PERFORMANCE SENSITIVE DEBT – THE EFFECT ON RENEGOTIATIONS, LEVERAGE, AND DIVIDEND POLICY

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ABSTRACT

Performance sensitive debt (PSD) contracts link the paid interest rate to a measure of firm performance. Using a simple trade-off model incorporating optimal leverage, endogenously determined debt renegotiations, and PSD, I show that firms using PSD would choose to renegotiate their debt earlier compared to firms using regular fixed rate debt. In other words, debt that makes a firm pay higher interest rates in times when cash flow is low, increase the probability of renegotiation. My result challenges the hypothesis that PSD contracts are used to prevent renegotiations, and supports recent empirical findings by Roberts & Sufi (2009). The model also provides testable predictions on dividend policies and leverage.

I. INTRODUCTION

Performance sensitive debt (PSD) contracts link the coupon paid on a firm's debt to a variable measuring its credit relevant performance. A typical PSD contract will trigger increased coupon payments when firm performance deteriorates and decreased coupon payments when firm performance is better. The two most commonly used categories of credit performance measures are either based on accounting measures[2] or firm credit ratings. Since the mid 1990's performance sensitive features in both private and public debt are common. For example Roberts & Sufi (2009)

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[2] A widely used measure is a firm's debt/CF ratio. Other examples include interest coverage ratio and leverage.

reports that 73% of loans in their sample include PSD features. Market participants indicate that more than 50% of recently issued syndicated bank loans in Europe include such features.

One of the main explanations for why PSD might be an efficient financing tool is found in Asquith, Beatty & Weber (2005). They hypothesize that contracts which determine ex ante how interest rates should vary if firm performance changes would be less prone to costly renegotiations. More specifically, if a firm accept fixed rate debt today and experience ex post improvement in credit quality, it would have incentives to engage in renegotiations to obtain better loan terms, e.g., reduced interest rates. If the same firm experience ex post deterioration in credit quality, the lender would have incentives to renegotiate the terms of the loan to obtain higher interest rates to compensate for the increased riskiness of the borrower. Intuitively, if a loan contract contains a predetermined schedule stating that interest rates should vary with borrower credit quality, the incentives for renegotiations are reduced, or maybe even eliminated. Asquith et al. (2005) find that PSD features tend to be used more often when the number of lenders in a syndicate is high. Using the number of syndicate members as a proxy for renegotiation costs, they claim that this finding supports their hypothesis.

Contrary to this finding, a recent paper by Roberts & Sufi (2009) comes to the opposite conclusion. Using a dataset of more than 1,000 private credit agreements they find that loans containing performance sensitive features are more likely to be renegotiated than regular fixed interest rate loans.

This paper aims to develop a theoretical model to study how the use of PSD would affect the incentives for the contracting parties to engage in renegotiations. I have tried to keep the model as simple as possible, yet rich enough to come up with sharp predictions that can be tested empirically. For this purpose I use a trade-off model similar to the one in Leland (1994), where the optimal capital structure of a firm is set by trading off tax advantages of debt with bankruptcy costs. Furthermore, I incorporate debt renegotiations using the same renegotiation game as Fan & Sundaresan (2000). The model predicts that firms using PSD would be more likely to renegotiate their debt compared to firms using fixed rate debt. Hence my theoretical findings support the empirical findings of Roberts & Sufi (2009). In addition, my model predicts that firms using PSD would optimally choose lower leverage and more restrictive dividend policies, i.e., choose a lower payout ratio[3].

My paper is related to the broad literature on static and dynamic optimal capital structure models, pioneered by the seminal work of Fischer, Heinkel & Zechner (1989) and Leland (1994), and further developed by, e.g., Goldstein, Ju, & Leland (2001). The paper is closely related to this strand of the literature incorporating debt renegotiations and strategic debt service[4]. The paper is also related to the rather small, but growing literature on performance sensitive debt. Important contribution on this field is Asquith et al. (2005), Lando & Mortensen (2004), Houweling, Mentink, & Vorst (2004), Bhanot & Mello (2006), Koziol & Lawrenz (2009), Tchistyi, Yermack & Yun (2010) and Manso, Strulovici & Tchistyi (2010).

