CAPITAL STRUCTURE AND SHORT-TERM DECISIONS

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ABSTRACT

Share price pressure can lead to managerial myopia as managers face incentives to make short-run decisions as modeled in Stein (1989). We show how long-run debt can negate myopic behavior by serving as an incentive to have high future earnings in order to avoid the risk of costly bankruptcy. The model shows how increases in leverage were a signal in response to growing share price pressure in the 1980s. It yields a theory of capital structure whose predictions are in line with recent empirically observed patterns, unlike the previous signaling models such as those of Myers and Ross. The model also predicts the recent series of corporate bankruptcies, and it demonstrates the benefits of high bankruptcy penalties in inducing efficient decision making. It then show how debt may, ex post, lead to inefficient decisions being taken in an effort to pay it off. This ex post consequence of debt can potentially undermine its ex ante incentive benefits.

INTRODUCTION

The 1980's was a decade which witnessed great changes in the financial structures and practices of most U.S. and U.K. corporations. The takeover boom led to great stress being placed on share prices and short-term earnings. In tandem with this trend, most large corporations made major changes in their capital structures, taking on substantial amounts of long-term debt or "leverage". Ultimately this led to a wave of corporate bankruptcies as firms struggled to make the debt payments. This paper is an attempt to reconcile these two patterns, by showing how such increases in debt were a response to the growing awareness and fears about the overemphasis on short-term earnings.

Stock prices have always been important for managers in the U.S. and the U.K.; surveys have found that managers consistently rate current stock prices as being among the most important factors to them. It seems probable that in the 1980s they became even more important, partly due to the great rise in the occurrence of hostile takeovers. There are many competing explanations for the takeover wave[1], but the most likely initiating factor was the lax antitrust enforcement of the Reagan and Thatcher administrations, coupled with the new techniques in finance instituted in the 1980s. Studies have shown that firms with current stock prices that were considered "high" were unlikely to be takeover targets, while firms whose prices were deemed to be "low" tended to be at high risk (Shleifer and Vishny (1988)). Managers almost uniformly regarded takeovers as unpleasant and sought to keep share prices high in

order to deter them. This was put very clearly by CEO and investor Warren Buffet in Coffee et al (1988):

"There are two impenetrable defenses, and one is to own half or close to half of whatever stock votes in the company ..... the other way is to have your stock sell at a price above its negotiated business value".

Stock prices were very sensitive to earnings announcements, so if the manager wanted a high stock price she had better make sure that current earnings were high.

This has led some economists to propound the idea that such stock price pressure leads to inefficiency. Stein (1989) and Narayanan (1987) both developed models in which the importance of having high stock prices led to managers taking actions not in the long-run interest of the firms. Essentially, the manager has an incentive to inflate current earnings by "borrowing" earnings from future periods. This is an attempt to convince the market that future earnings (of which current earnings are an important predictor) will be high. This can take a number of forms such as cutting investment or assigning less money to R & D, and is in general assumed to occur gradually over a period of time. Such borrowings are generally not in the long-term interest of the firm, as next period earnings fall by an amount greater than the amount borrowed. Crucially, the market, understanding the firm's incentive structure, treats current earnings with skepticism. In equilibrium, it correctly anticipates the amount "borrowed" and discounts future earnings by the amount to be paid back, which reduces the actual stock price. The manager is in a cleft stick; given the markets belief, the optimal response is in fact to "borrow" the equilibrium amount.

Such short-term behavior has received a tremendous amount of attention in both the U.S. and the U.K. in the last 10 years. A substantial number of academics and economic commentators share the belief that the financial systems in both countries forces managers to take decisions which are not in the best long-term interest of the firm. The continued economic progress and high levels of investment enjoyed by countries such as Germany and Japan has prompted speculation that the type of financial system in those countries - characterized typically by a much greater participation by banks, and a high degree of long-term partnership with lending institutions - is more conducive to continued growth. This has led to many calls for some kind of reform of the stock market in the Anglo-Saxon countries lest it lead to continued examples of managerial shortsightedness.[2] This phenomenon of "managerial myopia" (as it has come to be known) assumes totally rational agents; neither firm nor market act irrationally. However, in order to reach the Pareto-superior outcome the parties must be known to be punished for any defection. In our model, debt provides the punishment.

As stated above, most U.S. firms took on large amounts of long-term debt. Taggart (1988) discusses how yearly issues of new debt rose from $41.6 billion in 1980 to $120 billion in 1985. Hall (1991) documents the debt changes within different industries - see her NBER working paper for details. Leverage increased across all industries, but some industries tended to take on much more debt than others. Within industries there was little variation in leverage; firms considered to be of poor quality tended to take on just as much debt as high quality firms. The debt was uniformly long-term rather than short-term, and crucially, share prices showed clear evidence of rising after a firm took on its debt. Debt levels in the U.K. did not rise by quite as

much as in the U.S., yet there was still clear evidence of higher debt levels and increased takeover activity going hand-in-hand. Many authors, notably Jensen (1977, 1986) regarded such debt as unambiguously beneficial. Such theories saw managers as inherently wasteful; being forced to take on debt was the only way to prevent them engaging in wasteful forms of expenditure. Stock market pressure was viewed as a positive force in that it forced managers to keep earnings high or risk being taken over. Managerial myopia advocates were wary of debt arguing that it forced managers to take further short-term actions.

In this paper I argue that long-term debt is essentially a commitment to having high earnings in the future. Given bankruptcy is costly to managers, they signal by taking on sufficient debt to indicate to the market that they will not borrow from the future because of the extra risk of bankruptcy it would entail by the lowering of future earnings. The publicly observable nature of debt, and the legal forfeiture of control by the managers in the event of a default serve to ensure a commonly known and enforceable punishment. Equilibrium debt levels are determined by the structural characteristics of the firm, and the market reacts to both the firms debt level and its earnings reports.

This argument is different from the "free cash flow" theory which assumes the inherent wastefulness of managers, and the need for debt to control them. The problem here is just a commitment problem: managers may have good intentions but commonly known utility functions force them to take inefficient actions in the absence of a commitment device. The model yields a set of potentially testable predictions about firms debt levels. In firms with similar characteristics, stock prices where the firms issue debt are higher than prices where the firm is all equity-financed

- this is borne out by the evidence, but it becomes a question of how much debt firms with different characteristics will issue. As current stock prices became more important, debt levels rise; this is in accord with our interpretation of events in the 1980's. Debt also is found to be lower in firms with high variance in earnings, which again is in accord with empirical evidence. Debt levels are similar for firms within similar structural characteristics; firms perceived as performing "well" do not necessarily take on more debt than those performing "poorly". This is a departure from previous signaling models of capital structure and seems more in tune with the empirical patterns of the 1980s which witnessed rising debt levels among nearly all firms in a given industry [3]. Our model in unlike most previous models of debt structure in that it has stock prices reacting to both earning announcements and rises in firm debt levels - this is a departure from the literature started by Ross (1977), where a firm signaled its value entirely through its debt level. Signaling with debt may be costly however, (at least for the manager) as positive debt levels lead us to positive bankruptcy probabilities. Gilson (1989) presents evidence that managers of firms that do go into financial distress tend to be fired by the new controllers and have difficulties in finding new employment at a similar level. In our model, managerial myopia is still harmful as it leads ultimately to some needless bankruptcies. The sharp recession of the early 1990's did, in fact, witness many defaults on the large amounts of debt taken on some years before. Note however, that the higher the penalties for bankruptcy, the lower the debt levels required to enforce the correct actions. This suggests that from an incentive perspective, laws which strengthen the ability of bondholders to dismiss managers will be of help.

