentive problem in a weak market).

This result illustrates that the model captures the standard pecking order incentive for the manager to issue risky debt rather than external equity given the asymmetric information. The qualification is that this is a general prescription on financing choice only as long as it does not alter the incentives of a bad entrepreneur by "too much." If we ignore the impact of debt financing on decision making we derive a limit on the firm's motivation to use debt financing derived from asymmetric information at time 0 .

Proposition 1: The Pecking Order and Debt Capacity: In the absence of renegotiation, asymmetric information at the time of financing (time 0) implies that, holding liquidation decision-making constant, there is a pecking order for external financing in that the entrepreneur prefers to issue first riskless debt to the extent possible ($F = L$) and then risky debt to its point of informational equality with external equity ($F = Q$). Once this level of debt financing is reached, the entrepreneur is indifferent between issuing more debt or external equity. (Assuming the liquidation decision is made efficiently and setting $F = Q$ provides a benchmark value for the good manager's objective function.)

Proof: See the appendix

From Proposition 1 we immediately see that by changing the model to include a liquidation decision a version of the “debt capacity” discussed by Myers (1984) is identified by the model. At the point $F = Q$ there is no longer any motivation derived from asymmetric information between the firm and the market to use risky debt rather than external equity. An interesting aspect of liquidation value as a ceiling for debt capacity is that this value is state contingent. During economic expansions, firms in financial distress will be more likely to be liquidated as a going concern than piece-meal. Thus liquidation value may be very near firm value, implying a high ceiling. During contractions liquidations is more likely to be piece-meal, selling the firm for the highest value of its assets in an alternative use, which can be quite low. When the costs related to the distortion of incentives from the use of debt financing and the assignment of control rights to an inferiorly informed lender are considered, the optimal level of debt, in this simple version of the model, is below this ceiling.

The innovation in this model is that we also consider the implications of the asymmetric information between the firm and the market at the time (time I) of the liquidation decision (the agency problem). There are two issues to discuss. First is that the use of risky debt in the initial financing of the firm distorts the incentives of the manager of both a good and bad type firm in the time I liquidation/continuation decision. Second is that debt covenants, state contingent changes in the control of the liquidation decision, can help to limit the cost of the distorted incentives. The use of debt covenants may not perfectly control the incentive problem because the lender prefers liquidation to continuation if the debt is risky (they have their own distorted incentives) and because the lender makes decisions based upon inferior information. The net cost of the incentive

distortion associated with debt financing is balanced against the adverse selection benefits to the initial sale of debt in determining the firm's optimal capital structure.

In the model with a binary signal there are only two potential value added assignments of the ownership of the liquidation decision. The first is the use of an unrestrictive covenant. In the absence of renegotiation, this arrangement will tend to be preferred for low levels of debt (when there is little distortion to managerial decision making) as well as for high debt levels when the cost of uninformed decision making by the lender is larger than is the cost of distorted decision making by informed insiders.

Because we have assumed that it is efficient for both good and bad type firms to continue in a strong market (w_1) and because the lender's incentives are such that they will always want to liquidate, it will never be efficient to allocate control of the liquidation decision to the lender in this state. Therefore, only the use of a restrictive covenant, $w' = w_1$, leaving the manager in control of the liquidation decision in a strong market and allocating this decision to the lender in a weak market, is a second potentially optimal level of the debt covenant.

With only two public signals the potentially optimal levels for the face value of debt are also limited. A low level of debt ($F = F^L$) may be optimal if the cost of inefficient decision making is large. By choosing a low (but risky) debt level the incentives of insiders of bad firms remain efficient in the sense that they will make the right decision in both a strong and a weak market (the manager of a bad firm is just indifferent to continuation and liquidation in a bad market). The distortion of the incentives of the good firm manager is irrelevant in this version of the model and more generally will be partially controlled by the debt covenant. For any face value of debt

above F^L the manager of a bad firm will wish to continue for both realizations of the public signal. The manager of a good firm will also have a heightened preference for continuation; however it is efficient for good firms to continue in both weak and strong markets by assumption. If any $F > F^L$ is chosen, increases in F imply no increased expected incentive costs and a strict gain from lowering the time 0 discount applied to a good firm's securities. Therefore, if $F > F^L$ is chosen it will be optimal to issue debt with a face value of Q . We will label this the high debt level, F^H .

Proposition 2: If the “low” debt level, F^L , is chosen, it is optimal to use an unrestrictive covenant (set $w' = w_2$). This arrangement allocates control of the liquidation decision to the informed insiders and the low debt level, F^L , ensures efficient decision making in both a weak and a strong market.

Proof: Obvious from the discussion above.

Proposition 3: Assuming a high debt level is chosen, $F^H = Q$, it will be optimal to use a restrictive covenant if parameter values are such that it is efficient for an “average” firm, $\bar{t} = \theta G + (1 - \theta)B$, to liquidate in a weak market (if $w_7^* > w_2$). If it is efficient for a firm of average type to continue in a weak market then it is optimal to use an unrestrictive covenant. $Obj(Q, w_1) > Obj(Q, w_2)$ if $w_7^* > w_2$ and $Obj(Q, w_1) < Obj(Q, w_2)$ if $w_7^* < w_2$.

Proof: See the appendix

The time 0 capital structure decision can now be considered.

Proposition 4: In the version of the model with a binary public signal and infinitely costly renegotiation of debt covenants, it is always optimal for the good firm to choose debt with a face value of F^L and use an unrestrictive covenant. It is never optimal to use a high level of debt or a restrictive covenant.

Proof: See the appendix

Proposition 4 establishes that there is no high debt optimum in this version of the model due to the inefficient liquidation decisions introduced by a high level of debt. The model's structure implies that the low debt optimum is a corner solution. Intuitively, one would expect that when the adverse selection benefit from issuing lots of debt (the *ex ante* benefit of issuing debt with $F = Q$ rather than $F = F^L$) was larger than the net agency cost of the distorted incentives there would be a high debt optimum. By choosing parameter values that made the continuation decision of the bad type firm truly marginal it would seem possible to obtain high debt as the optimal solution. However, what determines the importance of the bad firm's continuation versus liquidation decision is the relative size of the liquidation value (Q). When the efficiency of the liquidation decision of the bad firm is unimportant (Q is low) there is also a very small total benefit to the use of risky debt rather than external equity in the initial financing decision.⁵

The current model shows that when we extend a model of financing choice under asymmetric information to consider the incentive costs associated with the use of risky debt, a good firm's incentive to use debt is limited by the distortion to the incentives of the bad type firm. Because the firms are observationally equivalent, the market, anticipating the distorted incentives associated with large amounts of debt for a bad firm, will "charge" a good firm for the anticipated inefficient decision-making. This makes the use of large amounts of debt suboptimal. In this version of the model, there is a pecking order for financing choices but the point at which firm's turn to external equity (the

⁵ The continuous signal version of the model does not share this stark result and so allows the development of more interesting empirical implications for capital structure choice under asymmetric information.

firm's debt capacity, F^L) is very low. In other words, the impact to the Myers and Majluf conclusions of this extension to their model is extreme.

Renegotiation of Covenants

Start by considering a good firm which has issued debt including a restrictive covenant; one which transfers control of the liquidation decision to the lender in a weak market. Within the existing model there is an intuitive renegotiation strategy that a good firm may use to separate itself from bad firms when the covenant is violated. A good firm is willing to offer to increase the time 2 payment to the lender in exchange for the lender waiving the covenant (not forcing liquidation of the firm).⁶ For simplicity we will assume that the firm makes a take-it-or-leave-it offer to the lender and faces any costs in all renegotiations. This assumption gives all the bargaining power in the renegotiation to the firm and may be justified by the presence of alternative sources of financing that are available to the firm in the event a covenant is violated and the lender calls the loan. However, because the relative amounts of bargaining power possessed by the firm versus the lender in renegotiation affects our results we will discuss the impact of alternative arrangements. Due to the asymmetric information between the firm and the lender, we consider Pure Strategy Perfect Bayesian Equilibria of the renegotiation game.