II. THE GENERAL SET-UP

I consider a model similar to the one presented in Manso et al. (2010), which is a generalization of the classical models in Fischer et al. (1989) and Leland (1994). Following Goldstein et al. (2001) a firm generates cash flows at a rate ξ_t, at each time t. I assume that the dynamics of ξ_t, under the physical probability measure P is specified by the following geometric Brownian motion (GBM):

$$d\xi_t = \mu\xi_t dt + \sigma\xi_t dW_t, \tag{1}$$

Where μ and σ denote the drift and the volatility of the cash flow process, respectively. Here dW_t is the increment of a standard Brownian motion.

Agents are risk neutral and discount future cash flows at the constant risk free interest rate r. Thus, the time t total value of the firm V_t is given by the total discounted value of all future cash flows

$$V_t = E_t\left[\int_t^\infty e^{-r(s-t)}\xi_s ds\right] = \frac{\xi_t}{r-\mu}, \tag{2}$$

Which is finite if $\mu < r$. From (2) we see that V_t only depends on the current cash flow ξ_t, implying that V_t also is a GBM with the same drift μ and the same volatility σ, i.e.,

$$dV_t = \mu V_t dt + \sigma V_t dW_t. \tag{3}$$

[3] This last result is depending on the values of input parameters. In Figure 2 I show that for reasonable parameter values, one might get situations where it is optimal for the firm to pay out zero dividends.

[4] See, e.g., Fan & Sundaresan (2000) and Christensen, Flor, Lando, & Miltersen (2002).

From (2) it is easy to see that the asset level V_t is monotonously increasing in the current cash flow ξ_t.

A performance sensitive debt (PSD) obligation is a claim on the firm that promises a non-negative payment rate which vary according to some credit relevant measure of firm performance. A performance measure π_t can, in theory, be any statistic measuring the firm's ability and willingness to serve its debt obligation in the future. However, accounting-based measures[5] and credit ratings are by far the most commonly used performance measures. Formally, a PSD obligation specifies a coupon scheme such that the firm pays $C(\pi_t)$ to its creditors at time t.

In this model, the current cash flow ξ_t, or equivalently the current asset level V_t is the only state variable. Any measure of a firm's credit quality is, thus, determined solely by V_t, and so V_t itself can be used as the performance measure. In other words, the coupon scheme of the PSD obligation is given by some function $C(V_t)$[6]. The function $C(\cdot)$ can in principle have any functional form, and, thus, this formulation is quite general. In this paper I will assume that $C(\cdot)$ is linear. This simplifies the procedure of solving the model and makes the analysis more transparent.

A. The Model

I assume that the firm's asset value V_t follows a diffusion process under the equivalent probability measure Q specified by

$$dV_t = (r - \delta)V_t dt + \sigma V_t dW_t. \tag{4}$$

This is the same process as in expression (3), but now the drift μ is equal to $(r - \delta)$. The drift term under Q shows that the total growth rate of the firm is equal to the risk-free rate r, gross of all payouts. The total cash payout rate is equal to δ, so the firm's assets have a net growth rate of $(r - \delta)$. In this specification δ is equal to the sum of all dividend payments made by the firm. Note that it suffices to assume $\delta > 0$ to ensure that equation (2) is valid.

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[5] Financial ratios such as debt/cash flow and interest coverage is widely used. See, e.g., Mjøs, Myklebust & Persson (2012) for an overview.

[6] Manso et al. (2010) use the term asset-based PSD on this type of debt obligations.

I consider a firm which has a very simple capital structure consisting of equity and a single issue of a perpetual PSD obligation[7]. The PSD obligation specifies a linear coupon scheme given by a function

$$C(V_t) = c - \gamma V_t c, \tag{5}$$

where $c > 0$ denotes the coupon rate, V_t is the current asset level, and γ is some ex ante determined constant that governs the performance adjustment rate of the contract. A large γ implies the PSD obligation is more performance sensitive. A $\gamma = 0$ is equal to regular fixed interest rate debt[8].