While debt may have some positive ex ante effects, it may, once taken on, have potentially negative effects. When the debt becomes due and there is a positive probability of default, the manager may engage in further short-term actions in order to pay off the current amount. Potential scenarios include firms engaging in panicked "fire-sales" in order to make a debt payment due in a few days time - a practice that certain major U.S. department stores have indulged in more than once !

The model falls within the ambit of hidden action or signal-jamming models where the firm has no informational advantage over the market, but can take actions that are hidden. In a later section we consider the model when the firm knows its type and the market does not. Hidden type models where debt is a signal have been developed extensively; see Myers (1984), Ross (1977). In such models high quality firms signal their type by taking on debt, while low quality firms find the risk of bankruptcy too costly to imitate them. However, a key point is that these predictions do not seem to accord to empirical patterns. Nearly all firms, profitable or not, in the same industry tend to take on similar levels of debt, while profitable firms in industries with different structural characteristics may take on a much lower level of debt. These models also predict that successful firms are as likely to go bankrupt as bad ones. This does seem in accord with empirical reality, (see Gilson 1992); in our model poorly-performing firms within an industry are more likely to default. Thus the large literature on models which use debt to signal quality does not seem to be an appropriate tool for analyzing the experiences of the '80s, and a set of models designed to indicate the near-unanimous increase in debt among firms of both high and low quality seems more relevant.

There are clearly many other reasons why firms may change their capital structure. They include potential tax advantages of debt, and the desire to concentrate voting shares in managerial hands to ward off potential takeovers as in Harris and Raviv (1988). Such reasons are very important but should not detract from the role that signaling might play. And unlike some models of debt, we assume that it is the managers who choose the level of debt. This seems far more in accord with reality than models which have the shareholders, presumably through the directors, choosing the optimal level of debt to discipline the managers. The capital structure changes that did take place were typically initiated by the managerial team, rather than by a widely dispersed group of shareholders who communicate their wishes through a group of directors.

Some other approaches to this problem have sought to correct it by designing managerial contracts which induce the correct behavior, see for example, Hagerty, Ofer and Siegel (1992). Such approaches are clearly valuable and might lead one to question why such structures as debt are used at all if they are not necessarily the optimal contract. A full answer to this question is outside the scope of this paper, but we will mention some reasons which cause one to question the efficacy of managerial incentive contracts in this context. Managerial contracts may not be enforceable as it is often difficult to contract on measured earnings. This problem led to an increase in the number of share options given to managers, and particularly options that were not redeemable until some specified time in the future. However, incentive schemes are often not public knowledge, which is absolutely crucial if the market is to be convinced. If the firms directors wish to avoid takeover (which tends to reflect poorly on the directors) the market will suspect that they will give the managers incentives to

have high current earnings. These objections do rely implicitly on the notion that directors are often not very good monitors of managers. However, I would claim that this is a not unreasonable characterization of many U.S. corporations. Directors are frequently appointed by the managers and may be reluctant to punish them. Bondholders, on the other hand, are not beholden to the managers and should have little hesitation in removing their control rights.

The paper is organized as follows. Section 2 sets up the model and demonstrates the incentive to take short-run decisions. Section 3 analyses the optimal debt level as a function of the parameters of the firm. Section 4 deals with the case where the manager knows her type. Section 5 examines the ex post incentive problems of debt and the product market behavior it gives rise to, while Section 6 briefly discusses the empirical issues and concludes. We prove the main results in a short appendix.

I. A SIMPLE TWO-PERIOD MANAGERIAL MYOPIA MODEL

In this section, we describe the structure of the model and demonstrate the incentive take short-run decisions. The approach chosen is similar to that of Stein, except that we constrain the model to be of two periods. Earnings in the first period are as follows:

$$e_1 = y_1 + u_1 \quad \text{where } y \in \{e_H, e_L\} \quad \text{and } e_H > e_L \tag{1}$$

The firms earning potential, or type, is either e_H or e_L. Both firm and market are unsure of the true type of the firm, and each have common priors denoted Pr(H) and Pr(L), which for simplicity we assume are both equal to .5. We also assume that the discount rate is zero, and that firms are remain the same type in the second period. We can write expected earnings as:

$$E(e) = (e_H + e_L)/2 = e_0 \tag{2}$$

Earnings in any period are also subject to a disturbance term, u, which is independent of y, and independently distributed from period to period with mean zero. The distribution of the disturbance term, which will depend on the structural characteristics of the industry in question, is assumed to be known by both the firm and the market. At the end of period 1 the firms earnings for that period become observable to both the firm and the market and the market assigns a stock price, P, to the firm based on its assessment of the firms quality and future earning power. The actual type of the firm is never directly observed by either the firm or the market, so, in any equilibrium, they must try and infer from period 1 earnings whether the firm is type H or type L. Given the earnings in period 1, the updated probabilities will be:

$$e_1 \text{ is observed and } Pr(H|e_1) = \frac{Pr(H)Pr(e_1|H)}{Pr(H)Pr(e_1|H) + Pr(L)Pr(e_1|L)} \tag{3}$$

In order to facilitate the analysis, we make specific assumptions about u_1, and assume it is uniformly distributed. Thus the earnings spread for type H will be U[a,b], while type L will have earnings coming from U[c,d]. In keeping with our assumption about similar variances: $d - c = b - a$. To make the analysis interesting, we

assume that $b > d > a > c$; in other words, first period earnings do not necessarily determine the type that generates them. The uniform distribution is chosen primarily because of its tractability, and when a different distribution might give slightly different results (e.g. a distribution with an unbounded support), we refer to it in what follows. At the end of the first period, earnings can fall into one of three areas, which lead the market to three possible conclusions about the firms type: (i) greater than d, and less than b, in which case the firm is definitely of type H, (ii) greater than a, but less than d, in which case the earnings signal is insufficiently precise and the firm could still be of either type, (iii) less than a, but greater than c, in which case the firm is of type L. We can thus write the ex ante expected price, P_1 as:

$$E(P_1) = Pr(H)[(b - d)/(b - a)]e_H + Pr(H)[(d - a)/(b - a)]e_0$$
$$+ Pr(L)[(d - a)/(b - a)]e_0 + Pr(L)[(a - c)/(b - a)]e_L = e_0 \qquad (4)$$

Each term can be expressed as the product of the ex ante probability that the firm is of that type, multiplied by the earnings level associated with a particular signal, multiplied by the probability of giving such a signal. Note that (b-d) = (a-c), which implies that the whole equation sums to e_0.