Costless Renegotiation

We begin by considering a firm that initially chose a high debt level and is attempting to renegotiate a restrictive covenant that has been violated. In this model the covenants serve to mitigate the costs of high debt levels. When renegotiation is not

⁶ Commonly, covenants give the lender the right to call the loan. In the absence of renegotiation, if the lender is the firm's only source of financing at time T this would be equivalent to forcing liquidation. When renegotiation is allowed, because we have assumed the lender has access only to public information, renegotiation or refunding of the debt can be accomplished by the lender or an alternate provider of capital. For simplicity we consider that the renegotiation occurs between the firm and the existing lender.

allowed or is infinitely costly, high debt levels, were they beneficial, would take full advantage of the low information sensitivity of debt and set the face value of debt equal to the liquidation value ($F = Q$). However, in anticipation of a separating renegotiation strategy in a weak market, a good firm will not set $F = Q$. When $F = Q$ there is no way for a good firm to make a restructuring offer that the bad firm will not mimic (if $F = Q$ a manager of a bad firm receives nothing in liquidation and will therefore mimic any strategy that waives the covenant). Therefore, assume that at time 0 the manager of a good firm chooses some F^R , with $F^L < F^R < Q$ (R indicates a “high” debt level associated with a restrictive covenant). Because a good firm’s cash flow distribution in continuation stochastically dominates that of a bad firm there is, in a weak market, a separating restructuring offer the good firm is willing to make, $F^S > F^R$, that a bad firm will not choose to mimic (F^S is high enough to satisfy a separation constraint) and that the lender will accept, believing the offer is made by a good firm. The equity value for a bad firm’s manager will be higher receiving $Q - F^R$ in liquidation with certainty rather than taking a small chance on $H - F^S$ from continuing in a weak market.

Figure 1 illustrates the possible combinations of an initial debt level with a restrictive covenant (F^R) and a separating equilibrium renegotiation offer (F^S). All combinations of F^R and F^S lie within the shaded triangle. Combinations on the lower edge of the shaded triangle are those for which the separation constraint binds (the bad firm is indifferent between mimicking the renegotiation offer and liquidating under the initial debt level). Note that while the good firm has all the bargaining power, satisfaction of the separation constraint implies that these offers share the efficiency gains from the renegotiation between the lender and the good firm.

Proposition 5: Consider a good type firm faced with the violation of a covenant in a weak market. If the face value of debt, F^R , chosen at time 0 is such that

$$Q > F^R \geq \frac{\frac{G}{B}Q - Gw_2H - (1 - Gw_2)L}{\frac{G}{B} - 1}$$

there is a renegotiation offer

$$F^S(F^R) \geq H - \frac{(Q - F^R)}{Bw_2}$$

which a bad firm will not mimic and the lender, believing a good firm has made the offer, will accept to waive the covenant. In the absence of renegotiation costs, the manager of a good firm is indifferent to all initial F^R that satisfy the first inequality.

Proof: See the appendix

Interestingly, rather than there being a strict benefit to issuing debt instead of external equity, as long as the initial face value of debt chosen at time 0 satisfies the inequality given in Proposition 4, the manager of a good firm is indifferent to a set of initial debt levels that are strictly less than Q . In other words, there is no optimal F^R . Intuitively, for higher initial levels of debt the savings a good firm receives on the *ex ante* adverse selection problem is balanced by the cost (in the form of a higher renegotiation offer) imposed on the firm by the need to separate *ex post* from bad firms. Simple algebra shows that there is always such a range for F^R if it is strictly efficient for a good firm to continue in a weak market.

We are now able to examine the capital structure implication of the existence of a costless and fully separating renegotiation in a weak market. Interestingly, in the case of costless renegotiation, asymmetric information does not motivate an extreme use of debt financing. Rather a good firm is indifferent between low debt ($F = F^L$) with an

unrestrictive covenant and higher debt ($F = F^R$) with a restrictive covenant (anticipating the good firm will renegotiate if the covenant is violated).

Proposition 6: When the renegotiation of bond covenants is costless firms are indifferent to choosing high debt $F = F^R$ with a restrictive debt covenant and low debt $F = F^L$ with an unrestrictive covenant. With high debt, in a weak market, good firms will renegotiate the covenant choosing $F = F^S$ and bad firms will liquidate.

Proof: See the appendix.

When renegotiation is costless, the separation induced by the renegotiation implies it is always optimal to include a restrictive covenant with a high debt level; rather than only for certain parameter values. Proposition 6 illustrates not only the usefulness of bond covenants in controlling the agency costs of debt but also the importance of the ability of firms to renegotiate these covenants. In the model with a binary signal, without an ability to renegotiate restrictive covenants they will not be employed. “Low” debt levels in combination with unrestrictive covenants are superior.

Propositions 5 and 6 present the results for the renegotiation of a restrictive covenant in which the good firm has all of the bargaining power and is constrained in the share of the rents that may be captured by the requirement that a bad firm will not mimic the good firm’s offer. An alternative arrangement is for a high initial debt level, F^U , to be chosen in combination with an unrestrictive covenant. In this case, renegotiation in a weak market would entail a bad firm offering to liquidate for a lower required payment. Figure 2 illustrates the nature of this type of a renegotiation. In the figure are pictured the three constraints the offer must satisfy. First, the offer, F^S , must be low enough that the bad firm does at least as well with a claim to $Q - F^S$ with certainty rather than owning a

small chance of $H - F^U$. Secondly, it must be that F^S is high enough that the good firm will not mimic (the separation constraint). Finally, the offer F^S must be high enough that the lender, believing that a bad firm is making the offer, is willing to accept it. The area of renegotiation is again represented by the shaded triangle and the lower edge of the triangle represents the bad firm's preferred offers. This is formalized in Proposition 7.

Proposition 7: Assume renegotiation is costless and that a debt structure including a high debt level F^U in combination with an unrestrictive covenant is in place. Then:

(a) In a weak market the manager of a bad firm offers to liquidate the firm in exchange for a reduction of the debt payment from F^U to F^S . For any initial level of debt F^U , such that $H > F^U \geq \frac{Gw_2H - Bw_2L - (Q - L)}{Gw_2 - Bw_2}$, the manager of a bad firm offers

$$F^S = Q - Gw_2(H - F^U) < F^U \text{ to the lender.}$$

(b) For all such $F^U < H$, the manager of a good firm strictly prefers a debt structure of low debt, F^L , with an unrestrictive covenant to a high debt level, F^U , with an unrestrictive covenant that will be renegotiated in a weak market by a bad firm.

(c) Only if $F^S(F^U) = Q - Bw_2(H - F^U)$ so that the bad firm receives none of the efficiency gains in the renegotiation, then the good manager is indifferent between high debt F^U with an unrestrictive covenant that is renegotiated in a weak market and low debt F^L with an unrestrictive covenant, for any level of $F^U > F^L$.

Proof: See the appendix.

Proposition 7 shows that an important aspect of the decision to use restrictive or unrestrictive covenants is the identity of the party at the bargaining table in the event of a renegotiation. With restrictive covenants, the separation constraint implies that the lender

and the good firm share the efficiency gains from the renegotiation in a weak market. These gains increase the value of the good manager's *ex ante* objective function.