I further assume that the firm is entitled to a tax benefit of debt equal to $\tau C(V_t)$, where τ is the corporate tax rate. This tax benefit is the only reason for issuing debt in this model. However, issuing debt also introduce a bankruptcy cost assumed to be proportional by the factor α to the firm value at default. Equityholders trade off tax benefits of debt and bankruptcy costs to determine the optimal capital structure. The risk free rate r is assumed to be constant, and equityholders are not allowed to sell assets to make coupon and dividend payments.

At time zero the firm will be optimally levered. When future realizations of the firm value are known equityholders may find that the initial leverage is sub-optimal. I therefore allow for the possibility that equityholders may renegotiate their debt at a lower barrier V_s [9]. The barrier V_s is endogenously determined by the equityholders.

B The Renegotiation Barrier

Assume that debt is issued at time zero when the value of the firm's assets is V_0. If the asset process hits the lower boundary V_s, equity holders want to renegotiate the debt to avoid bankruptcy. As in Fan & Sundaresan (2000) renegotiations could potentially result in either a debt-equity swap[10] or strategic debt service[11]. To keep the analysis simple and

[7] The model may be generalized to finite maturity debt and several layers of debt. This, however, complicates the analysis substantially and is left for future research.

[8] Note that this coupon scheme is not consistent in the sense that there is a positive probability that $C(V_t) < 0$. It is however possible to make this probability arbitrarily small by carefully choosing γ small enough.

[9] Although not included in this paper, one could also consider renegotiation at an upper barrier V_u as in Christensen, Flor, Lando, & Miltersen (2002).

[10] A debt-equity swap essentially means that debtholders are offered a proportion of the firm's equity to replace their original debt contract.

tractable I will only focus on the debt-equity swap in this paper[12]. The renegotiation game is the simple Nash bargaining game used in Fan & Sundaresan (2000). At V_s debt- and equity holders bargain over the value of the assets $V(V_s)$. I assume that the parties divide the assets according to a linear sharing rule[13], i.e.,

$$E(V_s) = \theta V_s \qquad D(V_s) = (1-\theta)V_s, \qquad (6)$$

where $E(\cdot)$ and $D(\cdot)$ denote the value of equity and debt, respectively, and where θ determines the fraction of the asset value going to each of the claimants.

Denote the relative bargaining power of equity holders by η, implying that the debtholders' bargaining power is equal to $(1-\eta)$ [14]. If the renegotiation fails, I assume that the firm is liquidated, implying that the equityholders receive 0, and debt holders receive $(1-\alpha)V_s$. In other words the disagreement point[15] is equal to $\left[0,(1-\alpha)V_s\right]$. The Nash solution θ^* is, thus, given by

$$\begin{aligned}\theta^* &= \arg\max\left[\theta V_s\right]^{\eta}\left[(1-\theta)V_s-(1-\alpha)V_s\right]^{1-\eta} \\ &= \eta\alpha.\end{aligned} \qquad (7)$$

The rationale for entering into renegotiations is to avoid that some third party runs off with the bankruptcy costs α. If $\eta = 1$ equity holders have all the bargaining power, and hence they receive the whole pie, equal to αV_s, whereas debt holders are left with the value they would have received if the firm was liquidated. In the opposite case, if debtholders have all the bargaining power $(\eta = 0)$, they receive the whole firm value V_s, whereas equity holders are left with nothing.

C. Optimal Renegotiation

In order to determine the optimal renegotiation boundary I first need to solve for the equity value $E(V)$ and debt value $D(V)$, where I simplify

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11 At the lower boundary equityholders will stop paying the contractually determined coupon and service debt strategically until the asset value again rise above the lower barrier.

12 The results in the paper does not depend on the choice of reorganization formulation.

13 A slightly more general approach would be to specify a sharing rule of the type $E(V_s) = \theta V_s + K$ and $D(V_s) = (1-\theta)V_s - K$. Adding the constant K complicates the analysis, without changing the conclusions.