The manager's utility function is :

$$U_m = e_1 + \pi P_1 + e_2. \qquad (5)$$

Thus the manager cares about the firms earnings in both periods, but she also values the first period stock price. The variable, π, is a measure of how important stock prices are to the manager. Given this utility function, the managers ex ante expected utility is simply;

$$E(U_m) = e_0 + e_0 + \pi E(P_1). \qquad (6)$$

We now give the firm the option of taking a short-run action X. Essentially, this consists of taking quantity X of earnings from the second period and shifting them to the first period. In period 2, earnings fall by rX, where $r > 1$. Thus the action of borrowing funds from the second period is clearly inefficient, but the manager may choose to do so in the hope of raising first period earnings and inducing a higher stock price. Fundamental to the model is the assumption that such borrowings are unobservable to the stock market. Clearly, this will not be true for many aspects of firm expenditures or revenues, but may be so for areas such as human capital investment, client coverage etc. We note that X is a discrete quantity, and for simplicity, restrict the firms options to there only being one possible level of X they could choose. Again for simplicity, we also restrict X to being of a limited size; specifically X is less than (d-a). We also emphasize that X is chosen at the start of the first period, before any information about first period earnings have become available. Choosing X raises e_1 by X and raises the probability that the market will consider the firm to be of type H. Intuitively, the increased probability of being thought of as a type H firm will rise by the size of X, divided by the variance of earnings. In the appendix we show that the gain in expected first period price is:

$$X\,[e_H - ((e_L+e_0)/2)]/(b-a) \qquad (7)$$

Thus the gain in utility of choosing X is the above expression multiplied by π, the importance accorded to current stock prices. The cost of choosing X is simply (r-1)X. Thus we have:

Lemma 1: Provided the benefit of choosing X, $\pi[e_H-((e_L+e_0)/2]/(b-a)$, is greater than the cost, $(r-1)$, then not choosing X is not an equilibrium.

Proof: See appendix.

The incentive to take short-run actions depends upon a number of factors, (i) the value of π, which measures the incentive to have high current prices. If π rises then the incentive to choose X rises also; (ii) $e_H - e_L$, the difference between the means of the two types. If the industry is subject to rapid movements, with core earnings having the potential to change dramatically from period to period, then the firm has a greater incentive to convincing the market that it is of type H; (iii) the value of r, which indicates the ease with which managers can transfer earnings between periods. In industries which are characterized by immense difficulties in transferring earnings secretly, the incentive to do so will be minimal.

At later stages in the paper, it will be more convenient to replace the expression $[e_H - (e_L+e_0)]$ with one involving the actual primitives of the problem. In Corollary 1, in the appendix, we show that this expression can instead be written as: $(3/8)[(a+b)-(b+c)]$. We will use this formulation in Proposition 1, below.

Now we must consider the markets response to the firms behavior. The market cannot observe whether X is chosen, but it has the same information as the firm and understands the incentive to choose X. Thus if there is an incentive to choose X, the market will expect X to be chosen. This will lead it to expect second period earnings to fall by rX. This discounting of future earnings leads to a fall in the firms expected price as the market presumes that expected future earnings will be less than current

earnings. The market is not "fooled" into thinking that the firm is of type H as it assumes that first period earnings have been artificially boosted by X. This leads to a signal-jamming equilibrium[4] where the market believes X to be chosen, and the firm does chooses X:

Lemma 2: In equilibrium, the ex ante expected price of the firm, $E(P_i)$, will be $e_0 - rX$.

Proof: See appendix.

We see the crux of the problem. The markets conjecture about firm behavior is fixed. Given such a belief, the firm will confirm to the market beliefs and actually choose X. If it does not, its earnings will be discounted even lower and its price will fall still further, i.e. if $e_i = e^*$, the market will assume the real e_i was $e^* - X$ and will assume the second period earnings will be rX lower. This encapsulates the market myopia problem: both parties act in a fully rational way, but the outcome is inefficient. The inefficiency is purely a result of the commonly known incentive to maintain high stock prices. The problem of course is that the firm is unable to commit to not increasing earnings in the first period. Barring the stock market being able to completely oversee every detail of firm operations (which is assumed to be unworkable or prohibitively expensive), managers must try and commit to accepting a punishment if they actually do choose X. The oft-quoted lack of stock price pressure on Japanese or German firms may be because lenders have seats on the board and may be able to scrutinize operation more closely. It is to using long-term debt as a commitment device that we now turn.

II. DEBT AS A SOLUTION TO SHORT-TERMISM ?

Here we give the firm the option of changing its capital structure by taking on debt of face value D. Typically, such changes are implemented through a debt-financed stock repurchase. This involves the firm borrowing from the capital market and using the proceeds to retire a certain amount of existing equity. This was the main method by which firms increased their leverage in the 1980's. Such debt is long term, i.e. due at the end of period 2, and is taken on during period 1, but before period 1 earnings are realized. We assume that earnings cannot be transferred across periods, implying that D must be paid out of period 2 earnings alone. This could be due to first period earnings being paid out as dividends. If D cannot be met by period 2 earnings, then control of the firm passes to the bondholders. They may choose to liquidate the firm, replace the manager or perhaps reorganize without many changes. But, on average, managers of firms which do go bankrupt are subject to penalties. They are likely to be fired, to have their prerogatives reduced and importantly, will suffer reputation loss which will harm their future earnings potential. We model this by levying a penalty B on a manager who cannot repay D. Alternatively, one could say that managers obtain a control rent of -B (>0) if they remain in control at the end of period 2. In the U.S., Chapter 11 of the bankruptcy law gives managers the right, under certain circumstances, to maintain control after bankruptcy for a specified period of time[5]. The UK system differs somewhat, being closer to Chapter 7 of the U.S. code. We discuss how this might affect our results below.

In terms of the timing of the model, we assume firms decide whether to choose X first, then choose their level of D afterwards. Reversing this (having D chosen before X) does not change the analysis in any substantive way, but the timing structure we use makes it possible to specify a perfect Bayesian equilibrium, where the firm, in deciding whether or not to choose X, implicitly formulates a "type", which it then signals via its choice of debt level. We make the assumption that the firm has sufficient assets to pay off D if the bondholders choose to liquidate; in other words, the state of the world is never so bad that the managers might wish bankruptcy to occur. This permits us to abstract from the question of the level of the interest rate charged on the debt. The bondholders always recover the amount due to them, whether by direct payment or by the proceeds from liquidation of the firms assets. This seems quite a strong assumption and in practice, the legal and administrative costs associated with liquidation may be very substantial for the bondholders, so much so that they may elect to write off or defer part of the outstanding debt. Even if this happens, bondholders frequently insist on current managers being replaced and may make specific demands about how the firm is run which will tend to be harmful to the managers. If the liquidation value is less than the outstanding debt then the lenders will demand higher interest rates, which may result in there being an efficiency cost to the firm of changing its capital structure. In any case, the capital structure changes of the 1980's mainly occurred in mature, established firms with tangible liquid assets.