If an unrestrictive covenant is renegotiated, the bad firm does the bargaining. To the extent that the bad firm extracts any of the efficiency gains from the renegotiation this reduces the value of the good manager's *ex ante* objective function. Part (c) of Proposition 7 states that only if the lender receives all the efficiency gains associated with the renegotiation of an unrestrictive covenant does the manager of a good firm achieve an *ex ante* value of his retained shares equivalent to a choice of high debt and a restrictive covenant. Unrestrictive covenants allocate control of the liquidation decision to the bad firm. As the firm must volunteer to relinquish control of this decision, it is likely that the bad firm will have most if not all of the bargaining power in this type of renegotiation and there is little control the good firm would have over this process. As Figure 2 shows, an exception to this is if $F^U = H$. If the manager of a good firm chooses an extreme level of debt at time 0 then the separation constraint will force the renegotiation to provide the lender with all the efficiency gains. This is effectively selling the firm to the lender since if $F^U = H$ then $F^S = Q$ and neither a good nor a bad firm receives any time 2 payoff.

This result offers an explanation for the observed use of restrictive covenants that are often renegotiated rather than a use of unrestrictive covenants with voluntary liquidation in exchange for a lower debt burden. For this reason, in the sequel we focus our attention on the use of restrictive rather than unrestrictive covenants.

Costly Renegotiation

Strictly speaking, when renegotiation is costly, the combination of low debt and an unrestrictive covenant is the dominant capital structure choice for a good manager.

However since this is an artifact of the simplicity of this version of the model we briefly discuss the impact of costs on the renegotiation of a restrictive covenant. When a restrictive covenant has been violated, the good firm's manager will consider the gain from a renegotiation of the covenant. The manager compares the portion of the efficiency gain that accrues to the firm (based on the initial debt level and the firm's bargaining power relative to the lender) to the cost of a renegotiation. If the firm's gain outweighs the cost the manager will make an offer to renegotiate the covenant.

At time 0 , a fixed and known cost of renegotiation will imply that the manager of a good firm is no longer indifferent to the range of possible values for F^R given in Proposition 5. Instead the range of possible values for F^R will consist of the lower end of the original range. Intuitively, for any given structure for the relative bargaining powers of the firm and the lender, the lower is the initial face value of the debt the larger is the firm's share of the efficiency gains from a renegotiation.⁷

In this version of the model, therefore, the initial choice of debt structure made by the manager of a good firm is very simple. If the cost of renegotiation is smaller than the firm's gain in a renegotiation, the good firm chooses a level of debt equal to F^R and a restrictive covenant at time 0 . If this cost is large, the good firm will initially choose a capital structure characterized by a debt level of F^L and an unrestrictive covenant.

2. The Model with a Continuous Signal

In order to develop a richer set of predictions we extend the current model by assuming the public signal w has a uniform ($w \sim U[\underline{w}, \bar{w}]$) rather than a Bernoulli

⁷ Randomness in the level of the cost of renegotiation would make the optimal choice of initial debt equal to the lower bound of the range given in Proposition 5.

distribution. Other than this change, the model in this section is identical to that used above. This apparently simple change increases the complexity of the representations to such an extent that we must resort to numerical solutions of the optimization problem. However, the added richness allows the development of cases in which it is strictly optimal for firms to use high levels of debt (even in the absence of renegotiation) and so develop more interesting capital structure implications.

No Renegotiation

The representation of the problem becomes more complex when we assume that the public signal has a continuous distribution. We first present the informed equity and debt values and then discuss the change to the problem. Using the same notation as above, $S_t^I(F, w')$, the informed value of the equity for a firm of type t , is given by:

$$S_t^I(F, w') = \text{prob}(w \geq \max(w_t^M(F), w'))(tE(w|w \geq \max(w_t^M(F), w'))(H - F)) \\ + \text{prob}(w < \max(w_t^M(F), w'))(Q - F).$$

Assuming that the public signal is uniformly distributed this becomes:

$$S_B^I(F, w') = \frac{\bar{w} - \max(w_B^M(F), w')}{\bar{w} - \underline{w}} \left(B \frac{\max(w_B^M(F), w') + \bar{w}}{2} (H - F) \right) \\ + \frac{\max(w_B^M(F), w') - \underline{w}}{\bar{w} - \underline{w}} (Q - F).$$

$$S_G^I(F, w') = \frac{\bar{w} - w'}{\bar{w} - \underline{w}} \left(G \frac{w' + \bar{w}}{2} (H - F) \right) + \frac{w' - \underline{w}}{\bar{w} - \underline{w}} (Q - F).$$

Similarly, with a uniform public signal the informed values of debt are given by:

$$D_B^I(F, w') = \frac{\bar{w} - \max(w_B^M(F), w')}{\bar{w} - \underline{w}} \left(B \frac{\max(w_B^M(F), w') + \bar{w}}{2} (F - L) \right) \\ + \frac{\max(w_B^M(F), w') - \underline{w}}{\bar{w} - \underline{w}} (F - L) + L.$$

$$D_G^I(F, w') = \frac{\bar{w} - w'}{\bar{w} - \underline{w}} \left(G \frac{w' + \bar{w}}{2} (F - L) \right) + \frac{w' - \underline{w}}{\bar{w} - \underline{w}} (F - L) + L.$$

Finally, the uninformed values are simply $S^U(F, w') = \theta S_G^I(F, w') + (1 - \theta) S_B^I(F, w')$ and $D^U(F, w') = \theta D_G^I(F, w') + (1 - \theta) D_B^I(F, w')$.

The equations for the informed security values indicate that a complication introduced by the use of a continuous signal is the question of whether, for a given F , the covenant is optimally set at a level of the public signal that is greater or less than the level at which a bad type manager benefits more from liquidating the firm than continuing. The relationship between w' and $w_B^M(F)$ again limits the search to two candidate optima.

If, for any F , the covenant is optimally set so that $w' < w_B^M(F)$ the covenant does not effectively constrain the bad manager in his liquidation decision. Any covenant set so that $w_G^* < w' < w_B^M(F)$ will inefficiently constrain good managers but not affect the decision making of bad managers. Therefore, only $w' = w_G^*$, an unrestrictive covenant, can be optimal if $w' < w_B^M(F)$. If an unrestrictive covenant is chosen it will also be the case that F is optimally set at a relatively low level. The optimal choice of F , in this version of the model, involves a smooth tradeoff. Fixing $w' = w_G^*$, as F rises above L in the time 0 financing decision, a good firm benefits from selling an informationally insensitive security. However, the good firm faces a cost from the bad firm's distorted incentives, an inefficiency the good firm will "pay" for in the price it receives for its securities. We again label the candidate low debt solution F^L .

On the other hand, if it is optimal for the covenant to constrain the manager of a bad firm, $w' \geq w_B^M(F)$, the same covenant will also constrain the manager of a good firm.

Given that the liquidation decision for both types of firms is controlled by this covenant, there is no additional cost derived from the incentive distortion induced by a high debt level. Assuming no renegotiation, the choice of debt that maximizes the time 0 benefit of selling (informationally insensitive) debt rather than external equity is to set $F = Q$.

Analytically, it is straightforward to show that if $F = Q$, then it is optimal to set the covenant so that control is transferred to the lender for levels of the public signal that are less than the level at which a firm of the average type (given the lender's information on type) would optimally liquidate, $w' = \frac{Q-L}{\bar{t}(H-L)} = w_{\bar{t}}^*$ where $\bar{t} = \theta G + (1-\theta)B$.

While it is clear that only two time 0 choices for debt structure are possibly optimal, $(F = F^L, w' = w_G^*)$ and $(F = Q, w' = w_{\bar{t}}^*)$, to date we have been unable to derive the analytical value of F^L and provide an tractable comparison of the value of the good manager's objective function under these debt structures as a function of the underlying parameter values. In what follows, we derive the value F^L and compare the value of the good manager's objective function at the candidate solutions numerically. Figures 3 – 5 demonstrate the nature of the solutions to the good manager's optimization problem when the public signal is assumed to be uniformly distributed.