14 I assume that η is exogenously given.

15 The value each of the contracting parties get if no agreement is achieved.

notation by letting V denote the current asset level. Following Merton (1974) it can be shown that equity- and debt value must satisfy the following ordinary differential equations:

$$\frac{1}{2}\sigma^2 V^2 E_{VV} + (r-\delta)VE_V - rE + V\delta - (c-\gamma Vc)(1-\tau) = 0, \tag{8}$$

$$\frac{1}{2}\sigma^2 V^2 D_{VV} + (r-\delta)VD_V - rD + (c-\gamma Vc) = 0. \tag{9}$$

The general solutions to (8) and (9) are given by

$$E(V) = V - \left(\frac{c}{r} - \frac{\gamma Vc}{\delta}\right)(1-\tau) + e_1 V^{x_1} + e_2 V^{x_2}, \tag{10}$$

$$D(V) = \left(\frac{c}{r} - \frac{\gamma Vc}{\delta}\right) + d_1 V^{x_1} + d_2 V^{x_2}, \tag{11}$$

where x_1 and x_2 are the roots of the corresponding characteristic polynomial

$$\frac{1}{2}\sigma^2 X(X-1) + (r-\delta)X - r = 0, \tag{12}$$

and $x_1 > 1$ and $x_2 < 0$, respectively. The constants $e_1, e_2, d_1,$ and d_2 can be determined by applying the appropriate boundary conditions:

$$\lim_{V\to\infty} E(V) = V - \left(\frac{c}{r} - \frac{\gamma Vc}{\delta}\right)(1-\tau), \qquad \lim_{V\to V_s} E(V) = \eta\alpha V_s, \tag{13}$$

$$\lim_{V\to\infty} D(V) = \left(\frac{c}{r} - \frac{\gamma Vc}{\delta}\right), \qquad \lim_{V\to V_s} D(V) = (1-\eta\alpha)V_s. \tag{14}$$

The upper boundary conditions state that when the asset value gets large, debt becomes riskless and hence equity value is just the firm value less the risk free debt. This condition implies $e_1 = d_1 = 0$. The lower boundary conditions state that when the asset value reaches the endogenous renegotiation boundary, equity and debt value must be equal to the firm value multiplied by the fraction of assets each claimant receive (cf. the result in (7)). Differentiating (13) with respect to V_s gives us the smooth pasting condition which helps us determine the optimal renegotiation boundary:

$$\frac{\partial E}{\partial V}\Big|_{V=V_s} = \eta\alpha. \tag{15}$$

Solving the model I find that the value of equity $E(V)$ and debt $D(V)$ are given by

$$E(V) = V - \left[\frac{c}{r} - \frac{\gamma Vc}{\delta}\right]\left(\frac{V}{V_s}\right)^{x_2}(1-\tau) + \left(V_s\alpha\eta - V_s\right)\left(\frac{V}{V_s}\right)^{x_2}, \tag{16}$$

$$D(V) = \frac{c}{r} - \frac{\gamma Vc}{\delta} - \left[\frac{c}{r} - \frac{\gamma V_s c}{\delta} - (1-\alpha\eta)V_s\right]\left(\frac{V}{V_s}\right)^{x_2}. \tag{17}$$

The optimal renegotiation boundary is given by

$$V_s = \frac{c}{r}\frac{x_2}{x_2-1}\frac{\delta(\tau-1)}{(\alpha\eta-1)\delta + c\gamma(\tau-1)}. \tag{18}$$

The total value of the firm $v(V)$ is now simply $v(V) = E(V) + D(V)$. I further assume that the capital structure of the firm is optimally chosen so that the firm value is maximized, i.e., the initial coupon c is determined from the following optimality condition:

$$\frac{\partial v(V)}{\partial c} = 0. \tag{19}$$

Condition (20) has no analytical solution, and I therefore turn to numerical procedures to solve it. Inserting the optimal coupon back into expression (18) we can now examine what effects the performance sensitive debt obligation have on debt renegotiation.