Our model does not necessarily assume bankruptcy is costly to the firm itself, rather than just to the manager. Some authors have argued that bankruptcy may be a good event for the firm in that it allows a thorough re-evaluation of the firms operations to be made, and potentially incompetent managers to be replaced. We do

not directly model managerial competence in this model, but note that type L firms are more likely to suffer bankruptcy and have their managers replaced. Bankruptcy certainly has legal and administrative costs for the firm. A number of papers, see for example Titman (1989), have argued that bankruptcy may place the firm at a significant disadvantage in the product market, mainly through it being harmful to the reputation of the firm. In any case, if significant non-private costs to bankruptcy exist they are a cost of the managerial signaling. If such costs are less than the waste of resources implied by stock market pressure then overall efficiency may improve.

We consider the following perfect Bayesian equilibrium: the primitives of the problem (e_H, e_L, B, π) will dictate an minimum debt level, D^*. Thus $D^* = f(B,\pi,e_H,e_L)$. This will be the level at which the gain from choosing X will be equaled by the extra risk of bankruptcy entailed by having period 2 earnings reduced by rX. If the market observes $D \geq D^*$, it concludes that the firm did not in fact choose X. It then treats period 1 earnings as not having being augmented by borrowing from period 2. If the firm chooses $D \geq D^*$, it will not choose X as this would increase its risk of going bankrupt. If the market observes $D < D^*$, then it concludes that the firm in fact chose X and discounts its earnings accordingly. We denote the market beliefs by μ, and specify posterior beliefs as being $\mu(X|D_i) = 0$, for all $D_i > D^*$, where D^* is defined as the D that satisfies equation (8) with equality. Thus the problem becomes one of choosing an equilibrium debt level, which, (i), has a high enough level of D so that the manager will not choose X (incentive compatibility), and (ii) ensuring that the debt level chosen leaves a higher level of utility than would have being the case for a debt level of zero.

Thus we have maximizing utility as being equivalent to:

Find D such that

$$[\pi[\{e_H-(e_L+e_0)/2\}/(b-a)] - (r-1)]X - [Pr.(B|D,X) - Pr.(B|D,0)]B \leq 0 \qquad (8)$$

and

$$E(U|D) \geq E(U|D=0) \qquad (9)$$

Here, Pr.(B|D, ;) refers to the probability of going bankrupt given the debt level, D. Equation (8) implies that the gain involved in choosing X, represented by the first term in the equation, must be less than or equal to the decrease in expected utility due to the increased risk of bankruptcy. Equation (9) requires that managerial utility after choosing D^* must be greater than it would have been if the manager set D equal to 0 and accepted the lower stock price. Intuitively, this means that the expected penalty from bankruptcy may not be too high or else the firm will just decide to continue as before.

One problem with this formulation is that it leads to a multiplicity of equilibria. If the market observes any D greater than D^* (the lowest value of D to satisfy the two constraints) it will still conclude that X was not chosen, and hence we will have a continuum of equilibria. We might arbitrarily choose to disregard any equilibria apart from the one involving D^*, but, in any case, we note that all the other equilibria can be eliminated by applying the following argument: no matter what debt level the firm chooses, the market will never assume the firm to be any other quality other than L or H. If the firm realizes this, then any firm which has not chosen X will never choose any $D > D^*$. If the market realizes this, it should respond to $D > D^*$ by assuming the firm has chosen X, and, then, a firm which has chosen X will never choose $D^* > D$.

This argument is simply a version of the intuitive criterion, which applies the concept of iterated conditional dominance[6].

Thus we now restrict ourselves to only analyzing equilibria where the first constraint is met with equality. We now move on to calculate the extra risk incurred by choosing X for any level of D:

Lemma 3: The increased probability of going bankrupt after choosing X is

(i) min(1, rX/(b-a)) for D greater than or equal to [a]

(ii) min(1,[rX-(a-D)/2]/(b-a)) for D less than [a], but greater than or equal to a - rX

(iii) min(1, [rX/2]/(b-a)) for D less than a - rX

Proof: See appendix.

Intuitively, this means that a low D implies that the cost of short-run behavior is low. At this low D, the extra probability of going bankrupt is low also. As the debt level rises, the loss from choosing X also rises until D reaches [a]. Higher debt levels have higher expected penalties for short-run behavior. The firm wishes to choose the lowest debt level that will persuade the market that it is not choosing X. This will depend upon the value of B; if B is high then a lower level of D will be sufficient. Note that the loss reaches a maximum once level [a] has been reached, which implies that debt levels above [a] will never be chosen. Note also that for levels of D below a-rX, there is no advantage in having a level of D greater than [c].

The actual level of D* will depend upon the primitives of the model, and will vary depending upon the relative values of some of the core parameters. In particular we distinguish between two cases, (i) $c < a - rX$, and (ii) $c \geq a - rX$. In order to express the value of D in terms that are consistent we now write $[e_H - ((e_L+e_0/2)]$ in terms of the primitives of the problem, and replace it with $3/8\{(a+b)-(c+d)\}$. We summarize what we know about D* in the following proposition:

Proposition 1:

(i) D* exists, provided B is greater than, or equal to, some critical level B_L

where $B_L = (3\pi/8r)[\{(a+b)-(c+d)\} - \{(r-1)/r\}(b-a)]$

(ii) <u>If $c < a - rX$</u>, then $D^* = 3/(4B)[\pi X\{(a+b)-(c+d)\}] - X(2/B)(r-1)(b-a) - 2rX + a$

iff $D^* \in [a - rX,a]$

Otherwise $D^* = c$

(iii) <u>If $c \geq a - rX$</u> then $D^* = 3/(8B)[\pi X\{(a+b)-(c+d)\}] - (X/B)(r-1)(b-a) - rX +$

$(a/2+c/2)$ iff $D^* \in [a - rX,c]$

If $D^* \in (c,a]$, then $D^* = 3/(4B)[\pi X\{(a+b)-(c+d)\}] - X(2/B)(r-1)(b-a) - 2rX + a$

(iv) Any D that satisfies the incentive compatibility constraint, equation (8), will also satisfy equation (9).

Proof: See appendix.