Figure 3a compares the value of the good manager's objective function at the candidate solutions for a given set of parameter values. Immediately apparent is the result that with a continuous public signal both the debt structure that includes a low debt level and a weak covenant $(F = F^L, w' = w_G^*)$ and the debt structure that includes a high debt level and a restrictive covenant $(F = Q, w' = w_{\bar{t}}^*)$ are optimal solutions to the good manager's problem under different parameter values. In the figure the vertical axis

represents the value of the objective function while the horizontal axis represents different values for Q the firm's liquidation value, holding H, L , and the other parameters of the model constant. The black curve charts the value of the objective function under the high debt solution for different liquidation values of the firm, Q , while the grey curve charts the objective function value at the low debt solution.

The low debt solution is characterized by the good manager capturing some of the benefit to selling informationally insensitive securities with minimal incentive costs. In the high debt solution, the benefit of initially selling debt rather than external equity balances the cost of the resulting investment inefficiency. For low values of Q there is little benefit to selling informationally insensitive debt at time 0 while the investment inefficiency remains. Therefore, for low values of Q the low debt solution is optimal. As Q , the relative values of the solutions reverse. As shown in Figure 3b, the low level of debt, F^L , rises very slowly with increases in liquidation value. This implies that the value of the objective function under the low debt solution will also change relatively little for increases in Q . As Q rises, the benefit available for issuing debt rather than external equity rises. The cost of distortions in the liquidation decision making by the bad manager also rise while the cost of inefficiently constraining the good manager falls. With a continuous signal, these costs are managed more effectively (setting $w' = w_T^*$) than they are with a binary signal. Therefore, the value of the good manager's objective function in the high debt solution rises relative to its value in the low debt solution.⁸

⁸ The general shape of the curves in Figure 3a may be explained as follows. With a low Q , the cost of distorted decision making is very low. As Q increases, holding the other parameters fixed, there are two effects. First the cost of the distorted incentives increases (the liquidation decision becomes more important). Secondly, there is more total value available (the NPV rises). The first effect is responsible for the initial decrease while the second effect soon becomes dominant.

Figures 4a and 4b present the same relation as in Figure 3a with a change in the value of the parameter θ , the probability of a good type firm/manager. There are two intuitive changes in these figures relative to Figure 3a. The first is the level of the curves. The value of the good manager's retained equity decreases as the probability of a good manager drops from 0.5 to 0.3 (Figure 3a versus Figure 4a) and increases as this probability increases from 0.5 to 0.8 (Figure 3a versus Figure 4b). This effect is simply due to the effect that changing θ has on total value. Secondly, for relatively high levels of the liquidation value, the dominance of the high debt solution relative to the low debt solution varies inversely with θ . In other words, for low θ and high Q the high debt solution is much more valuable to a good manager than is the low debt solution, while for high θ and high Q the high debt solution is only marginally better than the low debt solution. This difference is due to the change in the benefit of selling debt rather than external equity as the mix of observationally equivalent firms changes. When there are many good firms and only a few bad firms the adverse selection discount is relatively small. Therefore the benefit of the high debt solution is reduced. The net benefit of a restrictive covenant is also reduced, making the low debt solution with an unrestrictive covenant relatively attractive. However, when there are many bad firms and few good firms the benefit received by a good firm from selling debt instead of external equity is large. Similarly, the net benefit of the restrictive covenant in curtailing the choices of the bad firm manager is increased leading the solution with high debt and a restrictive covenant to be relatively attractive.

Figure 5 reinforces the above discussion. This figure illustrates the relative value of the low debt and the high debt solutions as the unconditional probability of a good

firm, θ , changes. The figure uses the same parameter values as in figures 3 and 4, with $Q = 1.35$ and θ varying from 0.10 to 0.80. Figure 5 shows that for very low levels of θ , and so a high probability attached to the firm being a bad firm, the benefit to the time t sale of debt is large and the net benefit to the use of a restrictive covenant is also large. As θ rises we see that the high debt solution becomes relatively less attractive and the low debt solution begins to dominate.

Costless Renegotiation of the Covenants

The renegotiation game in the case of a continuous signal works similarly to that in the case of a binary signal. This is due to the fact that when the renegotiation game commences, the signal has been realized and is publicly known, at which point the only remaining uncertainty from the perspective of the market is firm type. Thus when it is optimal for the firm to choose a debt level that is “high enough” to induce the use of restrictive covenants and the covenant is violated, inefficiently constraining the actions of a good firm, there is a renegotiation strategy the good firm may employ. We again work recursively, we first assume an initial debt level that induces the use of restrictive covenants and analytically solve the renegotiation game that is played when the covenant is violated and then solve numerically for the optimal structure of the initial financing (i.e. F^R and w').

Proposition 8: When renegotiation of debt covenants is costless, for any initial choice, F^R , of the face value of debt that induces a covenant $w' > w_G^*$ there is a separating renegotiation offer that may be made by a good firm in any realized state w such that $w_G^* < w < w'$ for which it is an equilibrium response for the lender to accept and which bad firms will not mimic.

$$F^S(F^R, w) = \max\left(\frac{F^R - L}{Gw} + L, H - \frac{Q - F^R}{Bw}\right)$$

The optimal covenant is to set $w' = w_B^*$; the most restrictive covenant is used when renegotiation is costless.

Proof: Follows the same argument as the proof of Proposition 5.

When renegotiation of the covenants is costless, for any realization of the public signal w for which the existing covenant inefficiently constrains the good firm, there is an offer to increase the debt payment in exchange for waiving the covenant a good firm may make to separate itself from bad firms. The difference between the nature of the offer in the case of a continuous signal and that with a binary signal is that there is a range of signals for which the covenant may be violated and the realization of the signal that causes the violation is not known *ex ante*. The result is a set of state dependent renegotiation offers.

Given the equilibrium renegotiation offers on a state by state basis we can now write down the equations that govern the time 0 informed and uninformed values of the debt and equity for firms of different types. The state contingent renegotiation strategy makes the representation of the debt and equity values for a good firm more complicated.

$$S_B^I(F, w') = \frac{\bar{w} - \max(w_B^M(F), w')}{\bar{w} - \underline{w}} \left(B \frac{\max(w_B^M(F), w') + \bar{w}}{2} (H - F) \right) + \frac{\max(w_B^M(F), w') - \underline{w}}{\bar{w} - \underline{w}} (Q - F).$$

$$S_G^I(F, w') = \frac{\bar{w} - w'}{\bar{w} - \underline{w}} \left(G \frac{w' + \bar{w}}{2} (H - F) \right) + \frac{w_G^* - \underline{w}}{\bar{w} - \underline{w}} (Q - F) + \frac{w' - w_G^*}{\bar{w} - \underline{w}} \left(\int_{w_G^*}^{w'} \left(H - \max\left(\frac{F - L}{Gw} + L, H - \frac{Q - F}{Bw}\right) \right) \frac{1}{w' - w_G^*} dw \right).$$

and

$$D_B^I(F, w') = \frac{\bar{w} - \max(w_B^M(F), w')}{\bar{w} - \underline{w}} \left(B \frac{\max(w_B^M(F), w') + \bar{w}}{2} (F - L) \right) + \frac{\max(w_B^M(F), w') - \underline{w}}{\bar{w} - \underline{w}} (F - L) + L.$$

$$D_G^I(F, w') = \frac{\bar{w} - w'}{\bar{w} - \underline{w}} \left(G \frac{w' + \bar{w}}{2} (F - L) \right) + \frac{w_G^* - \underline{w}}{\bar{w} - \underline{w}} (F - L) + \frac{w' - w_G^*}{\bar{w} - \underline{w}} \left(\int_{w_G^*}^{w'} \max \left(\frac{F - L}{Gw} + L, H - \frac{Q - F}{Bw} \right) - L \right) + L.$$

Finally, the uniformed values are simply $S^U(F, w') = \theta S_G^I(F, w') + (1 - \theta) S_B^I(F, w')$ and

$D^U(F, w') = \theta D_G^I(F, w') + (1 - \theta) D_B^I(F, w')$. The optimal debt structure maximizes the informed value of the good manager's retained equity via the choice of w' and F .