D. Numerical Results

In this section I present some of the results from the numerical solution of my model. I choose the base case parameters as follows: $r = 5\%, \sigma = 20\%, \tau = 35\%, \eta = 0.5, \delta = 2\%$. Choosing the parameter $\gamma = 0$, i.e., regular fixed rate debt, the optimal coupon is 5.6%, with a corresponding leverage ratio[16] of 70.6%. The endogenous optimal renegotiation barrier is 0.57. Making the debt contract performance sensitive by choosing $\gamma = 0.1$, I find that the optimal initial coupon is 6.8% with a corresponding leverage ratio of 67.8%. The optimal renegotiation barrier is now equal to 0.60.

[16] The leverage ratio is defined as the value of debt divided by the sum of debt and equity, i.e., D(V)/(D(V)+E(V)).

Figures 1 and 2 plot the leverage ratio and the optimal renegotiation boundary V_s for different values of the sensitivity parameter γ.

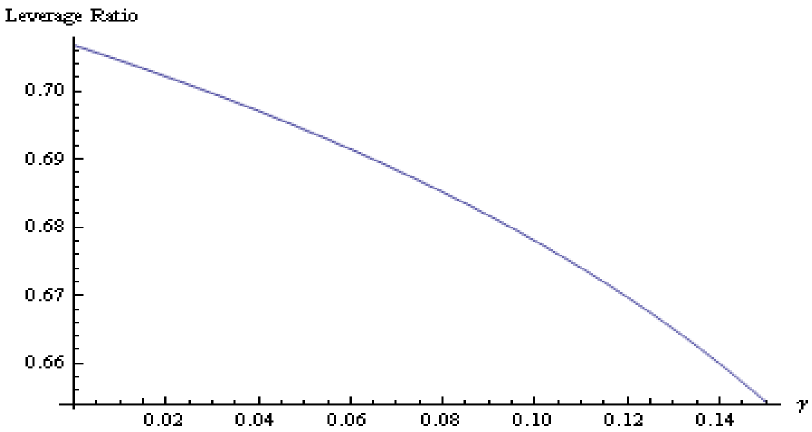

Figure 1: This figure shows how the optimally determined leverage ratio decreases when the performance sensitivity parameter increases.
Base case parameters: $r = 5\%, \sigma = 20\%, \tau = 35\%, \eta = 0.5, \delta = 2\%$.

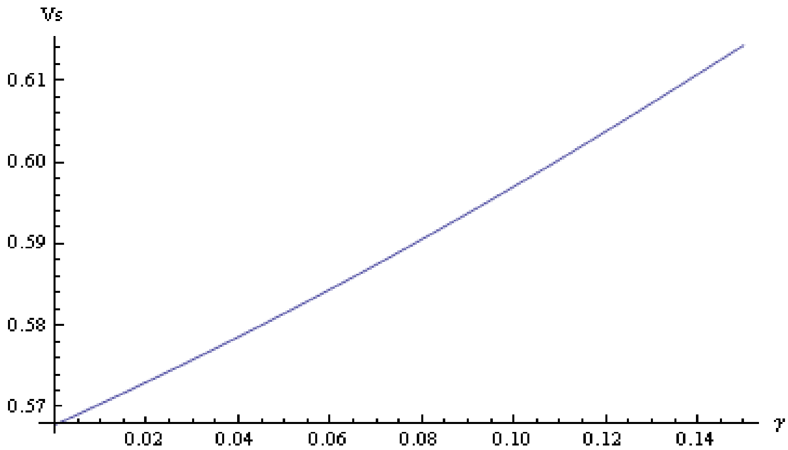

Figure 2: This figure shows how the optimally determined renegotiation boundary increases when the performance sensitivity parameter increases.
Base case parameters: $r = 5\%, \sigma = 20\%, \tau = 35\%, \eta = 0.5, \delta = 2\%$.