We see that if B= 0, i.e. managers suffer no penalty from losing control, then D* will always be zero and short-term actions will always be taken. In case (ii), we derive an exact specification for the value of the optimal debt level. Note that we focus on

two different possible relationships between the parameters. For $c < a - rX$, D^* is either a complicated expression or, if the value of that expression is below $a - rX$, then the optimal D^* jumps to [c]. This is a desirable situation in that when $D^* = c$, there is no risk of bankruptcy for either a "good" or "bad" firm as long as they do not choose to pad their first term earnings. D^* is decreasing in B until B is high enough that the optimal debt level is very low, in fact is equal to [c]. This suggests that a high punishment level for bankruptcy will help induce a lower level of debt. While it is difficult to attempt to define punishment levels exactly, casual evidence would indicate that the widespread adaptation of Chapter 11 provisions - which essentially gave managers a second chance - during the 1980s actually lessened the penalty for bankruptcy, and thus forced higher debt levels to be adapted. This result does rely partly on the boundedness of the uniform distribution - if the distribution was normal, bad results could still induce bankruptcies, but nonetheless it is at least suggestive that the change in the bankruptcy law actually helped increase debt levels. Note also that Britain, which experienced debt increases somewhat less than those in the U.S., probably had an, on average, higher level of B which might explain the lower levels of debt.

Looking at whether D^* is individually rational, we can identify two different effects. As B rises, the risk of going bankrupt increases and consequently expected utility falls. On the other hand, as B rises, by part (ii) of Lemma 4, the optimal D^* falls and the risk of bankruptcy falls, leading to a corresponding rise in expected utility. As shown above, once D^* has fallen to level [c] the manager suffers no risk in equilibrium no matter how large B is. In general, taking on D^* will be individually rational if :

$$\Pr.(B|D^*)B < [(1 + \pi)rX - X] \tag{10}$$

This means that the expected loss from bankruptcy risk must be outweighed by expected gains in both earnings and stock price from not choosing X. Part (iv) of proposition 1 shows that this condition is always met.

We now wish to examine how the optimal D^* will change when the parameters of the problem vary. Such changes are summarized in the following corollary:

Corollary 2: For $D^* > [c]$, (i) D^* rises when π rises, (ii) D^* falls when the variance of earnings rises, (iii) D^* falls when r rises, (iv) D^* rises when $e_H - e_L$ rises.

Proof: See appendix.

This yields a set of potentially testable implications about firm capital structure. Part (i) is a key result of the paper. It says that when π, which measures the pressure to maintain high stock prices, rises, the optimal debt level also rises. This explains why in the 1980's, when takeover pressure, and correspondingly π, rose the debt level also rose as firms needed to indicate they would not take short-term actions. Part (ii) is in accord with most empirical evidence which indicates that firms with high earnings variance do not take on much debt. Intuitively, if variance is high there is too big a risk that a firm will get a bad draw and go bankrupt. Part (iii) says that firms which cannot easily move earnings around gain less from short-term actions and consequently require less debt to discipline them. Part (iv) indicates that firms whose earnings change rapidly may need a lot of debt to prevent them from trying to imitate

higher types. When D^* is already equal to [c], then changes in any of the parameters will not induce any alterations in the optimal debt level; again this is due to the boundedness of the distribution.

We cannot establish any deterministic result about whether utility increases as B, the bankruptcy penalty, increases. For any B below B_L, an increase in the penalty will raise utility unambiguously. For higher values of B, where a change in B does not induce any change in the earnings or the stock price, it depends on the value of the bankruptcy penalty multiplied by the probability of bankruptcy. In any case, as B gets sufficiently high it will eventually drive the optimum debt level down to [c], at which point there is no risk of bankruptcy and utility is at its maximum level.

III. SHORT-RUN ACTIONS WHEN THE MANAGER KNOWS HER TYPE

The market myopia literature has mainly focused on "hidden action" models where the manager or firm does not have any informational advantage over the market, i.e. the manager does not know her type. In this section we look at the incentive to take short-run actions when the manager knows her type. Thus we have the same situation as in the previous section: the firm could be either type H or type L. However, we now assume that the manager is privately informed of her type at the start of period 1. Is there still and incentive to engage in short-run actions, and can debt help solve the myopia problem ?

We posit a very simple model: again, there is type H or type L. there are only two earnings levels, 1 and 0. Type H has probability β_H of earning 1 while type L has probability β_L. $\beta_H > \beta_L$. At the end of period 1, earnings are observed and the market

updates its priors as before. Clearly, type H has a higher expected price than type L. We give the firm the option, as before, of taking action X which increases the probability of high first period earnings by X. The probability of second period earnings being high is then reduced by rX, where $r > 1$. We show that, as long as $\beta_H < 1$ (type H does not always have a good outcome), the same incentive exists for both firms to choose X.

Lemma 4: If r is sufficiently small (made precise in the appendix), both types H and L will choose X.

Proof: See appendix.

Intuitively, type L tries to imitate type H, and type H is forced to increase its first period earnings in order not to be mistaken as type L. This is essentially the same reason for market myopia that we saw before: type L tries to signal-jam. Of course the market anticipates such actions and discounts prices downwards. We now introduce debt into the model. As there are only two outcomes in this simple model, there is only one potential debt level, where D is any value between 0 and 1. We show in the appendix that D prevents short-run actions as long as B is sufficiently large.

Lemma 5: D prevents X form being chosen if $B > 1 - r + \pi[P|1 - P|0]/rX$

Proof: See appendix.

Again, taking on debt must be individually rational and if B is too large firms will not do so. Here, however, firm H which knows its type can absorb a higher B than can type L; $B_H > B_L$.

This equilibrium is complicated by the fact that there are both moral hazard and adverse selection problems. Taking on D is designed to solve the moral hazard or "hidden action" problem. In this simple model it does so for a certain range of parameter values. However, there is also a "hidden type" issue; firms know their type and may wish to signal it to the market. This is the reason for taking on debt in the signaling models initiated by Ross (1977) and Myers (1984), where high quality firms take on debt to show their ability to have high future earnings, and type L firms only finance through equity. Such an equilibrium poses problems in this environment. Normally, the market observes earnings and makes a probabilistic inference about type, placing some probability weight on H and some on L. If a firms type is fully revealed through their capital structure then the market ignores the level of earnings. Thus if a type H firm takes on debt and gets a bad draw on first period earnings, the market does not reduce its stock price as it knows form the signal that the firm is of type H and will have high expected future earnings. While this is a rational equilibrium, it does not seem to correspond very well to the way the stock market works. Low earnings strongly affect current prices regardless of the capital structure, and a satisfactory model should have the market reacting rationally to both earnings and capital structure. If a fully separating equilibrium exists, then it resolves the hidden type issue rather than the hidden action. The high quality firm chooses a debt level sufficient to separate it from the low quality type. The low quality firm now has no incentive to choose X as there is no point in trying to imitate a firm of higher

quality, as it is known from the signal to be of type L. This result would hold for a continuum of types, with each one's quality being fully revealed by its capital structure.