Numerical solutions to be developed...

Costly Renegotiation of the Covenants

To be written...

3. Conclusion

The capital structure decision is examined in a setting with asymmetric information as the sole friction. The model is an extension of Myers and Majluf (1984) where the implication of having debt in the capital structure when there is asymmetric information after the initial financing is considered. The incentive problems created by debt financing and asymmetric information are controlled by the use of debt covenants which transfer control of the relevant decision making to the lender in some states of nature. We demonstrate that an optimal capital structure may be derived trading off the benefits of selling debt, given its relatively low information sensitivity, and the costs of

debt, derived from the inefficient decision making implied by transfers of control to uninformed parties.

The model considers the nature of the renegotiation of bond covenants that inefficiently constrain the actions of the firm. It has been shown that debt covenants are initially written to be very restrictive and are often renegotiated (Chava and Roberts (2005) and Dichev and Skinner (2001)). The model demonstrates that the use of restrictive bond covenants is optimal only when they may be renegotiated to remove the *ex post* inefficiencies. We examine the renegotiation game associated with restrictive covenants and highlight a number of testable implications from the model.

Appendix (proofs of the propositions):

Proof of Proposition 1: The structure of the model with a binary public signal allows us to define the following values for the informed value of equity (debt) for a good (bad) firm:

$$S_G^I(F^L, w_2) = pGw_1(H - F^L) + (1 - p)Gw_2(H - F^L)$$

and

$$S_B^I(F^L, w_2) = pBw_1(H - F^L) + (1 - p)(Q - F^L) = pBw_1(H - F^L) + (1 - p)Bw_2(H - F^L),$$

where the second equality derives from the definition of $F^L = \frac{Q - w_2BH}{1 - w_2B}$.

Furthermore the uninformed equity value is written:

$$S^U(F^L, w_2) = p\bar{t}w_1(H - F^L) + (1 - p)(\theta Gw_2(H - F^L) + (1 - \theta)(Q - F^L)).$$

Similarly:

$$D_G^I(F^L, w_2) = pGw_1(F^L - L) + (1 - p)Gw_2(F^L - L) + L$$

$$D_B^I(F^L, w_2) = pBw_1(F^L - L) + (1 - p)(F^L - L) + L$$

$$D^U(F^L, w_2) = p\bar{t}w_1(F^L - L) + (1 - p)(\theta Gw_2(F^L - L) + (1 - \theta)(F^L - L)) + L$$

Then $Obj(F^L, w_2) = (p\bar{t}w_1(H - L) + (1 - p)(\theta Gw_2(H - L) + (1 - \theta)(Q - L)) - (I - L)) \times \frac{G}{t}$

Similarly we can write

$$Obj(L, w_2) = (p\bar{t}w_1(H - L) + (1 - p)(\theta Gw_2(H - L) + (1 - \theta)(Q - L)) - (I - L)) \\ \times \frac{pGw_1(H - L) + (1 - p)Gw_2(H - L)}{p\bar{t}w_1(H - L) + (1 - p)(\theta Gw_2(H - L) + (1 - \theta)(Q - L))}$$

Direct comparison shows that $Obj(F^L, w_2) > Obj(L, w_2)$ whenever $w_B^* = \frac{Q - L}{B(H - L)} > w_2$

which is assumed (i.e. it is efficient to liquidate the bad firm in a weak market).

Finally if we abuse notation and label $Obj(F, \text{eff})$ as the value of the good manager's objective function with a face value of debt equal to F and assuming efficient liquidation decision making by all firms (holding the time I decision making constant) a similar analysis shows this value increases to the point $F = Q$ and then remains constant for further increases in F .

Proof of Proposition 3:

Similar to the definitions in the proof of proposition 1 we can write:

$$Obj(Q, w_2) = (p\bar{t}w_1(H-L) + (1-p)\bar{t}w_2(H-L) - (I-L)) \times \frac{G}{t}$$

and

$$Obj(Q, w_1) = (p\bar{t}w_1(H-L) + (1-p)(Q-L) - (I-L)) \times \frac{G}{t}$$

It is straightforward to show that $Obj(Q, w_2) > Obj(Q, w_1)$ iff $\frac{Q-L}{t(H-L)} < w_2$. In other

words, if a high level of debt is chosen it is optimal to include an unrestrictive covenant if and only if it is efficient for a firm of average type to continue in a weak market. Similarly, it is optimal to include a restrictive covenant if and only if it is efficient for a firm of average quality to be liquidated in a weak market.

Proof of Proposition 4:

Direct comparison shows that $Obj(F^L, w_2) > Obj(Q, w_2)$ whenever $w_B^* = \frac{Q-L}{B(H-L)} > w_2$

and $Obj(F^L, w_2) > Obj(Q, w_1)$ whenever $w_G^* = \frac{Q-L}{B(H-L)} < w_2$. Both of these conditions

were assumed to hold. Intuitively the first inequality holds because if equity controls the liquidation in both weak and strong markets and a high debt level is chosen the inefficient

continuation of the bad firm in a weak market will be priced into the securities. The second holds because when the lender owns the liquidation decision in a weak market, the inefficient liquidation of the good firm in a weak market is priced into the securities.

Proof of Proposition 5:

Assume that a restrictive covenant has been included in an initial (time 0) debt contract with a face value $F = F^R < Q$, and that this covenant has been “violated,” $w = w_2$. Note that in order for a renegotiation offer, F^S , from a good firm to be separating it must satisfy a separation constraint: $Q - F^R \geq Bw_2(H - F^S)$. The offer F^S must also be acceptable to the lender, given that $w = w_2$ and the lender believes that the offer is made by a good firm: $F^R \leq Gw_2(F^S - L) + L$. If the renegotiation offer is at least as large as the maximum of these two constraints, it is rational for the lender to assume that it is a good firm making the offer and to accept the offer.

Examining the relation between F^S and F^R (see Figure 1) in these two constraints it is straightforward to show that if

$$Q > F^R \geq \frac{\frac{G}{B}Q - Gw_2H - (1 - Gw_2)L}{\frac{G}{B} - 1}$$

the best offer the good firm can make in a renegotiation of the violated covenant is such that the separation constraint $Q - F^R \leq Bw_2(H - F^S)$ binds (bad firms will be indifferent between continuation and liquidation). If instead

$$F^R \leq \frac{\frac{G}{B}Q - Gw_2H - (1 - Gw_2)L}{\frac{G}{B} - 1},$$

then the lender’s willingness to accept the offer will constrain the choice of F^S and the lender is indifferent to accepting the offer while a bad firm strictly prefers to liquidate. It

is straightforward to show that the value of the good manager's objective function is strictly increasing in the initial debt level in this case and choosing F^R less than the value given in the right-hand side of this inequality is suboptimal.