The plots clearly show the main point in this paper. Including performance sensitivity in the debt contract is costly for the borrower since he faces the risk of having to pay higher interest rates in times when cash flow is low. This cost makes him choose a lower optimal leverage. The lower leverage is however, not enough to prevent the fact that the higher interest rates in bad times incentivize the borrower to engage in earlier renegotiations compared to what he would do when using regular fixed rate debt[17]. This result supports the empirical findings of Roberts & Sufi (2009).

As an additional analysis I want to briefly look at how equity value is related to the performance sensitivity parameter and the payout parameter δ. Intuitively, one would expect that the threat of having to pay increased interest rates when using PSD could make the firm more reluctant to pay dividends. This is so since a higher dividend ratio lowers the drift of the firm's assets and therefore increases the probability of paying higher interest rates. Figure 3 clearly shows that for $\gamma > 0.1$ the value of equity decreases in δ, suggesting that PSD might be used to enforce conservative dividend policies[18].

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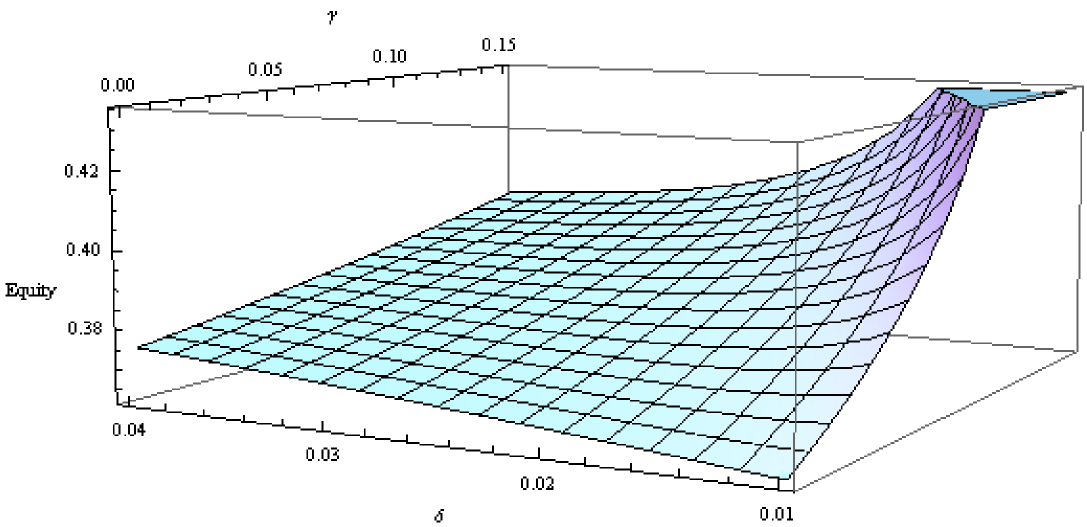

Figure 3: This figure shows how the equity value relates to the performance sensitivity parameter γ, and the payout parameter δ. Note that already for relatively small values of γ the optimal dividend policy is to pay zero dividends. Base case parameters: $r = 5\%, \sigma = 20\%, \tau = 35\%, \eta = 0.5, \delta = 2\%$.

[17] Saying that the renegotiation barrier is higher when using PSD is equivalent to saying that renegotiations would occur more frequently, or that renegotiations is more likely, when using PSD rather than fixed rate debt.
[18] Note that this result is parameter dependent, since a value of γ close to 0 still make the debt contract performance sensitive, but here the equity value is decreasing for decreasing values of δ.
[19]

III CONCLUSION

I have presented a simple trade-off model incorporating debt renegotiations and performance sensitive debt (PSD). When equityholders optimally choose the capital structure of the firm, as well as the renegotiation barrier, I have shown that firms using PSD would have incentives to engage in earlier debt renegotiations compared to firms using regular fixed rate debt. The result questions the finding of Asquith et al. (2005) that PSD contracts should prevent renegotiations, and supports the result of Roberts & Sufi (2009) that PSD contracts are renegotiated more often than regular debt contracts. The model also predicts that firms using PSD would have lower leverage ratios and more conservative dividend policies.

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