In order to the signal-jamming model to work the firms must not know their future type or, if they do, must be unable to signal it. Within the confines of this model, this means that signaling through capital structure must imply a pooling equilibrium; type L firms must choose the same level of debt as type H. In the simple model outlined previously there is only one possible debt level, so a separating equilibrium is ruled out by construction. But consider the following extension: again, there are two types, H and L, but now there are three possible earnings level, 2,1 and 0. There will be the same incentives to choose X as before, and D will help stop such choices. But now there are two possible debt levels, D_1 between (0,1) and D_2 between (1,2). One could find parameters whereby D_1 was sufficient to prevent the firm from choosing X. However, type H firms may wish to choose D_2 to show their type, and depending on the parameters, type L may find it too costly to choose D_2.

IV. NEGATIVE CONSEQUENCES OF DEBT

So far the analysis has had debt playing an efficiency enhancing role. Such conclusions are in tune with one of the dominant theories of recent capital market movements: Jensen's free cash flow theory. That set of arguments stresses the way in which debt forces managers to maximize future cash flows in an effort to pay it off, thus preventing them from engaging in wasteful expenditure on negative NPV projects. Here, debt has positive ex ante effects also, but the assumption that managers

can transfer earnings from period to period leads to other issues. Ex post, once the debt is taken on the manager gains a higher stock price but is then left with the risk of a bad earnings draw and the possibility of bankruptcy. The manager can put off this risk by desperately trying to borrow funds from the future in an attempt to pay off this periods debt. We assume that desperation borrowing of this nature *can* be observed by the stock market, and reacted to. Such behavior is relatively common, particularly in retail stores or firms with large quantities of inventory that can be sold quickly. Notable examples include Macy's attempts to stave off bankruptcy by engaging in massive sales on the weekend in order to make a debt payment due on a Monday. Such actions by their very nature are visible to the market but are taken purely to avoid the potential loss of control entailed by bankruptcy.

There are a number of ways to model this; we choose the following. During the second period, just before D^* is due, the manager finds out the realization of earnings for that period. If the firm is of type H, then there is no chance that it will go bankrupt; if it turns out to be of type L it is possible that a bad draw will ensue and mean that the firm will be unable to pay its debts. Note that this will not happen if B is high enough, as the debt level will then be [c]. We now give the firm the option of taking action Z which involves taking last-ditch, visible measures to improve the firms earnings. Z is a different type of action than X - the former entailed a diminishing level of long-term investments while the latter refers to an open attempt to meet an upcoming debt payment. We do note, however, that Z will affect the firms stock price, P_1, during the second period as the market reacts strongly to observing Z.

In deciding whether to take Z, managers must trade off the penalties associated with bankruptcy against the damage done to the firm if they in fact choose Z.

Thus if Z is not to be chosen, we must have:

$$B + \pi P_1 + e_{L2} \quad > \quad B(Pr.(B|Z)) + \pi P_{1Z} + e_{L2} + Z \qquad (13)$$

Here Pr.(B|Z) refers to the probability of going bankrupt after Z is chosen. P_{1Z} is the price of stock after the market observes Z being chosen; e_{L2} refers to the earnings of the firm, now revealed as being of type L, in the second period.

This inequality will only be satisfied if the probability of avoiding bankruptcy is matched by the immediate fall in the stock price upon public observation of action Z. Realistically, this will probably only matter to the manager if she has some stake in the firm even after losing control. This may explain why even if the manager knows she will be fired if the firm goes bankrupt, it may be in the firms interest to give some type of "golden handshake" in the form of the firms stock to ensure that the future health of the firm is taken into account by the current manager. Z is more likely to be chosen if B is very large; this creates a tension between the benefit of a high B in ensuring a low level of required debt and the cost of a high B if a bad realization does occur. If B is very high, such that the debt levels chosen were equal to [c], then no bankruptcies will be observed at all. This analysis is admittedly only suggestive, but does call into question the benefits debt might confer on an firm re disciplining it.

V. CONCLUSION

We will briefly discuss the possibility of testing these theories empirically. Clearly, π and B are not easy to measure yet are crucial to the model. As stated in the

introduction, there seems little doubt that π rose in the 1980's partly because of the great increase in corporate takeovers. As such, using the frequency of takeover attempts (rather than using the number of successful takeovers) would seem a possible proxy. Finding a proxy for B is harder, because it can vary a great deal across individual firms and industries - though the increasing use of Chapter 11 provisions seemed to indicate that B had been falling during the period considered.

Let us summarize the main results at this stage. The pressure on managers to maintain high short-term earnings is well-known in the US/UK corporate system. We found that the use of long-term debt can provide a signal to the stock market that the firm is committed to having high earnings in the future. The extent of the debt depends upon a number of factors, but the higher the stock price pressure, the higher the level of debt required, while the lower the penalty for bankruptcy, the higher the debt level required. This is one explanation for the rising levels of debt taken on by most corporations in the 1980s, and also can suggest a reason why the UK, with no Chapter 11 law, did not experience rises on the same scale as the US. The model differs from previous explanations by predicting that debt levels will vary across industries with different structural characteristics, but will see high debt levels in all firms within a given industry. This is in accord with the empirical patterns observed in the period. Debt levels are also found to vary in accordance with the penalties managers who run bankrupt firms suffer - we find that the higher the penalty the lower the debt level and probability of bankruptcy need be. This gives the policy recommendation that managers should be penalized heavily when they do preside over bankrupt firms; this harsh penalty should induce a low level of debt. We also examined the potentially negative ex post effects of debt, if firms can try and avoid a

bankruptcy realization by engaging in an attempt to sell off stock. As such we would expect firms in a position to manipulate their earnings openly (such as retail stores) to have lower levels of debt as the market realizes that such actions are likely to occur.

This leads to a theory of capital structure in the 1980s where debt levels rose in response to fierce pressure on stock prices. the efficiency consequences were an initial improvement in efficiency as less short-term actions were taken, but ultimately a wave of (potentially) wasteful bankruptcies and a lot of short-run decisions taken in an attempt to avoid them.

Appendix: Here we prove the main results.

We first need to derive $Pr.(H|e_1)$ and $Pr.(L|e_1)$ for the uniform distribution.

Given the realization of e_1, the updated probabilities are:

$Pr.(H|e_1) = 1$ if $(e_1 > d)$; $= .5$ if $(a < e_1 < d)$; and $= 0$ if $(e_1 < a)$

Remember: $b > d > a > c$.

Proof of Lemma 1:

We assume that the market believes $X = 0$. If so, the cost to the firm of choosing X is just rX. Let us now suppose the firm does choose X.

The probability that a type H firm will obtain earning of greater than d, and hence be thought of as type L has increased by X/(b-a). But the probability that a type L firm will have earnings greater than d, is now X/(b-a).

The probability of type L having earnings less than a, and thus being revealed as of type L, has now fallen by X/(b-a). The probability of type H having earning less that a is zero. The probability of type H being having earnings between a and d, and thus not being fully revealed, has fallen by X/(b-a), while the probability of type L having earnings between a and d stays the same.