Proof of Proposition 6:

The proof of this proposition comes simply by writing the objective function for the manager of a good firm for an arbitrary F^R and assuming that a renegotiation offer will be made by a good firm, when a weak market is realized, that leaves the bad firm indifferent between liquidation and mimicking the good firm's offer. It is straightforward to show that this objective function is not dependent upon the initial choice of F^R . The value of the objective function for a manager of a good firm is, for an arbitrary F^R and the associated $F^S(F^R)$ given renegotiation of the covenant if $w = w_2$, written as:

$$Obj(F^R, F^S, w_1) = \left(\frac{p\bar{t}w_1(H-L) + (1-p)(\theta gw_2(H-L) + (1-\theta)(Q-L)) - (I-L)}{p\bar{t}w_1(H-F^R) + (1-p)(\theta Gw_2(H-F^S) + (1-\theta)(Q-F^R))} \right) \times (pGw_1(H-F^R) + (1-p)Gw_2(H-F^S))$$

Imposing the requirement for separation by substituting $Q - F^R = Bw_2(H - F^S)$ into the denominator of the first term allows us to write the objective function as:

$$Obj(F^R, F^S, w_1) = (p\bar{t}w_1(H-L) + (1-p)(\theta gw_2(H-L) + (1-\theta)(Q-L)) - (I-L)) \times \frac{G}{\bar{t}}$$

which is independent of F^R . Finally, direct comparison shows that

$$Obj(F^R, F^S, w_1) = Obj(F^L, w_2) \text{ when } F^R \text{ is established by the separation constraint.}$$

Proof of Proposition 7: Any separating renegotiation offer in a weak market of an unrestrictive covenant must satisfy three constraints. The offer $F^S(F^U)$ must be large enough that the lender will accept it, believing that a bad firm is making the offer:

$F^S \geq Bw_2(F^U - L) + L$, the lender constraint. The offer must not include a large enough reduction in the debt burden that in a weak market a good firm will find it attractive to mimic: $Gw_2(H - F^U) \geq Q - F^S$, the separation constraint. For any initial F^U the separating take-it-or-leave-it offer F^S made by a bad firm will be equal to the greater of these constraints (written as equalities). (These constraints are lines C and A respectively in Figure 2.) Finally F^S must represent enough of a reduction in the debt burden that the bad firm is willing to make the offer in a weak market: $Q - F^S \geq Bw_2(H - F^U)$, bad firm participation constraint. Following the analysis developed above it is straight forward to demonstrate that if the renegotiation offer satisfies either the lender constraint (the relevant constraint if the initial debt level, F^U , is relatively low) or the separation constraint the value of the good manager's objective function is strictly less than the relevant benchmark $Obj(F^L, w_2)$. When the renegotiation offer F^S as a function of the initial debt level F^U exactly satisfies the bad firm participation constraint it can be shown that the value of the good manager's objective function exactly equals $Obj(F^L, w_2)$ for any initial choice of F^U .

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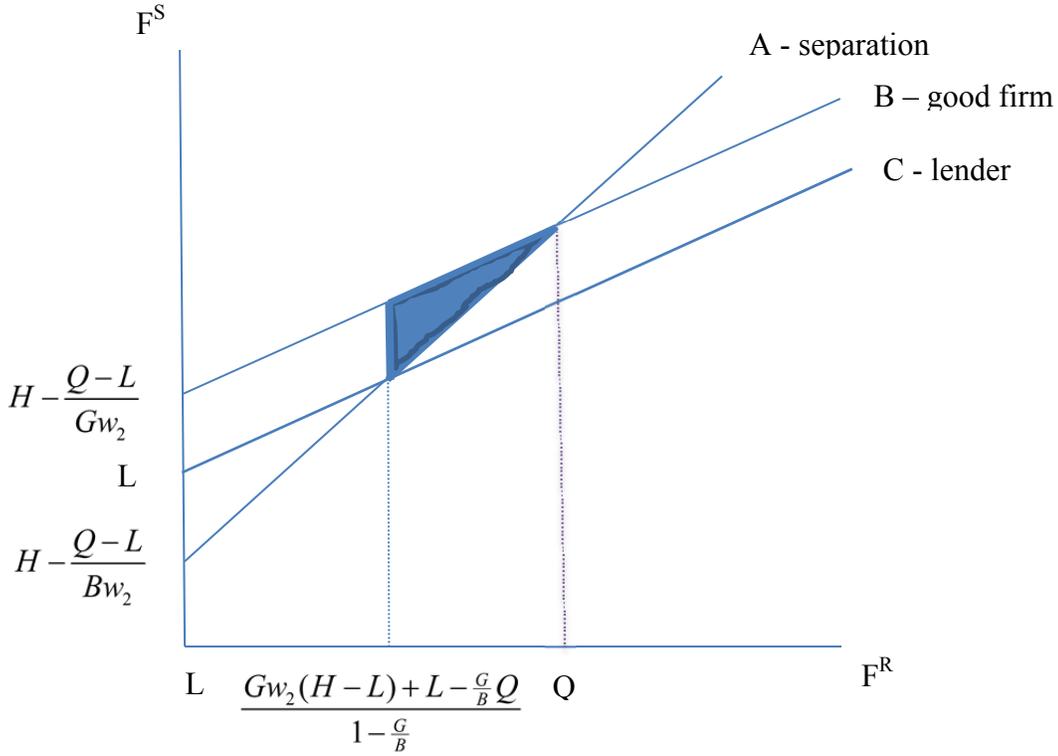
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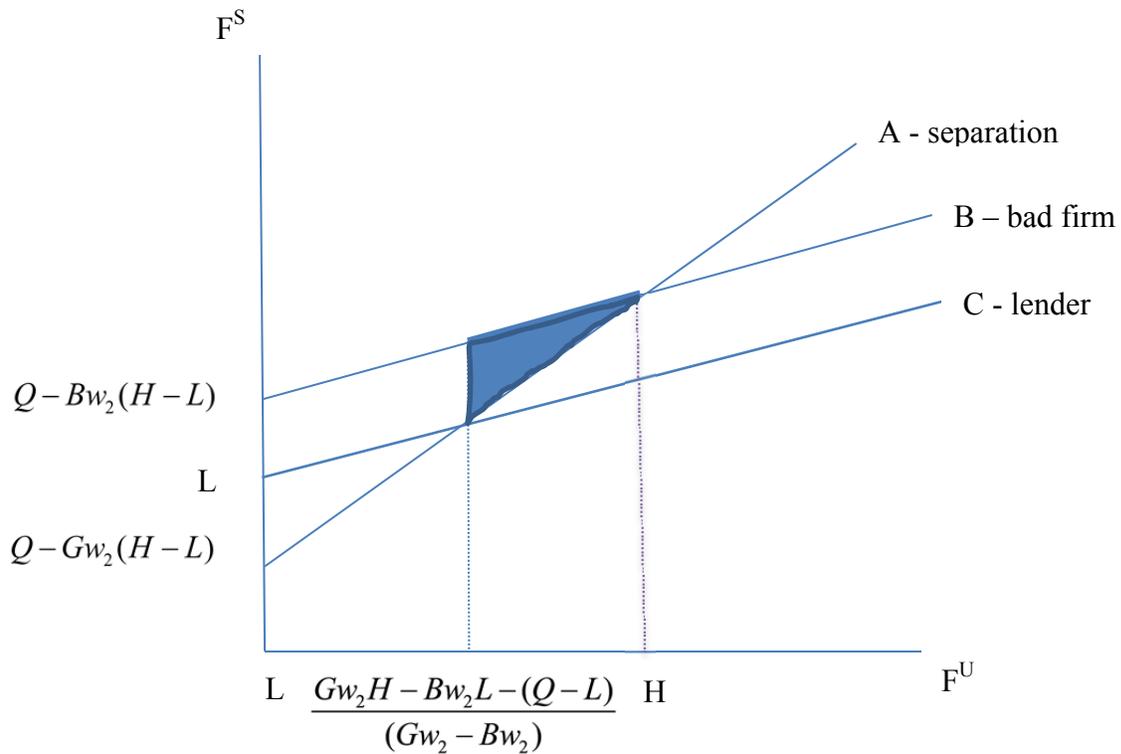
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Figure 1: Renegotiation of restrictive covenants.