Summing these effects together we have: Increase in probability of being thought of as type H = .5(X/(b-a) + .5(X/b-a)) = X/(b-a)

The decrease in probability of being thought of as both type L, and ones type not being revealed is .5(X/(b-a). Thus the overall change in price must be:

$X/(b-a)[e_H - (e_0/2) - (e_L/2))$. We multiply this by the importance managers place on stock prices, π, to obtain the benefit of choosing X. As long as this is greater than (r-1)X, the firm will always defect to choosing X, thus not choosing X cannot be an equilibrium. Q.E.D.

Proof of Corollary 1:

Note that e_H is just (a+b)/2, and e_L is (c+d)/2. Also e_0 is (a+b+c+d)/4

Thus $e_H - ((e_0+e_L)/2) = (a+b)/2 - (c+d)/4 - (a+b+c+d)/8$

We can write this as 3/8((a+b) - (c+d)) Q.E.D.

Proof of Lemma 2:

In our proposed equilibrium, the firm chooses X. The market believes that X was chosen, implying: (i) e_1 has increased by X, and, (ii) e_2 will fall by rX

The market then only infers the firm is of type H if it observes a first period earning level greater than d + X. It infers the firm is of type L if it observes earning below a + X. Otherwise the firms type is not revealed and the market assumes expected earnings equal to e0. However, the firm now expects second period earning to be rX lower than they would otherwise have been. We can thus write the resulting expected price as:

$$E(P_t) = P(H)(b-(d+X)/(b-a))[e_H - rX] + P(H)(d-(a+X)/(b-a))[e_0 - rX] + P(L)(d-(a+X)/(b-a))[e_0 - rX] + P(L)((a+X)-c)/(b-a))[e_L - rX]$$

Given this, the firm cannot improve by deviating and not choosing X. This makes the equilibrium ex ante expected price as:

$$E(P_t) = P(H)((b+X)-(d+X)/(b-a))[e_H - rX] + P(H)((d+X)-(a+X)/(b-a))[e_0 - rX] + P(L)((d+X)-(a+X)/(b-a))[e_0 - rX] + P(L)((a+X)-(c+X)/(b-a))[e_L - rX]$$

But, as b - d = a - c, this is just equal to e_0 - XY Q.E.D.

Proof of Lemma 3:

We wish to calculate how much the risk of bankruptcy increases when X is chosen.

The ex ante bankruptcy risk = Pr(H)[Probability of bankruptcy given H] + Pr(L)]Probability of bankruptcy given L] This is written as:

.5[(D-a/b-a)] + .5[(D-c/b-a)]. Choosing X reduces period 2 revenues by rX.

(i) When D ≥ a, risk increases to .5[(D-a +rX/b-a)] + .5[(D-c +rX/b-a)]

The increased risk simplifies to rX/b-a

(ii) When $D < a$, risk does not increase as much because type H firms have a 0 probability of bankruptcy when X is not chosen. Thus choosing X only gives type H firms positive risk for a lower set of earnings outcomes. Risk increases by nearly $rX/b-a$ if D is close to [a]. Generally, risk increases by $[rX-(a-D)]/b-a$ for type H firms. Type L firms still have an increased risk of $rX/b-a$, thus the overall ex ante increase in risk is $[rX-(a-D)/2]/b-a$

(iii) When $D \leq a-rX$, type H firms never have any chance of going bankrupt. Therefore the increase in risk is only suffered by firms who turn out to be of type L.

$Pr.(L) = .5$ which implies that the increased risk $= rX/2(b-a)$ Q.E.D.

Proof of Proposition 1:

(i) We wish to check whether D^* exists, and in order for it to do so, the incentive compatibility constraint, (8), must be satisfied. As argued in the text, we are interested in the minimum possible value of D^*, thus the constraint will be satisfied with equality.

$$[\{3\pi X\{(a+b)-(c+d)\}/8(b-a)\} - X(Y-1)] - [Pr(B|D^*,X) - Pr.(B|D^*,0)]B = 0$$

The first term in the above equation is fixed as B varies, so in the second term must be equal to or greater than it. The highest possible value for $[Pr.(B|D^*,X) - Pr.(B|D^*,0)]$ is $XY/(b-a)$, from Lemma 3. Therefore:

$$[\{3\pi X\{(a+b)-(c+d)\}/8(b-a)\} - X(r-1)] - [rX/(b-a)]B_L = 0$$

Bringing B_L over, we have: $[3\pi X\{(a+b)-(c+d)\}/8(b-a)\} - X(r-1)] = B_L[rX/(b-a)]$

Dividing across by $[rX/(b-a)]$ give us: $B_L = (3\pi/8r)[(a+b)-(c+d)] - \{(r-1)/r\}(b-a)$

(ii) We now wish to calculate D^*, for the parameter values: $c < a - rX$

If $c < a - rX$, we know that $D^* \in (c,a-rX)$ is not an equilibrium, by Lemma 3.

This means that, if D^* less than $a-rX$, it must be $= [c]$

If $D^* \geq a-rX$, then by equation (7) we have,

$$[\{3\pi X\{(a+b)-(c+d)\}/8(b-a)\} - X(r-1)] - [(\max(0,D-a+rX)/2(b-a) + (\max(0,D-c+rX)/2(b-a) - (\max(0,D-c)/2(b-a) - (\max(0,D-a)/2(b-a)]B = 0$$

Note that the fourth maximum term will yield zero as D is always greater that on equal to [a]. The other terms will all be positive. Adding them together gives us:

$$[\{3\pi X\{(a+b)-(c+d)\}/8(b-a)\} - X(r-1)] - [B/(b-a)][D/2 - a/2 + rX] = 0$$

Bringing D to the right hand side and multiplying across by $(b-a)/B$ gives us:

$$[(b-a)/B][\{3\pi X\{(a+b)-(c+d)\}/8(b-a)\} - X(r-1)] - rX + a/2 = D/2$$

This means that $D^* = [3\pi X\{(a+b)-(c+d)\}]/(4B) - [2X(r-1)(b-a)]/B - 2rX + a$

(iii) Now $c > a-rX$, then if $D^* \in (c,a]$ then it is exactly the same as above.

If $a-rX \leq D^* \leq c$, then by equation (7) we have:

$$[\{3\pi X\{(a+b)-(c+d)\}/8(b-a)\} - X(r-1)] - [(\max(0,D-a+rX))/2(b-a) + (\max(0,D-c+rX))/2(b-a) - (\max(0,D-c))/2(b-a) - (\max(0,D-a))/2(b-a)]B = 0$$

Here, the last two maximum terms are $= 0$, thus we have:

$$[\{3\pi X\{(a+b)-(c+d)\}/8(b-a)\} - X(r-1)] - [B/(b-a)][D + rX - a/2 - c/2] = 0$$

Bringing D to one side we obtain:

$$D^* = [\{3\pi X\{(a+b)-(c+d)\}/8B] - [X(r-1)(b-a)]/B - rX + a/2 + c/2$$

(iv) Now, we assume that the incentive compatibility constraint, equation (8), holds, and we wish to show that equation (9) also holds. As stated in the text, equation (9) holds if: $Pr(B|D^*)B < (1 + \pi)rX - X$. We immediately see that if $D = [c]$, the constraint must hold as there is no chance of bankruptcy if the firm does not choose X.

We note that $Pr(B|D^*)B$ must be less than $Pr(B|D^*,X)B - \pi X[(3/8)\{(a+b)-(c+d)\}/(b-a)$ from the fact that the incentive constraint is binding.

$Pr(B|D^*) = Pr(L)[(D^* - c+X)/(b-a)] + Pr(H)[X/(b-a)]$

Thus, substituting in for D^* from part (ii), we have:

$.5B/(b-a)[(3/4B)\{\pi X((a+b)-(c+d))\} - 2X(r-1)(b-a)/B - 2rX + a - c + X] + .5B[X/(b-a)]$

$- [3\pi X\{(a+b)-(c+d)\}/8(b-a) - (r-1)X]$ must be less than $(1+\pi)rX - X$

We multiply through on the LHS, obtaining: $3/8(b-a)[\pi X\{(a+b)-(c+d)] - 2X(r-1) - rXB/(b-a) + (a-c+X)B/(b-a) + BX/2(b-a) - [3\pi X\{(a+b)-(c+d)\}/8(b-a) - (r-1)X]$

Canceling terms, we obtain: $(a-c+X)B/(b-a) + BX/2(b-a) - X(r-1) - rXB/(b-a)$ must be less than $(1+\pi)rX - X$. Bringing over terms, we get:

$(a-c+rX)B/(b-a) + BX/2(b-a) - rXB/(b-a) < (2+\pi)rX - 2X$

Isolating B, we obtain: $B < (2rX+\pi rX-2X)(b-a)/(a-c+(3/2)X-rX)$

Thus, in order for the constraint to hold, we cannot have a penalty above this level. We now show that when we substitute this value of B into D^*, we obtain a level less than or equal to [c], in which cast the constraint is met automatically.

So , letting B be equal to its maximum value (denoted Bmax), we have:

$D^* = 3\pi X\{(a+b)-(c+d)\}/4[(2rX+\pi rX-2X)(b-a)/(a-c+(3/2)X-rX)] - 2rX + a$

$- X(r-1)(b-a)/2[(2rX+\pi rX-2X)(b-a)/(a-c+(3/2)X-rX)]$

Now, any D^* below $a - rX$ must be = [c], and must therefore have no risk of bankruptcy. Thus, dividing across by (b-a) and subtracting $a - rX$, we require:

$[1/2Bmax]\{3\pi X\{(a+b)-(c+d)\}/8(b-a) - 2X(r-1)\} < rX/(b-a)$

But note that $\{3\pi X\{(a+b)-(c+d)\}/8(b-a) - rX(r-1) = [Pr(B|D^*,X) - Pr(B|D^*)]B$, by (8)

And by Lemma 3, the maximum value for $Pr(B|D^*,X) - Pr(B|D^*)$ is:

$[rX-(a-D^*)/2]/(b-a)$. But this is less than $rX(b-a)$. Thus any time equation (8) is met, equation (9) is also satisfied. Q.E.D.

Proof of Corollary 2:

(i) $dD^*/d\pi = (3X/4B)[(a+b)-(c+d)] > 0$.

(ii) If $c > a-XY$, then $dD^*/d(b-a) = -(X/B)(Y-1) < 0$,

If $c < a-XY$, then $dD^*/d(b-a) = -(2X/B)(Y-1) < 0$

(iii) If $c > a-XY$, then $dD^*/dY = -(X/B) - X < 0$

If $c < a-XY$, then $dD^*/dY = -(2X/B) - 2X < 0$

(iv) We can rewrite $e_H - e_L$ as being equal to $(4/3)\{(a+b)-(c+d)\}$. We then have

$dD^*/d(e_H-e_L) = (4/3)[(3/4)\pi X]/B = (\pi X)/B > 0$, if $c < a-rX$

If $c > a- rX$, then $dD^*/d(e_H-e_L) = (\pi X)/2B > 0$. Q.E.D.

Proof of Lemma 4: Type L has an expected price of $\beta_L(P|1) + (1-\beta_L)(P|1)$

Note that, $P|1 = \beta_H(Pr.(H|1) + \beta_L(Pr.(L|1)$, where $Pr.(H|1) = .5\beta_H/[.5\beta_H+.5\beta_L]$

$\Rightarrow$ choosing X gives the firm an expected gain of $\pi X(P|1 - P|0)$

Note the gain is the same for both types of firms. The cost to this action is $(r-1)X$ which means that X will be chosen if $\pi(P|1 - P|0) > (r-1)$ Q.E.D.

Proof of Lemma 5: In order of X not to be chosen, the gain must be balanced by the increase risk of bankruptcy. This means:

$\pi(P|1 - P|0) - 1 - r \leq [Pr.(B|D^*,X) - Pr.(B|D^*)]B$

But, $Pr.(B|D^*,X) - Pr.(B|D^*) = rX$ which implies that

$B \geq [\pi(P|1 - P|0) - 1 - Y]/rX$ Q.E.D.

Example: We now construct an example to show the parameter values that might arise (all numbers are normalized around 0):

Let $(a,b) = (.2, 1.2)$, $(c,d) = (-.2, .8)$ $e_H = .7$ $e_L = .3$

$\pi = 1$ $X = .2$ $r = 1.2$

With these parameters the maximum possible debt level is $D^* = [a] = .2$

At $D^* = .2$, we need a minimum punishment of $B = .085$

Thus $B_L = .085$

As B get bigger, D^* falls.

If say, $B = .15$ (a high fraction of the firms profits), then $D^* = -.01$.

Once B gets to $B_H = .166$, then the optimal D^* drops to -.04.

Any level of D^* above this will not serve any purpose - however all values of D^* will be changed if any of the underlying parameters change, as stated in Proposition 1.

Endnotes

1. For a survey of the main competing explanations for the 1980's takeover wave, see Bhagat, Shleifer and Vishny (1990).

2. For an example of popular attitudes towards such behavior, see Hutton (1995). See Hoshi et al (1990) and Franks et al (1990) for analyses on the differences between financing patterns in the countries named.

3. For evidence on this subject, see Morck, Shleifer and Vishny in Auerbach (ed) (1988).

4. This kind of signal-jamming equilibrium was first named by Fudenberg and Tirole (1986).

5. A comprehensive analysis of the effect of Chapter 11 on the investment behavior of firms is given by Scharfstein (1991).

6. This argument was basically derived from Fudenberg and Tirole (1991), which gives an excellent summary of these concepts.

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