Line “A” represents the “separation” constraint, and identifies the necessary renegotiation offer of a new face value, for each initial level of face value with a restrictive covenant, F^R , for which the bad firm will be indifferent between mimicking the offer and accepting liquidation with a debt level F^R . For any renegotiation offer by a good firm in a weak market to separate good firms from bad the offer must include a face value greater than or equal to this constraint. Line B represents the maximal offer, F^S , of an increase in debt burden that the good firm is willing to make for each initial debt level, F^R . Line C represents the minimal increase in debt level the lender is willing to accept in exchange for waiving the covenant when the lender believes it is a good firm making the offer. The shaded triangle represents the renegotiation region and its bottom edge represents the set of optimal choices from the good firm’s perspective.

Figure 2: Renegotiation of unrestrictive covenants.



Line “A” represents the “separation” constraint, and identifies the necessary renegotiation offer of a new lower face value the bad firm may make, for each initial level of face value with a restrictive covenant, F^U , for which the good firm will be indifferent between mimicking the offer and continuing with a debt level F^U . For any renegotiation offer by a bad firm in a weak market to separate bad firms from good the offer must include a face value greater than or equal to this constraint. Line B represents the minimum offer, F^S , of a decrease in debt burden that the bad firm is willing to make in exchange for a voluntary liquidation for each initial debt level, F^U . This line represents the renegotiation offers that give all rents to the lender. Line C represents the maximal decrease in debt level the lender is willing to accept in exchange for a liquidation when the lender believes it is a bad firm making the offer. The shaded triangle represents the renegotiation region and its top edge represents the set of optimal choices from the good firm’s perspective.

Figure 3a: Value of the objective function for a good type manager against different levels of Q . Other parameters of the problem are held constant: $H = 4$, $L = 1$, $\underline{w} = 0.15$, $\bar{w} = 1.2$, $\theta = 0.5$, $G = 0.75$, $B = 0.60$, and $I = 1.25$.

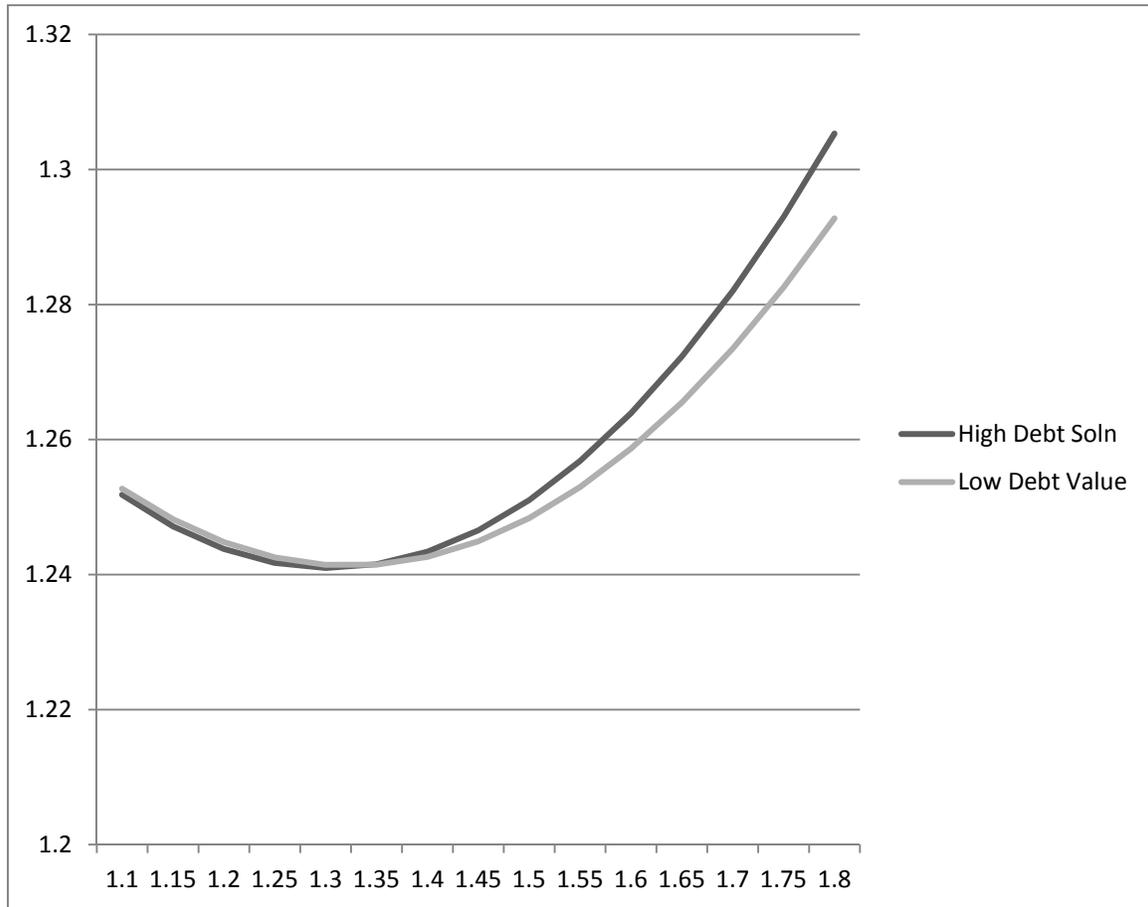


Figure 3b: Numerical representation of the relation between Q and F^L . Parameter values are as reported in Figure 1a.

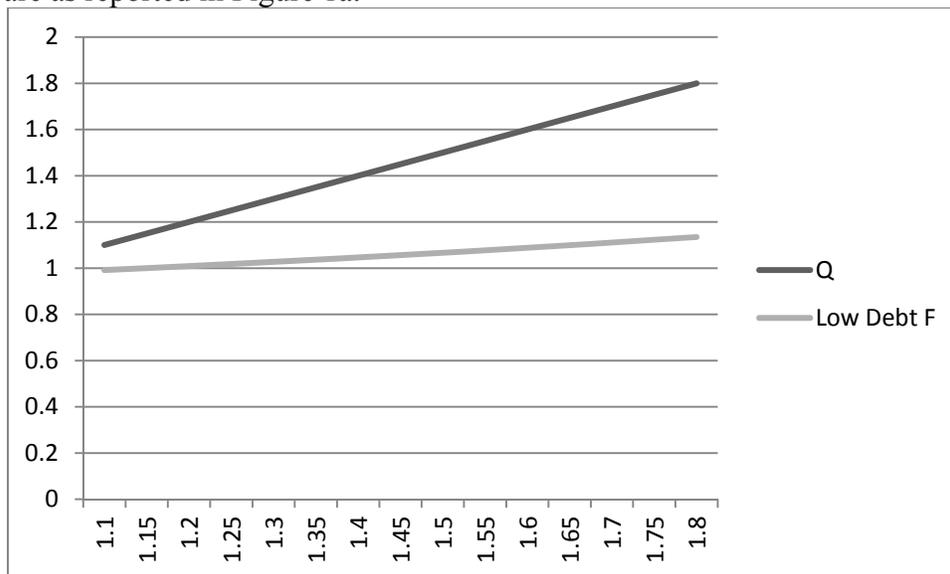


Figure 4a: Manager's objective function against Q for the parameter values used in Figure 1a except that $\theta = 0.3$.

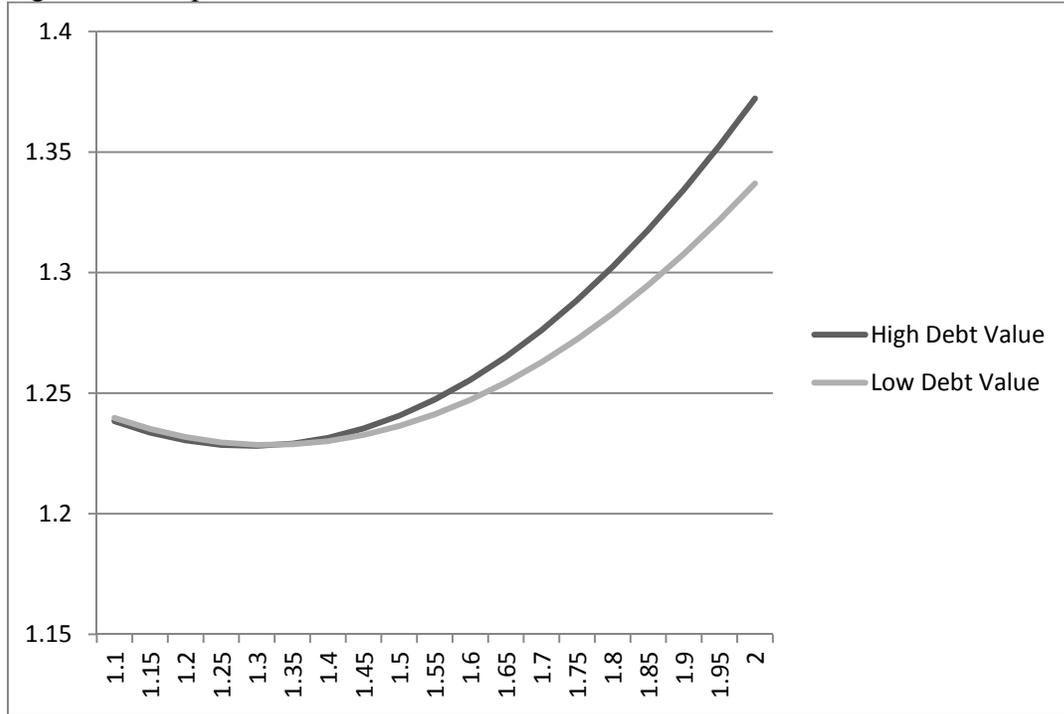


Figure 4b: Manager's objective function against Q for the parameter values used in Figure 1a except that $\theta = 0.8$.

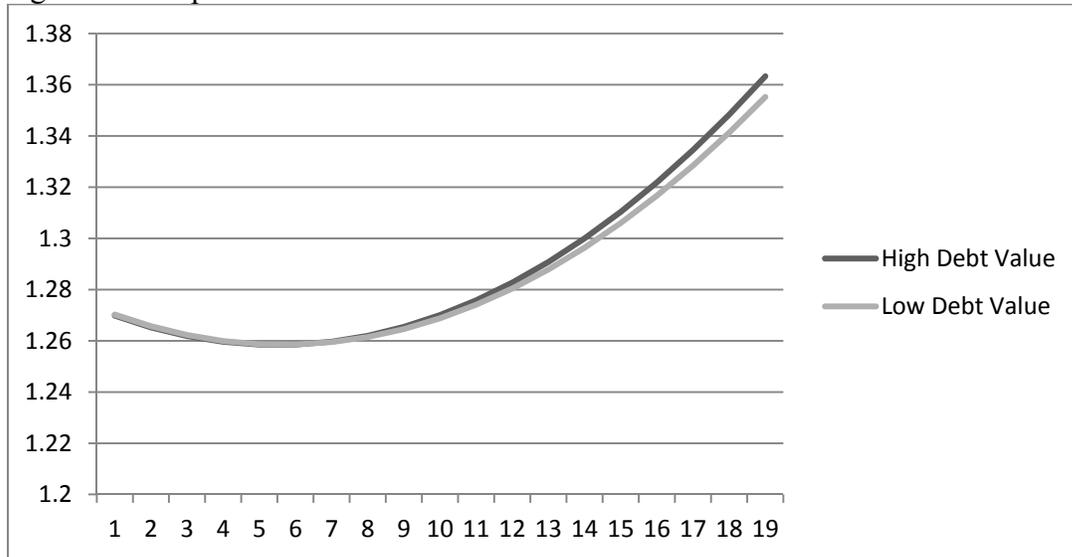
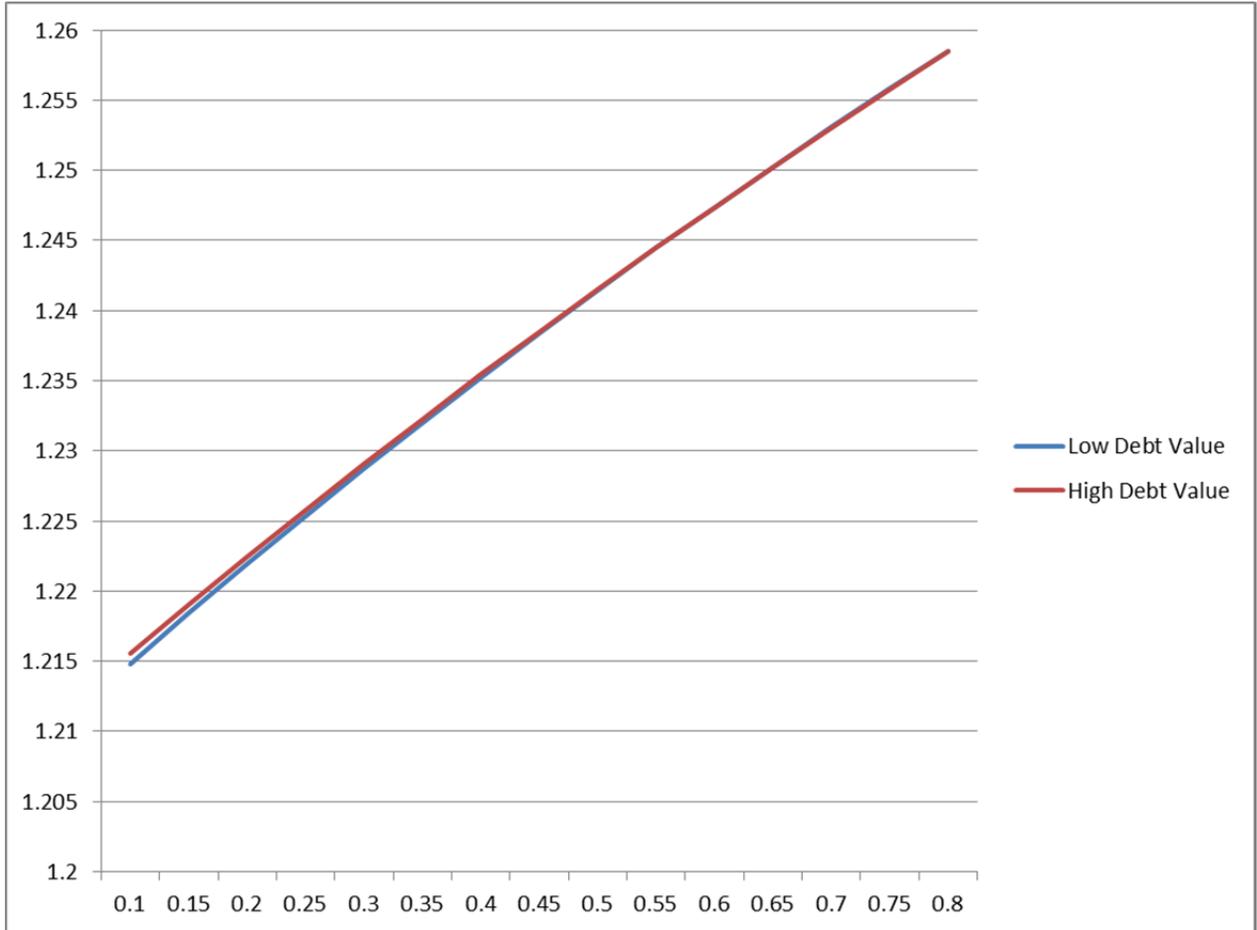


Figure 5: Manager's objective function value versus θ .



While difficult to identify visually, the figure shows that for low levels of the unconditional probability of a good firm (θ) the high debt solution with a restrictive covenant dominates the low debt, unrestrictive covenant. For high levels of θ the reverse is true, low debt levels and an unrestrictive covenant offer a superior debt structure.